# MIDDLE AND LATE WOODLAND PERIOD CULTURAL TRANSMISSION, RESIDENTIAL MOBILITY, AND AGGREGATION IN THE DEEP SOUTH

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

MIDDLE AND LATE WOODLAND PERIOD
CULTURAL TRANSMISSION, RESIDENTIAL MOBILITY, AND AGGREGATION
IN THE DEEP SOUTH

Presented by Karen Y. Smith

A candidate for the degree of Doctor of Philosophy of Anthropology

And hereby certify that in their opinion it is worthy of acceptance.

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Professor Vernon J. Knight, Jr.

Professor R. Lee Lyman

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To my son, Casey.

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# CHAPTER 1. WOODLAND-PERIOD INTERACTION IN THE DEEP SOUTH

Interregional interaction achieved through the construction and maintenance of trade networks and social alliances is portrayed as a hallmark of the Middle Woodland period in much of eastern North America. That human interaction occurred on a scale considerably larger than the local area during this time is evidenced by the presence of tools and other goods made from nonlocal materials, the sources for which often are hundreds of miles away. According to some studies, an increase in ceramic decorative diversity also marks this period of heightened interaction (Dickens 1980; Dickens and Fraser 1984; Neiman 1995), as does elaborate mortuary ceremonialism expressed through differential treatment of clan or religious leaders and their lineages. Though widespread, the apparent epicenter of interaction was the Midwest, leading Caldwell some 50 years ago to identify this prehistoric phenomenon as the Hopewell Interaction Sphere (Caldwell 1964; see also Seeman 1998). Subsequently, the Late Woodland period, beginning about A.D. 400 or A.D. 500, is characterized by a collapse in interregional interaction as evidenced by the disappearance of exotic goods and materials from archaeological contexts that postdate the Middle Woodland period. Increasing regionalization and localized territorialism also seem to mark the Late Woodland period throughout the East.

For the last half century, Woodland-period research has centered on the Midwest. Few studies beyond the site level have examined the impact increasing interaction and subsequent decrease had on Midwest peripheries, that is, those areas where nonlocal goods and materials found on sites in the Midwest originated. One area where regional-scale studies are lacking is the lower Chattahoochee-Apalachicola waterway, the shortest navigable route in the Southeast between the Gulf Coast and the Piedmont and one thought by some to be a major trade corridor for coastal shell during the Middle Woodland period (Anderson 1998:278–280; Knight and Mistovich 1984:8). The lack of regional-scale comparative research of the Woodland period in this area is surprising. Large-scale excavations at several prominent Middle Woodland-period sites, such as Block-Sterns in northwest Florida and Mandeville in southwest Georgia (Figure 1), have provided clear evidence of regional participation in the Hopewell Interaction Sphere (Jones and Tesar 1996; Jones *et al.* 1998; Kellar *et al.* 1962). A tremendous and largely untapped dataset on Middle and Late Woodland-period mortuary ceremonialism is available through the efforts of C. B. Moore early in the twentieth century (Moore 1901, 1902, 1903, 1907, 1918; see also Brose and White 1999; Frashuer 2006). Ongoing work at Kolomoki, a Late Woodland-period site on a tributary of the Chattahoochee River, has revealed a rich and patterned domestic and ceremonial assemblage, one that appears to be even more elaborate than its Middle Woodland antecedents (Pluckhahn 2003; Sears 1956). Several segments of the Chattahoochee-Apalachicola valley have been subjected to intensive survey, though much of the work was conducted during the 1950s and 60s and was salvage in nature (Bullen 1950, 1958; DeJarnette 1975; Kelly 1950, 1960; Kelly *et al.* 1962; for more recent survey work see Belovich *et al.* 1982; Knight and Mistovich 1984; and White 1981). In short, a robust archaeological record is available for examining the waxing and waning of interregional interaction and the impact fluctuations in interaction had on residential and intracommunity-level social strategies. The primary goal of the research presented here is to marshal this record to reconstruct the extent of interaction within the lower Chattahoochee-Apalachicola River valley and neighboring Gulf Coast for the period spanning 200 B.C. to A.D. 1000.

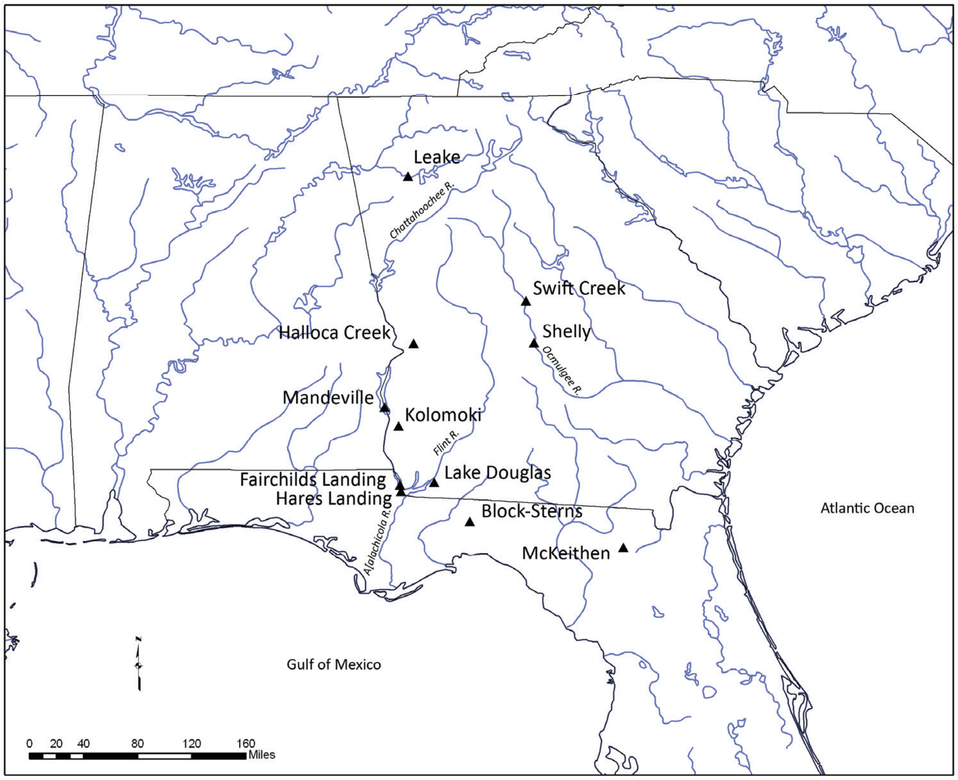


*Figure 1. Map of sites discussed in the text.*

In addition to the lack of regional-scale studies, few synthetic treatments of the Middle and Late Woodland-period record exist. Those that are available posit a natural increase in population density through time and pulses in interregional trade as the primary mechanisms for change in settlement and social strategies throughout the period (Anderson 1998:279, 280; Milanich 1994:148, 153–154; White 1985:173). Empirical studies that document the exact nature of such changes or attempt to map these changes onto subsistence and climatological variability across the Woodland period also are lacking (for an exception that uses survey data to infer population-density changes, see Knight and Mistovich 1984:230). One relevant issue that has received very little scrutiny is the extent to which Woodland groups were sedentary (Anderson 1998:283; Milanich 1994:148; White 1985:172). Many researchers either explicitly or implicitly assume that an increase in the number of sites through time reflects an increase in the regional population size of relatively sedentary nonagricultural villagers rather than a shift in the prevailing residential strategy (see Brose and Percy 1974 and Percy and Brose 1974 for a counter scenario). Within the former framework, group fissioning occurs when local, residentially stable populations become too large and subsequent daughter populations form new villages in previously unoccupied locales (Milanich 1994:145, 169; Milanich 2004:358). Smaller sites are largely viewed as special-use camps used at various times by nearby settlements with permanent populations (Milanich 1994:145). This is a distilled characterization of extant descriptions of population and settlement dynamics, to be sure. Yet, the extent to which sedentism was the preferred residential strategy has seen little vetting against the archaeological record; that is, sedentism rather than seasonally variable and mobile habitation has been assumed but has yet to be demonstrated.

Mobility is highly variable and multidimensional (Kelly 1992:43; see also Kelly 1983). Seasonality and site-structure studies provide important, but not the only, keys to exploring residential mobility (Kelly 1992:52, 56). The following study examines interregional interaction throughout the Middle and Late Woodland periods, but an unanticipated outcome of the study is that the results also seem to document the extent to which residential mobility fluctuated through time. That is, the following study captures pulses both in interaction and in relative sedentism, both of which likely articulated with population size, climate, subsistence, and intracommunity social differentiation in important ways. As briefly described in the following section and detailed in Chapters 5 and 6, interregional interaction and pulses in relative sedentism are monitored primarily by reference to changes in intra-assemblage ceramic decorative diversity and interassemblage ceramic distance across a 1000-year ceramic sequence. How these changes map onto climatological variability also is explored as prolonged shifts in rainfall, in particular, would seem to restrict the ability of hunter-gatherer groups to stay put for extended periods.

Impeding research within the Chattahoochee-Apalachicola river valley has been the lack of a “highly detailed [and unified] chronology” (Anderson 1998:293; Percy and Brose 1974:7). Chronologies exist, but most tend to treat time in several-hundred-year segments, and these segments vary in terminology and, to a lesser extent, in content between the Gulf Coast and the interior Coastal Plain of southern Georgia and Alabama, making comparisons across the region difficult. Thus, one major contribution of this study is to present a unified and fine-grained Middle and Late Woodland-period chronology using survey and excavation data. The dataset comprises 99 ceramic assemblages from 32 sites located in the lower Chattahoochee-Apalachicola River valley and neighboring Gulf Coast, from present-day Columbus, Georgia, which sits at the Fall Line, to the mouth of the Apalachicola River at present-day Apalachicola, Florida, a straight-line distance of about 180 miles (290 km). Inconsistent reporting of ceramic inventories and the use of dissimilar classifications among the sources (Trigger 1989:323) necessitated the use of ceramic decorative modes rather than ceramic types. Thus, the ceramic assemblages, taken from published and unpublished sources, are coded by surface treatment or decorative mode (e.g., simple stamped, check stamped, complicated stamped, incised).

The diverse history of archaeological research in the area is discussed in Chapter 2. In Chapter 3, prevailing chronologies and an overall view of the Woodland periods are outlined. A necessary prerequisite for any regional-scale study is a continuous, detailed chronology. As described in Chapter 4, chronological ordering of the 99 ceramic assemblages is achieved by means of frequency seriation and correspondence analysis (Smith and Neiman 2007). The millennium-long ceramic sequence is evaluated against available radiocarbon dates and is found to be an accurate and fine-grained measure of temporal change. More important, this high-resolution chronology provides an important historical framework for the analyses that follow.

## 1.1 An Evolutionary Model of Neutral Variation in Ceramic Decoration

Archaeologists have long marshaled ceramic decorative variability to build local and regional chronologies, explore postmarital residence patterns, infer changes in the extent of interaction, identify trade routes, and measure social differentiation, among many other things asked of the lowly potsherd (Eerkens and Lipo 2005:317). Lyman *et al.* (1997) document culture history's engagement with chronology building during the first half of the twentieth century, emphasizing the important role that ceramic variation played in such attempts. As they point out, however, few efforts offered explicitly formulated theoretical propositions regarding variability; that is, why did variation in pottery decoration allow the alignment of sites and assemblages in time (Lyman *et al.* 1997; see also Eerkens and Lipo 2007; Lipo *et al.* 1997; Lyman and O'Brien 2002:77–79)? Plog (1978) provides a critique of several now-classic processual approaches to ceramic variability made popular during the 1960s and 1970s. Unlike their predecessors, processualists sought explicit theoretical warrants for using ceramic variation from the larger discipline of anthropology, particularly ethnographic studies and ethnological theory, though as Plog describes, the linkages between theory and expectations often were flawed. Some of the more-recent attempts to harness ceramic variation employ an evolutionary framework within which expectations for variation are modeled (Bentley and Shennan 2003; Bentley *et al.* 2004; Eerkens and Lipo 2005; Kohler *et al.* 2004; Lipo and Madsen 2001; Lipo *et al.* 1997; Neiman 1995; Shennan 2000; Shennan and Bentley 2008; Shennan and Wilkinson 2001). Among these, Neiman's modeling efforts and ceramic case study proved to be the most relevant to the current study goals and available ceramic dataset.

Neiman (1995) modeled the temporal effects of drift on within-assemblage ceramic decorative diversity and interassemblage distance. His model is, in effect, a random-copying model, one that predicts some functionally equivalent variants will decrease in frequency simply through sampling error in finite populations, and is a useful null hypothesis against which one can test real-world data (Bentley *et al.* 2004:1443; Bentley *et al.* 2007:152; Kohler *et al.* 2004:109; Shennan 2008:82). Using a Middle and Late Woodland-period ceramic dataset compiled by Braun (1977) for the Midwest, Neiman compared actual measures of diversity and distance to modeled expectations. Because he found that the actual measures responded in a manner consistent with the models, Neiman was able to use changes in these measures to infer changes in interregional interaction and population dynamics in the Midwest during the Middle and Late Woodland periods. The following research builds on Neiman's study and several that have followed it (e.g., Kohler *et al.* 2004; Shennan and Wilkinson 2001).

The models employed here and described in detail in Chapter 5 predict a negative co-variation of ceramic decorative diversity within local groups, or social demes, and ceramic decorative distance among local groups when variation is *neutral*, or adaptively equivalent (Neiman 1995). When drift and interaction are the primary forces shaping neutral ceramic variation, an increase in among-group interaction should be accompanied by an increase in ceramic decorative diversity within social demes, as new variants are introduced, and a decrease in ceramic decorative distance, as the flow of information about pottery decoration crosses local learning groups. Periods of lessened interaction should result in a decrease in decorative diversity within groups groups, as drift works to winnow variation, and an increase in among-group decorative distance, as within-group decorative traditions take on unique trajectories. The negative co-variation of distance and diversity follows from the expectations of a theory of neutral-trait transmission and is modeled on the behavior of neutral alleles in biological populations.

However, translating the modeled behavior of learning (or breeding) groups and neutral variants to artifacts and archaeological contexts, assemblages, or sites requires additional considerations and assumptions. To get from the models to archaeological data and back requires the presumption that the variants in an archaeological assemblage, or set of artifacts from a given context (Grayson 1984:17), are representative of the variants in the group of social learners who created and discarded the artifacts that comprise the assemblage. As Neiman (1995:17) put it, “we might expect the [diversity] values that are derived from an assemblage will be correlated with the [diversity] values that would have been derived from a random sample of the population of social learners responsible for the assemblage.” This assumption may not be valid in all cases, sample-size issues and post-depositional disturbances being among the most-well known complications in one-to-one correlations of the archaeological record and the people responsible for creating the record. For now, I will suggest that the successful application of frequency seriation indicates the assemblages are not sufficiently ill-constructed or the post-depositional biases too great as to render the ceramic data useless for making additional inferences.

Here, decorative diversity is measured using Simpson’s Diversity Index, though calculations of both theta estimates developed by Neiman show similar trends. Interassemblage distance is inferred from the squared Euclidean distance between pairs of assemblages at the regional level and correspondence analysis, which is based on a chi-square distance matrix, at the intrasite level.

Unlike Neiman's study, the results described here do not fit the modeled predictions as clearly as was expected. Interassemblage ceramic distance and within-assemblage ceramic diversity are positively correlated through time among the lower Chattahoochee-Apalachicola River assemblages. As discussed in Chapter 6, two possible implications follow from a lack of fit to the model. One implication is that the decorative-mode variants are not neutral among these data, meaning that transmission errors and random sorting alone cannot account for the positive correlation between interassemblage distance and within-assemblage decorative diversity. Other researchers arriving at similar results have suggested that a selective environment or transmission biases shaped the measures observed among their data (e.g., Kohler *et al.* 2004; Shennan and Wilkinson 2001). In fact, Neiman's models differ from the expectations provided by Braun (1977; see also Braun and Plog 1982; O'Brien 1987). Braun argued that as neighboring groups become increasingly interconnected—Neiman's increased interaction—both ceramic diversity and interassemblage distance should decrease. Although the latter (distance) fits an expectation of the drift model under increased interaction as outlined above, the former (diversity) does not. It is unclear why ceramic diversity also should be expected to decrease under the condition of increased interaction among groups, unless the ceramic decorative variants are not selectively neutral or unless learning biases favor conformity, which is ultimately what Braun was arguing albeit in different terms. Rather, interaction should increase the number of available decorative variants generated within a group through individual innovation and copying errors by pooling the number of potters and episodes of pot making between groups.

If one or more selective conditions did shape diversity and distance here, then changes though time in these measures cannot be used to infer changes in interregional interaction and potential selective conditions or alternative forms of biased transmission would need to be explored. In the present case, though, the battleship-shaped curves observed in the frequency seriation across all decorative modes through time suggest selective forces are not a significant contribution to ceramic-frequency variation.

There is another more subtle but equally intriguing possibility. An assumption of Neiman's case study, briefly described above, is that his and Braun's archaeological assemblages represent discrete, residentially stable local learning groups. Although groups probably were residentially stable in the Midwest by the beginning of the Middle Woodland period (Braun 1987; O'Brien 1987), where human-plant interdependence through incipient domestication was bourgeoning, they like were not in the Deep South. Rather, within some range Woodland-period groups probably were mobile prehistoric hunter-gatherers or highly mobile foragers. Among highly mobile groups or during periods of increased mobility, one social deme may reside in a number of locations throughout the year and from year to year. That is, the same social group, or learning community, may generate what will become several of our archaeological assemblages. So, how would mobility affect diversity and distance measures of neutral variants? Put simply, both interassemblage distance and intra-assemblage diversity (measured on assemblages from different archaeological sites) should be low during periods of increased mobility compared to those same measures during periods of increased sedentism. This interpretation is compelling as it seems to account for a number of additional, though anecdotal, observations among the sites in this study. The diversity and distance results and their implications are briefly described below.

## 1.2 Summary of Results and Interpretations

Seven ceramic periods, called phases throughout, were defined based on the seriation of all assemblages. Here I focus on the diversity and distance results for the three groups that had the largest and smallest measures of diversity and distance through time. The Halloca Creek phase marks the first peak in interassemblage distance and ceramic decorative diversity during the Woodland-period sequence. The phase probably dates between A.D. 220 and A.D. 310, though this and the other dates given here should be taken as rough estimates at best (see Section 6.3). Contained in the Halloca Creek group are seven assemblages, two of which are from nonmortuary mound deposits at Mandeville (9CY1), a site where clear evidence for interregional trade is found in the form of imported materials (Kellar *et al.* 1962). If the construction of earthworks is any indication of relative residential stability, then the presence of mounds at the Mandeville site lends support to the idea that stability in the valley had increased by the third century A.D.

The Kolomoki I phase, which probably dates between A.D. 430 and A.D. 560, contains assemblages that are the most geographically distant. Yet, Kolomoki I is characterized by a virtual bottoming out of ceramic diversity and a concomitant decrease in interassemblage distance. This pattern is interpreted as a material outcome of increased mobility. In other words, Kolomoki I sites do not represent the material remains of independent groups of people but are the remains of a (relatively small?) set of highly mobile, and probably highly fluid, groups. Ceramic decorative similarity and low ceramic diversity are the result of the resampling of these finite groups as they frequently move across the landscape. Importantly, the ceramic of choice for Kolomoki I was what archaeologists have come to call Swift Creek Complicated Stamped (SCCS), a type which at its peak relative frequency was distributed across Georgia, northern Florida, and neighboring areas but is found as far away from this "heartland" as present-day Indiana. Reconstructed paddle-stamped designs taken from SCCS sherds often show wide distribution too, with the same paddle connecting sherds found on sites as much as several hundred miles apart (Broyles 1968:51; Snow 1975, 1982; Snow and Stephenson 1998; Snow *et al.* 1979). But the results of my study suggest that paddle-design matches should be viewed not as the result of interaction—the trading of pots or paddles or the sharing of design ideas—as is so often invoked (Broyles 1968:51–52) but as the result of the frequent movement of people who owned the paddles (Stephenson *et al.* 2002:349). If residential mobility is the primary process shaping paddle-stamp distributions, then Kolomoki I should be the period during which design matches within and perhaps outside the study area are the greatest, though the data needed to test this prediction at the present time are not readily available.

The second major peak in ceramic diversity and interassemblage distance is seen in the Hare's Landing phase, which probably dates between A.D. 770 and A.D. 825 (see Section 6.3). This peak is marked by the increasing prevalence of a suite of new decorative techniques, called Weeden Island, which include a variety of incised, punctated, and red-filmed designs executed primarily on bowl forms. If the preceding period (Kolomoki I) can be inferred from the ceramic data to be a period of relatively high mobility, then increasing residential stability begins late in Kolomoki II and reaches its peak during the Hare's Landing.

During the second sedentary period (late Kolomoki II-Hare's Landing), the residential area at one site for which we have good spatial data is characterized by intrasite ceramic variation late in the site's occupation (Smith and Neiman 2007). This new dimension of variation may reflect new social signaling strategies advantageous only within the context of larger and more stable residential groups but ones comprised of several households lacking reckoned kin ties beyond the household level (Hildebrandt and McGuire 2002; McGuire and Hildebrandt 2005; Neiman 1997). Signaling strategies also may help explain the mortuary practice of vessel caching that was prolific during the post-Kolomoki I period. Ceremonial caching, which resulted in the interment of carpets of sherds and whole but "killed" pots not associated with individual burials, likely was engineered to visually signal and materially codify group commitment (Palmer and Pomianek 2007; Sosis *et al.* 2007) but also may have served to mitigate increasing social distance occurring both within and among residential communities.

### 1.3 Implications and Avenues for Future Research

This study suggests that prehistoric mobility should not be viewed across a directional spectrum (*sensu* Dunnell 1978:194) from highly mobile bands of Archaic hunters to permanently settled, hierarchically organized Mississippian agriculturalists, with semisedentary, semiegalitarian Woodland-period foragers sandwiched in the middle. Rather, during the Middle and Late Woodland periods, residential patterns, at least within the study area, seem to have cycled between more sedentary and more mobile strategies; atemporal, intrasettlement social differentiation, particularly acute during the post-Kolomoki I period, also appears to have accompanied increased sedentism. Some general conclusions as well as avenues for future research are discussed in Chapter 7.

Clearly lacking from the above introduction is any discussion of the contributions of environmental and subsistence factors to the inferred shifting patterns of mobility. Comparative archaeological data on subsistence are sorely needed, but those few that are available seem to suggest that horticulture probably played no part in subsistence strategies during all of the middle and most of the Late Woodland period (Anderson 1998:284–285; Belovich *et al.* 1982:420; Gremillion 2002b:Figure 22.3; Milanich 1994:144). Maize and pre-maize cultigens, such as goosefoot and pigweed, are not absent from all collections, but, when present and quantified, they do not fall within the relative-abundance range indicative of resource intensification (Gremillion 2002b:Figures 22.1 and 22.2; Pluckhahn 2003:Table 7.1). Thus, there is little evidence that subsistence among the residents of these sites was based on anything other than the gathering of wild nuts and berries, the hunting of wild game, and the collecting of riverine and coastal aquatics for most of the period under consideration. There also is little evidence that the hunting and collecting strategies changed much during the period. Although one recent study points to “the use of focused capture techniques (i.e., weirs, spears, lines) in the Apalachee Bay area” among Deptford– and Swift Creek–period site occupants (Byrd 1995, cited in Anderson 1998:283), lack of comparative faunal and botanical data sampled across Middle and Late Woodland contexts within the study area precludes for the moment an examination of shifts in the intensity of hunting/collecting or in the overall subsistence strategy (Anderson 1998:283 on lack of faunal analyses; Milanich 1994:117, Nanfro 2004:70, and White 1985:173 on lack of botanical studies; Percy and Brose 1974:5, 10; Lawson 2005 for a recent and notable exception). Bow- and arrow-technology appeared later in parts of the Deep South than elsewhere in the East, but just how late this technological shift occurred remains unanswered (Anderson 1998:297–298).

What can be said is that the ecologically rich and diverse environment of the lower Chattahoochee-Apalachicola River system and neighboring Gulf Coast, described in Chapter 2, would seem to favor either sedentism or mobility and would open up the possibility for changes in residential mobility to be shaped by factors unrelated to technological innovation or incipient domestication. Increasing population density, perhaps spurred by a new method of foraging, the direct evidence for which has not survived in the record, or by the infilling of the valley with additional people who commingled with the existing population, would certainly seem to impact mobility in novel ways. If evidence for a persistent foraging subsistence strategy holds up under further scrutiny, the significance of this study reaches beyond the Deep South as horticulture or incipient plant domestication is often hailed as the impetus for or the direct result of sedentism and ceremonial complexity (Jackson and Scott 2002:462). The ultimate cause of a more stable residential strategy needs to be explored. It may be found that an increase in population density played some role or that the shift simply was one from circulating to radiating mobility, with the latter fostering increased competition and territorialism among neighboring groups. Only through a comparative research program that systematically and longitudinally mines skeletal, faunal, and botanical data will new insights into the ceramic changes documented here ultimately be found.

Kelly (1992:50) notes that sedentism is a relative condition but should not be viewed as a point of no return; that is, the degree of relative sedentism often is subject to oscillations or pulses (see also Kelly *et al.* 2005). Given this, it may be just as pertinent to ask why these groups may have become more mobile during the Kolomoki I phase as it is to ask why they appear to be more sedentary during Halloca Creek and Kolomoki II/Hare's Landing. Several studies have brought climatological data to bear on questions of dispersal following periods of marked sedentism or aggregation with significant success (e.g., Anderson 1994, 2001; Kohler *et al*. 2008). What does the environmental record for the Deep South reveal about Woodland-period climate fluctuations? A drought reconstruction from tree-ring sample data indicates persistent drought conditions were in place between A.D. 388 and A.D. 420 (Cook and Krusic 2004, 2008). This period maps onto rather nicely the period interpreted here as being marked by higher levels of mobility during the Kolomoki I phase. Given that the subsistence base of Woodland-period peoples in the Chattahoochee-Apalachicola region varied by local environment but generally focused on fish (marine and riverine), deer, oysters, mussels, and nuts, all of which would be negatively impacted by persistent dry periods, it is more than tempting to suggest that resource stress brought on by drought conditions forced relatively sedentary villages to disperse. A second persistent dry period occurred between A.D. 659 and A.D. 724, though it is unlikely that this period corresponds to the post-Hare's Landing phases. As mentioned earlier, dates for several of the phases are best guesses. This is particularly true for the Hare's Landing phase, for which there are no radiocarbon dates. A third period of reduced rainfall occurs between A.D. 811 and A.D. 891, and, based on Bayesian smoothing of the available radiocarbon dataset (see Section 6.3), rather clearly maps onto the Late Weeden Island, or post-Hare's Landing, phase. The interval between A.D. 421 and A.D. 658 is marked by favorable climatic conditions, though the impact of the second drought beginning ca. A.D. 659 does not seem to be reflected in the ceramic data presented below. This suggests that groups must have remained fairly mobile throughout Kolomoki I and into Kolomoki II and that evidence for increases in sedentism should post-date ca. A.D.724 and predate the second quarter of the ninth century.

# CHAPTER 2. ARCHAEOLOGICAL RESEARCH IN THE CHATTAHOOCHEE-APALACHICOLA VALLEY AND GULF COAST

The temporal and regional focus of this study is on Middle and Late Woodland-period sites located along the lower Chattahoochee-Apalachicola rivers, their tributaries, and adjacent segments of the neighboring Gulf Coast. The choice of this region as a study area was driven by a number of factors. Among them, the amount of previous survey and excavation work along the rivers, due in part to dam construction during the mid-twentieth century, is fairly substantial (Figure 2). The area is within the Southeastern Evergreen Forest, though a significant portion of the region no longer retains the old-growth forest characteristics it would have had during the prehistoric past, due largely to intensive and large-scale agriculture.

By some measures, the study area can be divided into two environmental groups at the Georgia-Alabama and Florida state lines. North of this line, the study area is characterized as regularly mesothermal, with hot summers and mild winters but with frequent freezes during the winter. South of this line, the region is better described as subtropical with rare freeze episodes during the winter months (Visher 1954:360–361). Average annual temperature throughout the study area is above 70-degrees Fahrenheit (Visher 1954:361).

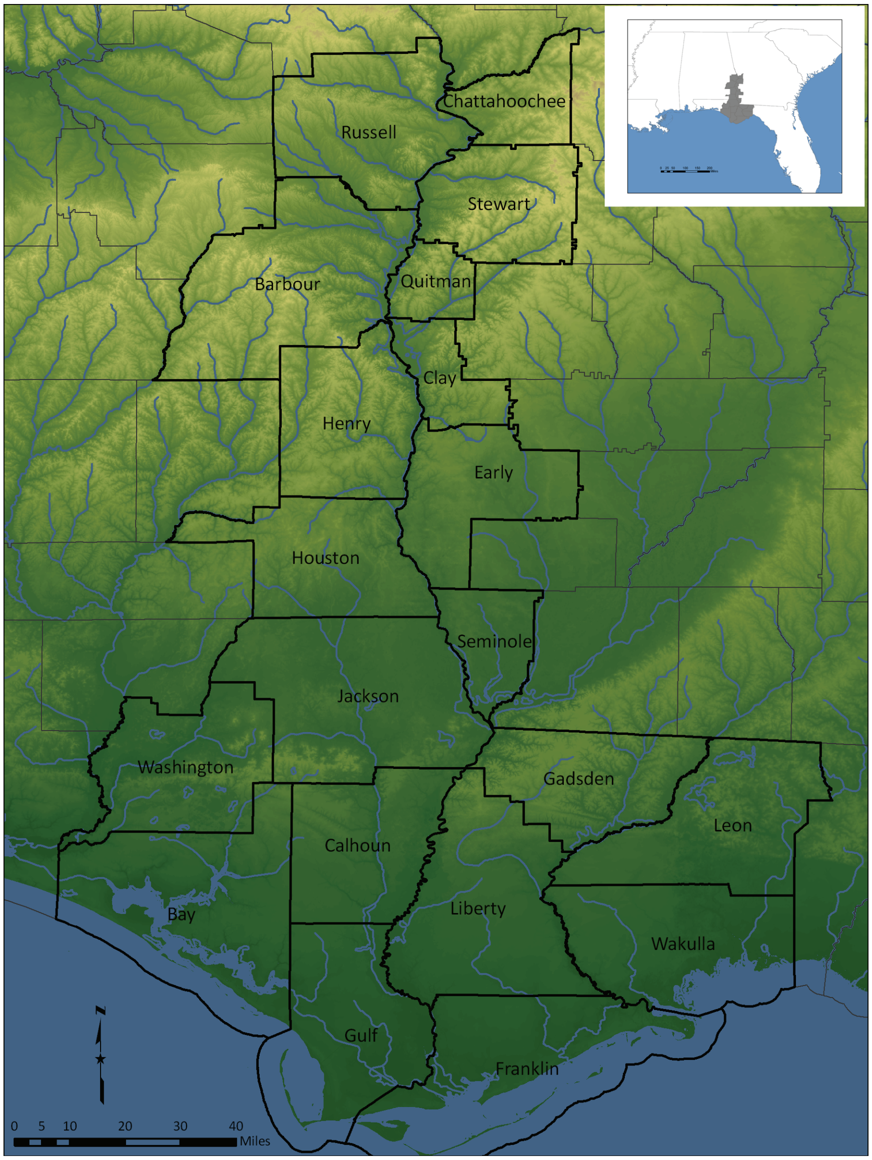


*Figure 2. The study area with counties identified.*

Located in the northern part of the study area, the lower Chattahoochee River is the southern-most subdivision of a river that finds its headwaters in the Blue Ridge Mountains, where it begins as a natural spring of the same name located in northeastern Georgia. From Chattahoochee Spring the river flows into and westward across the Piedmont, through present-day Atlanta to the Alabama state line before turning south to form the modern boundary between Alabama and Georgia. The lower

Chattahoochee River is defined as the section of river below the Fall Line, the physiographic boundary between the Piedmont and the Coastal Plain, at Columbus, Georgia. Physiographic characteristics of the lower Chattahoochee River are shaped primarily by the underlying geology of the area. Although exclusively within the Gulf Coastal Plain, the river and its tributaries cut through a number of distinctive geological zones that help shape the surface topography, vegetation, and drainage patterns. Within the lower Chattahoochee River, two very distinctive physiographic zones are recognized, the Fall Line Hills and the Dougherty Plain, and each is plainly visible on elevation maps of the region (Figure 3). The Fall Line Hills, as the name implies, "rise above the Flatwoods" as sand hills and, in Georgia, also include the Red Hills Belt (Fenneman 1938:73). The Fall Line Hills, in the lower Chattahoochee Valley, share more ecological characteristics with the Piedmont than the Costal Plain (Knight and Mistovich 1984:6). The Dougherty Plain is "nearly flat" with "shallow flat-bottomed or rounded depressions [of all sizes] made by solution" (Fenneman 1938:76). Here, most small drainages flow in underground channels (Fennenman 1938:77). The Apalachicola River begins at the confluence of the Chattahoochee and Flint rivers in the far southwestern corner of Georgia. From there, the river flows south through the Tifton Uplands (Fenneman 1938:78) and across the coastal lowlands, which share drainage characteristics with the Dougherty Plain, to the Gulf Coast (see also Hunt 1967). The southern end of the study area is bounded by two large estuaries, Apalachicola Bay to the east and St. Andrews Bay to the west, and one lagoon, St. Joseph Bay. A number of smaller bays or inlets line the coast east of Apalachicola Bay to the eastern edge of the study area.

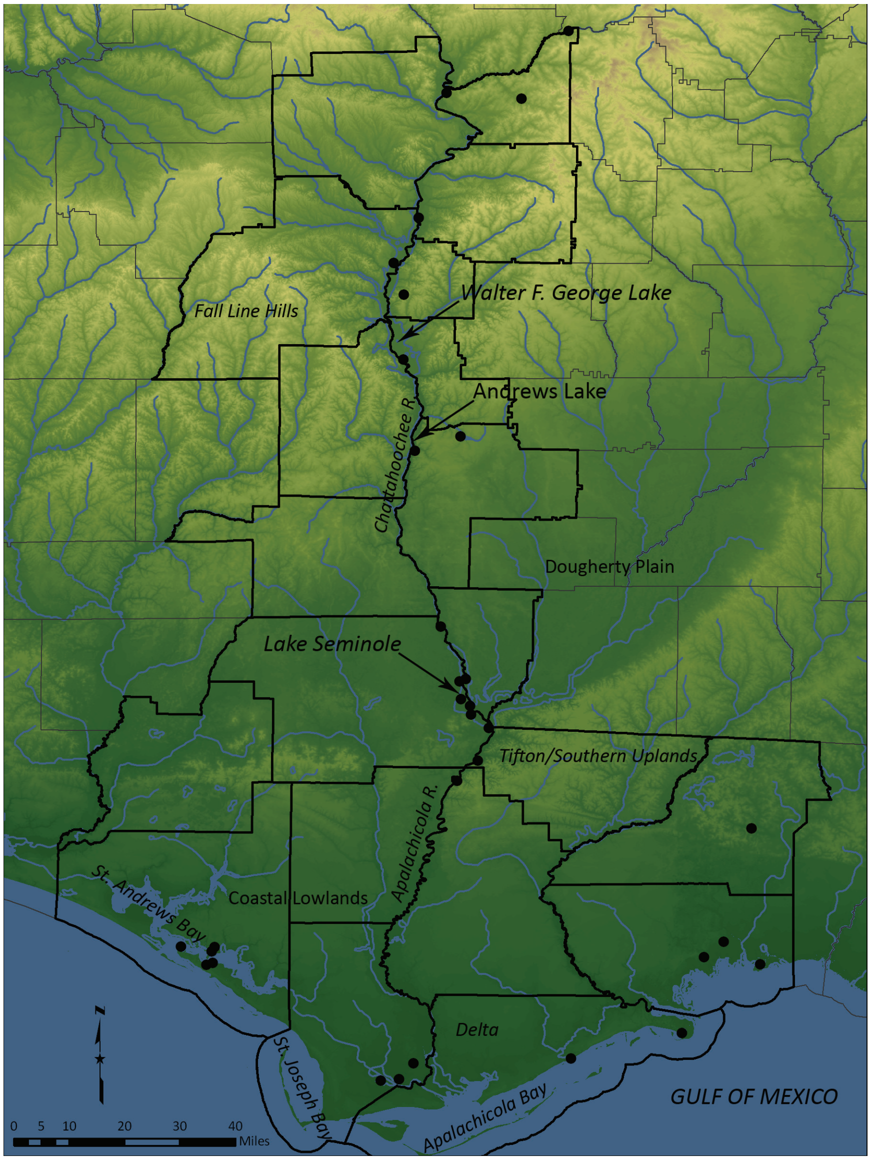


*Figure 3. Major geographic features within the study area.*

The remainder of the chapter focuses on the history of archaeological research, paying particular attention to the major survey and excavation efforts that led to chronology development and provided many of the ceramic collections used in the current study. Major fieldwork was conducted early in the twentieth century by C. B. Moore, described in Section 2.1, Willey and Woodbury, described in Section 2.2, and a compendium of survey and excavation spanning decades under the auspices of the River Basin Surveys and later site-management surveys along reservoir boundaries are described in Section 2.3.

## 2.1 Clarence B. Moore Explorations

Clarence B. Moore, a wealthy Philadelphia native, officially began his forays to southeastern mound sites in 1891, sidelining his career as a business man to take up “archaeology as a serious vocation” (Knight 1996:2). Annually between late fall and spring for the next 28 years, he and a small crew traversed the Southeast aboard a sternwheel riverboat, called the Gopher of Philadelphia (Knight 1996:3), targeting mounds for their funerary interments. His initial expeditions centered on the Atlantic coast of Florida, but before his career ended he uncovered finds in other parts of the Florida peninsula and the panhandle and in South Carolina, Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Kentucky. Much of Moore’s work was sponsored by the Academy of Natural Sciences of Philadelphia, and timely reporting of his research appeared in the *American Naturalist*, the *American Anthropologist*, and the *Journal of the Academy of Natural Sciences*, the latter publication funded by Moore himself.

Today, Moore’s contributions are met with mixed reviews, yet his peers thought highly of his work. Peabody (1905:187) praised Moore for his contributions: “to him is due much of the recent great progress of our knowledge of the art in articles of clay and shell of the southern Indian tribes." Similarly, Haynes (1900:30) remarked that "for some years [he] has been the most prominent and energetic private investigator of American antiquities." Moore operated during a time when American archaeology, not yet a formal discipline, was conducted primarily by self-taught amateurs rather than professionals educated in widely accepted methods of field work and reporting (Meltzer 1985:258). Judged on these terms, Moore "produced . . . highly competent and well illustrated reports" (Schuyler 1971:399), "the first [in fact, to be] widely disseminated . . . [for] Deptford, Santa Rosa-Swift Creek, Weeden Island, and Fort Walton-Pensacola complex[es]" of Florida (Brose and White 1999:vii), yet many of the contextual details of his finds went un- or under-reported as did a full inventory of mound contents. And, though most of his collections returned with him to Philadelphia to be studied and placed on exhibit at the Academy, he gifted some finds to landowners and friends alike (Brose and White 1999:3), making conclusions drawn from quantitative and some qualitative studies of the extant collections difficult if not impossible to evaluate.

The value of his work lies primarily in the fact that many of the mounds he described and excavated have since been destroyed, severely impacted by development, or, if extant, are difficult to relocate. Were it not for Moore we might know very little indeed. This is particularly true for many of the Woodland period-mounds, so much so that any study of "Middle Woodland burial mound ceremonialism and settlement cannot be discussed without reference to Moore's work" (Brose and White 1999:11). Moore spent a total of five field seasons exploring the mounds located along the northwest Florida coast and up the Apalachicola, Chattahoochee, and Flint rivers into southwestern Georgia and southeastern Alabama, being especially drawn to the vessel-rich Weeden Island burial mounds that once dotted this landscape. His work, originally published between 1902 and 1918 for sites within the study area, was recently reprinted in a compilation produced by the University of Alabama Press with an introduction by Brose and White (1999:1–41). As the editors of this volume chronicle, Moore spent 1902 exploring the stretch of coast between St. Andrews Bay and Tampa, documenting a total of sixty-eight mounds in a single season (Brose and White 1999:5). In 1903, he traveled up the Apalachicola River and returned in 1906 to explore the mounds along the lower Chattahoochee and Flint rivers (Brose and White 1999:6–7). After an extended hiatus from Florida expeditions, Moore returned in 1918 to revisit the Apalachicola-Flint region, but, as Brose and White (1999:7) noted, the quality of his reporting had diminished considerably by then. This trip would conclude his efforts in the region, but Moore's legacy would survive in his beautifully illustrated publications. His work also would serve to complement and frame the regional survey conducted by Willey and Woodbury some two decades later.

## 2.2 Gordon R. Willey and Richard B. Woodbury Survey

In the summer of 1940, Gordon R. Willey (1973:37) and Richard B. Woodbury, then graduate students at Columbia University, conducted a site survey within a narrow strip of the Florida Gulf Coast between St. Marks to the east and Pensacola to the west (see also Willey and Woodbury 1942). This short project—funded by the University and the National Park Service—developed, in part, as a result of the striking similarities between stamped pottery in central Georgia and pottery from the Panama City area that Willey had observed during a visit to Florida in 1938. As newly appointed chief of the Archaeologic Sites Division at the National Park Service, A. R. Kelly funded the project likely because he viewed it as filling a major gap in survey coverage for prehistoric sites in the Southeast (Lyon 1996:175–176).

In less than three months, Willey and Woodbury located 87 sites and revisited or attempted to relocate many of the mounds Moore described earlier that the century (Willey and Woodbury 1942:234). The project met its primary goal by providing a ceramic collection robust enough for Willey and Woodbury to establish a chronological outline for the region. Strategically placed stratigraphic excavations at six sites in the area supplied Willey (1973:38) with independent confirmation of a tentative ceramic seriation that had been created from surface collections over the course of the summer. The final publication, “Archeology of the Florida Gulf Coast,” included not only the work described above but also what Willey (1973:103; see also Haag 1985:274) considered “site reports” for a number of sites excavated by the Smithsonian Institution on Florida’s west coast between 1923 and 1936. In a “historical reconstructive” and comprehensive fashion, Willey (1973:1) presented site summaries, temporal-period outlines, and ceramic type descriptions—many of which were being defined for the first time. That the major elements of the Willey and Woodbury chronological scheme remain intact some seven decades later is a testament to the value of their methods for developing useful ceramic typologies and constructing regional temporal sequences (Milanich

1994:159; Trigger 1989:383). Four surface collections and two stratigraphic excavations from Willey and Woodbury's work are included in the current study. The remaining collections were either too small or too mixed to be used in the analyses presented here.

## 2.3 River Basin Surveys

The lower Chattahoochee-Apalachicola River System is well known for being the shortest water route between the Gulf of Mexico and the interior Piedmont (Anderson 1998 278–280; Knight and Mistovich 1984:8). No doubt used as a travel corridor, or a "great canoe highway" (Milanich 1974:3), for millennia prior to the arrival of European settlers, the river system continued to function as a navigation route between the Fall Line and the Coast throughout the nineteenth century. Changes in the use of this and other major rivers came only as travel and shipment of goods by other means, especially by train, grew in popularity (Willoughby 1999:77). At least by the 1930s, the federal government began to consider rivers and their valleys for new uses, namely hydro-electric power and recreation by means of dams and reservoirs. The architects of these new reservoir projects envisioned agricultural benefits as well: reducing soil erosion, enhancing irrigation, and controlling floods.

By the early 1940s, hundreds of dams across the county were either being planned or were already being built in order "to develop the river valleys of the county" (Brew 1947:212). Such engineering efforts threatened archaeological resources, but it was not until the mid-1940s that archaeologists collectively realized the scale of these projects and the impact their completion would have on the archaeological record. The Committee for the Recovery of Archaeological Remains, of the American Council of Learned Societies, formed in 1945 to ensure that all river basin efforts operated with common goals, field standards, staff qualifications, and end products (i.e., timely publication). “The emergency brought about by the extensive Government program” meant that archaeologists had to embark on a “new type of archaeology,” one dedicated to “[making] certain that archaeological remains . . . are preserved” (Brew 1947:209, 213). The Smithsonian Institution, under the direction of Frank H. H. Roberts, Jr. of the Bureau of American Ethnology, was the lead agency charged with managing the effort and, as such, entered into interagency agreements with the National Park Service, the Bureau of Reclamation, and the Corps of Engineers to salvage “vital information of American prehistory . . . before the waters rise” (Brew 1947:209; see also Lyon1996:203). Survey projects sprang up across the county as a result of the Inter-Agency Archeological and Paleontological Salvage Program, though archaeologists working for state and local agencies, such of the Florida Park Service or the Alabama Museum of Natural History, conducted much of the field work, analysis, and reporting and, depending upon the specific arrangement, shared the costs of time and labor but also retained the rights to excavated material (Brew 1961:4).

In the end, hundreds of archaeological sites were recorded, but a far smaller subset of those sites was tested prior to inundation. Nevertheless, despite the concerted effort toward large-scale survey and limited excavation of sites in many river valleys throughout the United States, these river basin projects still had the ultimate outcome of covering an untold number of sites under many feet of water. Unfortunately, this is the condition of several sites included in the present study. A total of three government-initiated reservoirs were built on the lower stretches of the Chattahoochee River. Much of this work received congressional authorization through the River and Harbor Act of 1945. The archaeological projects conducted in advance of reservoir inundation are briefly described below in order of their construction schedule.

### *Lake Seminole (Jim Woodruff Lock and Dam)*

Lake Seminole, as it is known today, is located in southwestern Georgia and adjacent portions of the northwest Florida interior panhandle. The Jim Woodruff Lock and Dam was constructed just south of the junction of the Chattahoochee and Flint rivers, about a mile and a half northwest of Chattahoochee, Florida (White 1981:6). Construction began in 1947, and the lake opened 10 years later. Today, Lake Seminole includes some 37,500 acres of inundated land (White 1981:1), extending about 50 miles up both the Chattahoochee and Flint rivers (Hubbell *et al.* 1956:1), and is a top-ranked lake for bass fishing.

The Florida Park Service, under the supervision of John W. Griffin with the Florida Board of Parks and Historic Memorials, led “an archaeological survey of the west side of the Chattahoochee River to include the 8,500 acres of Florida to be inundated” (Bullen 1950:101), an area undocumented archaeologically at the time. Ripley P. Bullen, also with the Florida Board of Parks and Historic Memorials, was in charge of the daily field operations conducted between October and November 1948. Within the project boundaries, survey was restricted to areas adjacent to and below the 80-foot contour line to be impacted by reservoir construction. A surface survey was employed for plowed fields and other exposures with limited testing to determine whether artifacts were "present below the plowed zone" (Bullen 1950:101). Bottomlands, including river levees, were tested for buried sites. In all, Bullen (1950:103) recorded 54 sites and used the emerging chronological sequences and ceramic typologies to tentatively date many of them.

In June 1953, five years after the Florida survey, Bullen (1958), now with the Florida State Museum, returned to the area to conduct archaeological salvage excavations in advance of dam construction. Efforts focused on six sites within the floodplain of the Chattahoochee and Apalachicola rivers that would soon be flooded (Figure 4 and 5).

A. R. Kelly, in the Department of Anthropology at the University of Georgia, spearheaded archaeological survey on the Georgia side of the Lake Seminole project area (Kelly 1950:27). Survey work on the lower Chattahoochee and lower Flint rivers began in 1948 and continued through 1950 and involved "surface collections and some testpitting and minor trenching" to evaluate the significance of individual sites (Kelly 1960:20). Significant rainfall during the first season delayed work on the Chattahoochee River until the following season (Kelly 1950:27, 1960:1), and much of the eventual site reconnaissance on this river involved "fortuitous and accidental" discoveries made in river cuts, upturned trees, and animal disturbances as the "area had not been cleared . . . at the time of survey" (Kelly 1950:27). The University of Georgia "had no river basin appropriations from federal sources," so the University field school was enlisted at times for labor (Kelly 1960:20). Despite the unfavorable weather, ground, and funding conditions, Kelly (1950:28) recorded 45 sites "equally distributed on the Flint and Chattahoochee drainages." Full publication of survey and salvage work stalled until "renewed survey activities along the lower to middle Chattahoochee region" in preparation for the Walter F. George and George W. Andrews Lakes could be completed (Kelly 1960:iii). Limited funding may have played a role too in the recommendation of so few sites for mitigation (Kelly 1960:20). After three years of survey and limited testing, Fairchild's Landing appears to have been the only site on the lower Chattahoochee River to be classified as a priority site and recommended for salvage (Kelly 1950:32, 1960:3, 21).

*Figure 4. Aerial photograph of the Jim Woodruff Lock and Dam construction site in 1952 at the confluence of the Flint (right) and Chattahoochee (left) rivers (Agricultural Stabilization and Conservation Service Image LK-1M-031).*

*Figure 5. Aerial photograph of the completed Jim Woodruff Lock and Dam in 1962 (Agricultural Stabilization and Conservation Service Image LK-1DD-084).*

Joseph R. Caldwell, of the Smithsonian Institution, conducted salvage excavations at Fairchild's Landing in 1954. Hare's Landing, though not explicitly singled out in 1950 for salvage, also was excavated at that time. These two sites are the only ones on the lower Chattahoochee River in Georgia that received any salvage excavation prior to inundation. No formal and complete publication of the Lake Seminole survey or salvage work conducted on the Georgia side of the lower Chattahoochee River ever materialized. Caldwell's excavations are available only in manuscript form (Caldwell 1978). Kelly (1950, 1960) summarized survey and testing results at the close of the project and briefly described the Lake Seminole survey in a University of Georgia Lab Series publication that focused primarily on the Lake Douglas Mound and related sites on the lower Flint River.

More recently, in 1978 and 1979, Nancy White (1981:1) led a survey of the land around Lake Seminole for the U.S. Army Corps of Engineers, Mobile District. In addition to basic survey of federal lands and easements of "immediate potential adverse impact," the contract called for the relocation and evaluation of all previously known sites (White 1981:79). This work represented the "first *systematic* archaeological survey" in the region (White 1981:2, emphasis added) and resulted in the location of 302 sites, 164 of which met criteria for eligibility to the National Register of Historic Places (White 1981:ii). Two sites (8JA233 and 9SE102) that were previously unrecorded had collections large enough to be included in the current study. Two sites included here (8JA5 and 8JA19) had been recorded earlier by Bullen and were resurveyed by White (1981). White (1981:71–72) also discussed her unsuccessful attempts to relocate Fairchild's Landing (9SE14).

### *Walter F. George Lake (Lake Eufaula)*

Known locally to Alabama residents as Lake Eufaula, Walter F. George Lake extends some 85 miles from Columbus, Georgia, south to the dam site at Fort Gaines (Knight and Mistovich 1984:1). Construction of the reservoir began in 1957, following authorization from the River and Harbor Act of 1945, and was completed six years later. Approximately 45,180 acres of inundated land are contained within the lake limits.

The Alabama Museum of Natural History, with funding from the University of Alabama, carried out survey and excavation on the Alabama side of the Chattahoochee River from the Florida state line to Phoenix City, Alabama, prior to inundation of Walter

F. George Lake (DeJarnette 1975:1). Wesley R. Hurt, Jr., a research associate at the museum, surveyed the area to be impacted in 1947 with the goal of locating "as many aboriginal remains [threatened by inundation] as possible" (DeJarnette 1975:1). In all, 124 sites with surface scatters "sufficient . . . for analysis" were recorded as were "20 mounds and mound groups and a large flint quarry" (DeJarnette 1975:1). The University of Alabama, with assistance from "student field training units . . . [and] a local labor crew," conducted excavations at key sites in Barbour and Russell counties, including Shorter (1BR15), from 1960 to 1962. Hurt's survey results languished in manuscript form for years before being incorporated into a volume that included results of the eight University of Alabama site excavations (DeJarnette 1975; see Knight and Mistovich 1984 for a detailed discussion on the history of the Hurt manuscript).

Harold Huscher, chief archaeologist with the Smithsonian Institution, carried out additional survey work in 1958 to relocate "previously listed archeological sites, to explore both banks of the river . . . , to test selected sites that seemed [promising] . . . , and to" map and photograph the sites, including those in Clay and Quitman counties, Georgia (Huscher 1959b:1; see also Jennings 1985:289 and Kelly *et al.* 1963:i). He returned in 1959 and, with some assistance from G. Hubert Smith, focused attention on 10 sites requiring further investigation within the reservoir proper and, in cooperation with David Chase, excavated two sites within the Fort Benning Military Reservation boundaries.

Between 1983 and 1984, Knight and Mistovich (1984:1), no longer limited by state boundaries and archaeological politics (White 1981:21), returned to the area to locate sites on US Army Corps of Engineers fee-owned lands bordering the lake in Alabama and Georgia and to make recommendations for additional work. They also developed a much-needed chronology in light of all prior work, including site excavations led by Caldwell, Chase, DeJarnette, Kelly, and Sears. Test excavations based on their survey results followed two years later (Mistovich and Knight 1986).

Over 300 sites were recorded during the surveys for Lake Eufaula and Andrews Lake, described below, and over 100 of these were considered significant (Kelly 1960:21–22). Far fewer received any substantive testing prior to inundation, and, as mentioned above, no comprehensive report of the survey work, at least on the Georgia side of Lake Eufaula, ever made it to print. A. R. Kelly and University of Georgia staff, under an agreement with the Smithsonian Institution, led the testing effort at eight sites designated as top priority in 1959 and 1960. The most well-known product of this work, which was disseminated in a report and a subsequent *American Antiquity* article, was the extensive excavation of village and mound deposits at Mandeville (9CY1). As the only well-publicized and published Middle Woodland-period mound site on the Georgia side of the lower Chattahoochee River, save for Kolomoki and the mounds excavated by Moore at the turn of the century, Mandeville figures prominently in all chronological schemes of the region. The testing results for the remaining seven sites are available as a University of Georgia Laboratory series publication (Kelly *et al.* 1963); however, Kelly *et al.* (1963:ii) lamented that “overall systematic interpretation and conclusions for the total Chattahoochee basin survey” cannot be made until all “significant site excavations” are available.

### *George W. Andrews Lake (Columbia Lock and Dam)*

Andrews Lake, formerly known as the Columbia Lock and Dam, or Columbia Reservoir, begins on the lower Chattahoochee River at Columbia, Georgia, 29 miles south of its larger neighbor, Walter F. George Lake and is west of the Kolomoki mound site (9ER1). The lock and dam, built for navigation rather than hydroelectric power, was completed in 1963, five years after plans were announced for its construction (Belovich *et al.* 1982:21). Compared to the other reservoirs on the lower Chattahoochee River and elsewhere, Andrews Lake is considerably smaller in extent, covering only 1,620 acres of land under water. Its small size meant that the reservoir "remained almost entirely within the original river valley" (Belovich *et al.* 1982:21). Thus survey efforts of the 1950s focused on the larger reservoir projects to the north and south of Andrews Lake, though some survey was conducted at the dam site. The U.S. Army Corps of Engineers, Mobile District contracted for a survey of fee-owned lands around Andrews Lake, and, in 1979 and 1980, White and Weisman led the survey effort (Belovich *et al.* 1982:2) with a scope of work similar to their contemporary survey of Lake Seminole. Fieldwork included surface collecting and shovel test pitting. Belovich *et al.* (1982:iii) identified a total of 187 sites, a third of which met minimum criteria of eligibility for National Register recommendation. Unfortunately, none of the collected ceramic assemblages was large enough to include in the current study.

# CHAPTER 3. CHRONOLOGICAL OUTLINE FOR THE STUDY AREA

Initial efforts to construct a temporal sequence for Georgia go back some seven decades to A. R. Kelly's work in the Ocmulgee River Basin, or Macon Plateau area, at the Fall Line near present-day Macon, Georgia. Between 1933 and 1938, Kelly directed excavation and testing efforts at a number of sites in the area, including the Swift Creek type site. The work was federally sponsored both as a Civil Works Administration project and, in 1934, as a Federal Emergency Relief Administration project. Kelly also employed a number of now-distinguished archaeologists, including James A. Ford and Gordon R. Willey both of whom, during their careers, would make substantial contributions to Southeastern Archaeology. By the mid-1930s, the archaeological complexes of Swift Creek, Macon Plateau, Lamar, and Historic Creek had been defined (Kelly 1938), and, by 1938, the stratigraphic relationship of Lamar and other complexes to Swift Creek had been demonstrated (Willey 1939). These early efforts would set the chronological and typological stage for subsequent work and would serve to frame all additional discoveries in relation to what was known for central Georgia. Relevant here is the Willey and Woodbury survey of the northwest Florida Gulf Coast, described in the preceding chapter, and the chronological scheme that they developed from the survey, described below.

This chapter presents an overview of the chronological picture as it is currently understood. Beginning in Section 3.1, I briefly discuss the temporal and cultural characteristics of the Woodland period. In Section 3.2, I describe the major ceramic types used to construct chronological schemes. The final section, 3.3, covers three chronologies most often found in local Woodland-period literature.

### 3.1 Defining the Woodland Period

The Woodland period, an Eastern North America archaeological construct derived from a nineteenth century recognition of the Eastern Woodlands as a culture area, is characterized in terms of both time and content (Anderson and Mainfort 2002:2–4). As a *time* period, the Woodland spans 2,000 years, from 1000 B.C. to A.D. 1000, and is subdivided into early, middle, and late segments. Dates for the subperiods vary from somewhat to greatly depending upon the region and the researcher. The cutoff for the Early Woodland period in the Deep South is generally accepted as 200 B.C., though occasionally it is reported to be as early as 500 B.C. or as late as A.D. 1. More agreement exists regarding the end date for the Middle Woodland period in the Deep South, which is reported most often as either A.D. 400 or A.D. 500.

Strictly in terms of time, cut off dates are arbitrary. Thus, discrepancies among the above subperiods arise not because archaeologists cannot agree on arbitrary dates but because the Woodland period also is conceived of in terms of changes in cultural practices or material content. Such changes vary not only from region to region within eastern North America (Willey and Phillips 1955:725) but also through time as new discoveries are made and novel studies revise existing interpretations. From a perspective of archaeological systematics, *stage* is perhaps a more appropriate term for higher-order, content-based units (*sensu* Krieger 1953:247–248; Willey and Phillips

1955:725), where the content typically is based on technological features that have coherent distributions in time (Dunnell 1971:161). Although stage and period also have been used interchangeably (Lyman and O'Brien 2001:1–25), *period* still is employed far more often for identifying a suite of temporally overlapping prehistoric cultural developments. Regardless, most archaeologists envision the Woodland period/stage as a time during which pottery making, burial ceremonialism, and interregional trade became widespread, even though we now know the roots for these cultural practices are found in the preceding Archaic period at least in some parts of the Eastern Woodlands. During the Woodland period, permanent villages appear along with social differentiation and intensive food harvesting. Formal community plans organized around platform-burial mound complexes and centrally placed, community plazas also find their beginnings in the Woodland period. Regional variation in these practices remains high, though all of these features appear to have existed within the lower Chattahoochee and Apalachicola river valleys and the neighboring Gulf Coast.

For clarity, the Woodland period here is treated as a unit of time. The Middle Woodland period brackets the time from 200 B.C. to A.D. 400, and the Late Woodland period falls between A.D. 400 and A.D. 1000. Within this basic chronological framework, further subdivisions exist. Those in the literature that relate directly to the study area are presented in the following section. This chronology will be further refined and integrated in Chapter 4.

## 3.2 Major Ceramic Typologies

The focus of Chapter 4 is on the construction and interpretation of a regional chronology that unites a number of independently created Woodland-period sequences used by researchers in the area since the 1930s. Here the point is only to introduce these independent frameworks within which so many of the sites in my analysis have been placed. Two common ceramic themes link the following chronologies: the widespread distribution, in time and across space, of Swift Creek Complicated Stamped pottery and the introduction of a novel suite of ceramic decorations and vessel forms known as the Weeden Island series.

### *Swift Creek Complicated Stamped*

Swift Creek Complicated Stamped pottery, an example of which is shown in Figure 6, takes its name from the type site in Macon, Georgia, but the distinctiveness of the ware was realized even by C. B. Moore (1902:154, 162), who often referred to sherds "[with] a complicated stamp decoration" or "bearing the complicated stamp." This pottery is, in fact, ubiquitous on most middle and many Late Woodland-period sites located on the Chattahoochee, Apalachicola, Flint, Ocmulgee, and Oconee rivers and their tributaries and is also found at sites in northwestern Georgia, on the southern Atlantic coast of Georgia and northeast Florida, and in the northwest Florida panhandle. Pottery resembling Swift Creek has been found even as far away as Indiana. Given its distribution, Swift Creek pottery can be characterized as a relatively wide spread ceramic decorative phenomena, or a horizon style, but Swift Creek can also be characterized as a decorative tradition that persisted for almost a millennium.

*Figure 6. Swift Creek Complicated Stamped sherd from Halloca Creek (9CE4), a site on the Fort Benning Military Reservation near Columbus, Georgia (left). A partial paddle stamp drawn by the author from the sherd (right).*

Kelly (1938:32–33), who assigned the type name, believed that “the significance of Swift Creek lies . . . in the existence of a typological series of stamped sherds, stratigraphically distributed, which show stylistic variation . . . of a distinctive pottery decoration over . . . several generations.” Variation also is noted in the type description: “this type is divisible into Early, Middle, and Late showing . . . a progressive increase in size of designs, improvement of firing and surface finish[, and] a lessening of rectilinear elements” (Jennings and Fairbanks 1939:29). The salient element of Swift Creek pottery is its decorative style, which uses paddle-carved curvilinear and linear elements “carefully cut and precisely applied” and combined “into elaborate composite designs” (Jennings and Fairbanks 1939:29).

Not only is the Swift Creek decorative style distinctive, but Swift Creek paddle designs—the combination of elements carved on a single paddle—are distinctive as well. As illustrated in Figure 6 and 7, paddle designs can be reconstructed from sherds in a systematic and highly accurate manner, though recreating the entire paddle often requires access to many different sherds bearing the same design (Frankie Snow, personal communication, 2000). Compared to other paddle-carved and stamped pottery, such as check stamped and simple stamped, which exhibit almost no variation in elements or in the way those elements are placed on the paddle and transferred to the vessel, Swift Creek paddle designs are highly variable. Individual check-stamped or simple-stamped paddles can be identified only in extremely rare cases, but Swift Creek paddle stamps, when they have been reconstructed from impressions on sherds, are almost always unique (Frankie Snow, personal communication 2000). Researchers have long realized the utility of reconstructed Swift Creek paddle designs for tracking, in a uniquely fine-grained way, Woodland-period interaction. Two pioneers of this research, Bettye Broyles (1968) and Frankie Snow (1975, 1982; Ashley *et al.* 2007; Snow and Stephenson 1998; Snow *et al.* 1979), have discovered repeated examples of the same reconstructed Swift Creek paddle stamp or a virtually identical design occurring on sites separated in space by hundreds of miles. The implication is that the paddles, the pots, and/or the people moved across the landscape. The mechanism often invoked to account for these shared designs is human interaction, not the movement of people but the exchange of paddles or pots and ideas. The research that follows speaks directly to this issue. As discussed briefly in Chapter 1 and in detail in Chapters 5 and 6, additional data suggests that residential mobility rather than human interaction, or face-to-face encounters of distantly situated individuals, may have shaped the majority of Swift Creek paddle distributions found archaeologically.

*Figure 7. Swift Creek Complicated Stamped sherd from Halloca Creek (9CE4), on left, and a partial paddle stamp drawn by the author from the sherd, on right. The lands, or raised areas, on the sherd correspond to the grooves, or carved areas, on the paddle. The paddle grooves are shaded or darkened on design reconstructions made by Snow and his students. Broyles's designs are rendered in the opposite manner, with white space representing paddle grooves.*

Several archaeologists have attempted to divide Swift Creek Complicated Stamped into types that exhibit less temporal variation in order to make the ceramic classification scheme more time sensitive (Caldwell 1978:63–68; Sears 1951:9–10, 1956:15–17, 52–53; see also Smith and Neiman 2007:50). Yet, these modified classifications, even the simple ones identifying early and late rim varieties, have never been implemented consistently across multiple assemblages (Figure 8 and 9; see also Smith and Neiman 2007:Figure 4). Other potentially time-sensitive ceramic attributes lack consistency in reporting as well. Thus, in many ways, we are no closer to understanding the exact nature of the temporal variation in Swift Creek pottery noted almost 70 years ago. Where is the earliest Swift Creek pottery found and what does it look like? Are scalloped and notched rims indicative of early Swift Creek everywhere? How do vessel form and volume change through time? Does vessel form diversity increase through time, peaking with Weeden Island series ceramics, in which as Willey (1973:406) suggested “vessel forms are exceedingly numerous”? What are the implications for changes in cooking, consumption, and ceremonial practices? These questions and others related to them are difficult to answer even today largely because studies of Swift Creek ceramic variation often have been from the perspective of only one site, Fairchild’s Landing or Swift Creek or Kolomoki, rather than from the perspective of a group of chronologically ordered sites and assemblages. The chronology presented in Chapter 4 provides a framework within which additional variation in Woodland-period pottery finally can be cast.

*Figure 8. Swift Creek Complicated StampedsSherds from Leake (9BR663), a site in North Georgia (Southern Research, Inc. 2008). Photo on the left (9BR663 Lot Number 300 Test Unit 13 Level 2a) is an excellent example of a paddle edge, rarely preserved on sherds because of over-stamping and vessel curvature (Frankie Snow, personal communication, 2000). Photo on the right (9BR663 Lot Number 499 Test Unit 35 Level 1a) illustrates a scalloped rim thought by many researchers to be an early Swift Creek trait.*

*Figure 9. Two Swift Creek Complicated Stamped vessels (Vessel 1, left; Vessel 8, right) from Shelly (9PU3), a Woodland-period burial mound and occupation site on the lower Ocmulgee River in central Georgia. Both vessels were recovered from an east-side pottery cache and both exhibit features, such as folded rims, constricted necks, and zoned stamping, considered by many researchers to be markers of late Swift Creek.*

### *The Weeden Island Series*

The Weeden Island ceramic series, first defined by Willey (1973:407–408), includes the types Weeden Island Plain, Weeden Island Incised, Weeden Island

Punctated, Weeden Island Zoned Red, Carrabelle Incised, Carrabelle Punctated, Indian Pass Incised, Keith Incised, Tucker Ridge Pinched, and Hare Hammock Surface-indented (Figure 10). Willey (1973) was also the first archaeologist to describe many of the types he considered part of the series, though Stirling (1936, cited in Willey 1945:225) is credited with first applying the name “Weeden Island” to the ware found at a site bearing the same name in southwest peninsular Florida. As is clear from the above list, “incision and punctation are two of the principal techniques” as is modeling, and, though these three co-occur, they are “only rarely . . . combined upon the same vessel” with stamping (Willey 1973:407). Weeden Island series pottery does occur in assemblages with stamped pottery. In fact, the temporal distribution of both Weeden Island and Swift Creek Complicated Stamped shows considerable overlap. Nevertheless, Weeden Island pottery is distinctive in terms of decorative technique, decorative application, vessel form, and, some would argue, archaeological context.

*Figure 10. Weeden Island Pottery from McKeithen (8CO17), a Woodland-period mound-plaza-village complex in north central Florida. Weeden Island Plain bowl with effigy adornos (top left). Weeden Island Incised unusual canoe-shaped bowl (top right). Weeden Island series sherds (bottom left). Tucker Ridge Pinched bowl (bottom right). Photos courtesy of Jerald Milanich and the Florida Museum of Natural History.*

The list of researchers intrigued by Weeden Island pottery and its ubiquitous association with certain aspects of Woodland-period ceremonialism is a long one (Allison 2003; Brinkley 2006; Brose and Percy 1974; Cordell 1984; Milanich *et al.* 1997; Rice and Cordell 1985; Roberts 1975; Sears 1953, 1973; Steinen 1976; Willey 1945). Willey (1973:406) referred to Weeden Island pottery as “the most outstanding [pottery] of the Gulf Coast and, in many respects, of the entire aboriginal eastern United States. This relative excellence pertains to quality of ware, vessel form, and surface decoration.” He was not alone in this assessment. Even earlier, Moore, referring to pottery we would now classify as Weeden Island, often and with great enthusiasm remarked on the “excellent ware” of some vessels he had recovered from burial mounds along the Gulf Coast, bearing “graceful outline[s]” and interesting designs (Moore 1902:334; 1907:431, 443). Some of the more elaborately decorated vessels were among “the most interesting ware” Moore was compelled both to describe and to illustrate (Moore 1902:259). Goggin (1947:116) referred to Weeden Island, identified at the time in terms of ceramic assemblages, as “the climax culture” of the northwest Gulf Coast, noting that it “appears to extend up the Apalachicola-Chattahoochee-Flint river system for over a hundred miles into the state of Georgia.” Goggin was correct. Today, we have an even greater understanding of the distribution of sites with Weeden Island pottery. As shown in Figure 11, counties with at least one site where Weeden Island pottery is found are distributed throughout northern and central Florida and along several major riverways, including the Alabama, Apalachicola- Chattahoochee-Flint, and Ocmulgee rivers.

Willey (1973:407) suggested that Weeden Island potters were more “closely bound up with ritual observances for the dead” than were their predecessors. This, perhaps, was Willey’s acknowledgment that certain styles and forms of Weeden Island series vessels are found almost exclusively in burial contexts (Figure 12). It was this very class of pottery that Moore sought in his Gulf Coast expeditions. Sears (1973) would later present the concept of ritual wares as a sacred and secular dichotomy in vessel form, decoration, and context based on his work at the Kolomoki site. More recent work aimed at measuring craftsmanship and manufacturing effort (Cordell 1984; Rice and

Cordell 1985) and intrasite spatial patterning in ceramic types (Smith and Neiman 2007) has revealed a more complex picture. The so-called mortuary pottery is indeed found almost exclusively in mound contexts and “consists exclusively of effigy vessels . . . some [of which] have the characteristic cutout areas, incising, and slipping, while others lack embellishment other than rim adornos” (Rice and Cordell 1985:282). But other wares, which are found in both mounds and middens, also exhibit a high degree of craftsmanship. Weeden Island Incised, Red, and Zoned Red (Figure 13) have subsequently been labeled prestige or elite wares on the basis of craftsmanship and their occurrence across contexts (Rice and Cordell 1985:282–283). Finally, a recent intrasite study of ceramic distributions at Kolomoki revealed Weeden Island Red (probably including the zoned red variety) to be more abundant in spatial contexts closely associated with the central plaza than in contexts farther removed from this central feature (Smith and Neiman 2007:65–66). This pattern suggested to Smith and Neiman a different role for red-filmed pottery than the one implicated in sacred-secular or mortuary-elite divisions.

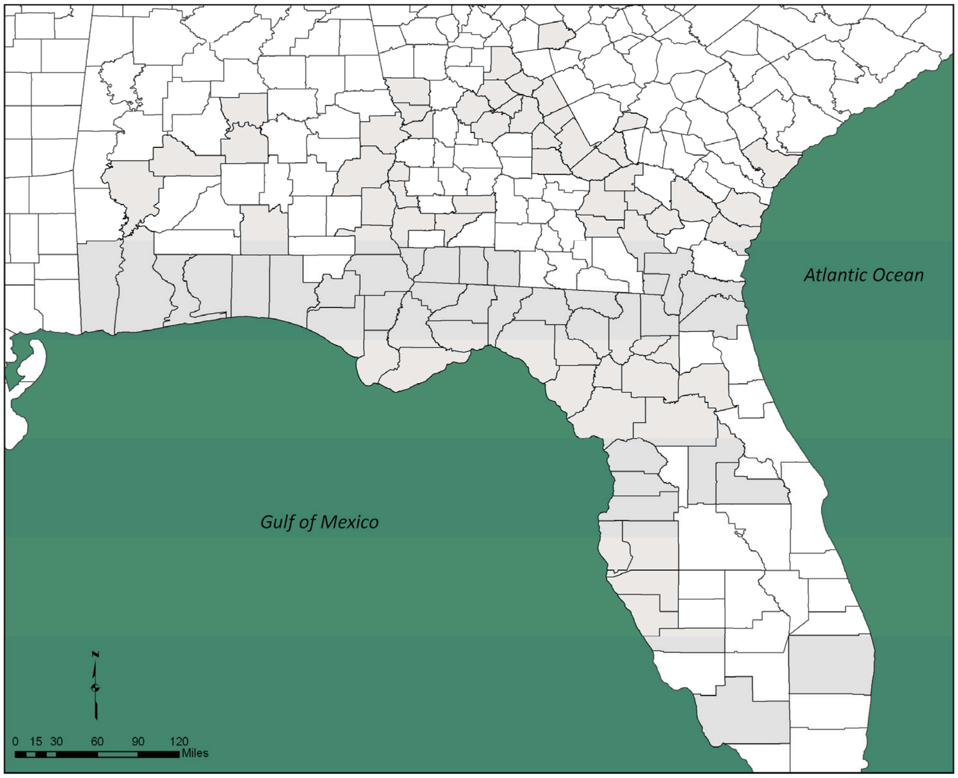


*Figure 11. Distribution of Weeden Island pottery in the Deep South. Shaded counties are those in which Weeden Island pottery has been reported. Data compiled from Blanton (1979), Elliott (2004), Snow (personal communication, 2009), Walker (1971), Willey (1973), Worth (1988), and the Florida Master Site File.*

*Figure 12. Weeden Island Effigy cutouts from McKeithen (8CO17). Photos courtesy of Jerald Milanich and the Florida Museum of Natural History.*

*Figure 13. Weeden Island Zoned Red vessels from McKeithen (8CO17). Photos courtesy of Jerald Milanich and the Florida Museum of Natural History.*

## 3.3 Regional Ceramic Chronologies

A number of local chronological sequences have been developed, with a few developed through comparative work across many sites (e.g., Knight and Mistovich

1984; Percy and Brose 1974; Willey 1973) and others taking a more or less single-site approach (e.g., Caldwell 1958; Sears 1956). The following treatment of existing chronologies is not meant to be exhaustive. Rather, the focus is on the ceramic sequences that have come to be standard references. Table 1 shows how these chronologies align based on ceramic content. As a point of reference, revised ceramic phase groups, developed using frequency seriation and correspondence analysis as described in Chapter 4, also are presented in Table 1 in the far right column (Smith and Neiman 2007). The dash line represents the break between the Middle Woodland and the Late Woodland periods.

**Table 1. Regional Ceramic Periods.**

| Est. End Date | Hurt 1947* | Willey 1973 | Percy & Brose 1974 | Knight & Mistovich 1984 | Smith & Neiman 2007 |
|---|---|---|---|---|---|
| A.D. 950 | Complex D | Weeden Island II | Weeden Island 5 | Late Weeden Island-Cat Cave | Sycamore |
| A.D. 850 | | | Weeden Island 4 | | Late Weeden Island |
| A.D. 800 | Complex C | Weeden Island I | Weeden Island 3 | Cummings | Hare’s Landing |
| A.D. 750 | | | Weeden Island 2 | Quartermaster | Kolomoki II |
| A.D. 500 | | | Weeden Island 1 | Kolomoki | Kolomoki I |
| A.D. 350 | Complex B | Santa Rosa-Swift Creek | Late Swift Creek | A Gap | Swift Creek |
| A.D. 300 | | | | Mandeville | Mandeville II |
| A.D. 200 | | | Early Swift Creek | | Halloca Creek |
| A.D. 100 | Complex A | Deptford | | | Mandeville I |
| A.D. 1 | | | N/A | Shorter | Shorter |

* Hurt’s 1947 complexes are correlated with phase terminology in Huscher (1959a:23).

### *Willey and Woodbury (1942) Scheme*

Gordon Willey and Richard Woodbury developed the first, and arguably the most influential, ceramic chronology for the northwest Florida Gulf Coast in 1940 (Willey 1973; see also Brose 1985:156; Goggin 1949:14; Milanich 1994:157–158; Willey and Woodbury 1942). The Willey and Woodbury survey and testing effort, which culminated in a widely adopted regional chronology, was described above. As mentioned, their results quickly circulated among a larger audience and were so well received, and so needed in 1940, that virtually everyone working anywhere in or near the Florida Gulf Coast, then as now, referenced their work. Their chronology was initially constructed from a ceramic seriation of surface collections from a number of sites visited during the 1940 survey, though the preliminary diagram was never published. Excavations targeting stratified deposits at 6 key sites confirmed the relative order of the major ceramic types as displayed in the seriation. These stratified sequences were interdigitated, or fitted together, to form a region-wide ceramic sequence, which Willey and Woodbury then divided into five ceramic periods. Both the interdigitated seriation and the period divisions appeared in the final volume (Willey 1973:Figure 14). The periods—Deptford, Santa Rosa-Swift Creek, Weeden Island I, Weeden Island II, and Fort Walton—formed the culture historical framework within which other aspects of the archaeological record were placed.

Four of the five periods are relevant to the following study. The earliest, according to Willey (1973:353), is the Deptford-period ceramic assemblage dominated by both linear and bold varieties of Deptford Check Stamped. Deptford Simple Stamped also is found in Deptford-period assemblages. Willey recognized only eight or nine sites during the survey that dated to the Deptford period. Santa Rosa-Swift Creek–period assemblages are dominated by Swift Creek Complicated Stamped, with minor amounts of Santa Rosa and Crystal River series incised, rocker stamped, and painted types (Willey 1973:366). The number of sites Willey assigned to this period rose sharply to 17 pure and 21 mixed sites (Willey 1973:367). Willey (1973:396–397) defined the Weeden Island I period by the introduction of the Weeden Island series of incised, punctated, and painted types, although, importantly, Swift Creek Complicated Stamped, remains "a marker type" for the period. The Weeden Island II period is marked by the introduction of Wakulla Check Stamped and "the virtual disappearance of Swift Creek Complicated Stamped" (Willey 1973:397). The number of sites that Willey (1973:397–401) assigned to these periods is larger than that of the preceding periods, with 21 pure Weeden Island I sites and 29 pure Weeden Island II sites. Willey noted that many of the sites are mixed middens dating to the Santa Rosa-Swift Creek and one or both of the Weeden Island periods.

Even though Willey and Woodbury initially developed their ceramic chronology using frequency seriation and interdigitation, both of which portray the continuous nature of ceramic change, they described the periods using marker types, or ceramic indices, which gives the false impression of a discontinuous ceramic record; in fact, many of the marker types occur in more than one time period—that is, they are not unique to one period. The drawbacks to honoring periods or phases over ceramic sequences derived from frequency seriation will be discussed in Chapter 4. Willey and Woodbury hoped that ultimately the periods they outlined would come to represent distinct cultures.

### *Percy and Brose (1974) Scheme*

Percy and Brose (1974:3) believed that Willey's study suffered from a lack of survey and excavation data from the interior regions of Florida. Though they acknowledged a continuing deficiency in survey and excavation coverage in 1974, they offered the first preliminary refinement of the Weeden Island I- and II-period divisions with the intention of "more accurately [characterizing] ceramic trends" (Percy and Brose 1974:4–7; see also Milanich 1994:162, 203). Importantly, they recognized that a refined ceramic chronology would allow "the possibility of arranging midden collections more precisely for purposes of studying sequences of change in other aspects of Weeden Island culture" (Percy and Brose 1974:7). Within their scheme, Weeden Island 1, beginning about A.D. 500, is represented by a few Weeden Island series incised and punctated types but an overall dominance of Swift Creek Complicated Stamped (Percy and Brose 1974:6). Ceramic assemblages assignable to Weeden Island 2 have a greater percentage of Weeden Island–series types. Wakulla Check Stamped appears in Weeden Island 3 assemblages, and Swift Creek Complicated Stamp disappears by Weeden Island 4. Weeden Island 5, dating between about A.D. 800–900 or A.D. 1000, marks the final Woodland-period ceramic phase and is characterized by only limited amounts of Weeden Island series incised and punctated types but is dominated by Wakulla Check Stamped.

Despite the apparent chronological refinement offered by the Percy-Brose scheme, it seems to have never caught on, perhaps because it was never published even though their 1974 conference paper was fairly well circulated. Over a decade following the 1974 conference, Brose (1985:162) remained puzzled by the perpetuation of Willey's 1940s chronology in light of "masses of new data . . . [and] numerous new methods and techniques." Others have since acknowledged the need to test the Percy-Brose scheme (Milanich 1994:162; White 1985:173). The ceramic seriation presented in Chapter 4 lends overall support to their divisions and, as shown in Chapters 5 and 6, provides a more detailed sequence in which to evaluate changes in other aspects of Woodland-period life in the Deep South.

### *Knight and Mistovich (1984) Scheme*

The most recent chronological synthesis, and one that is consistently referenced by local researchers, was developed by Knight and Mistovich (1984:211–232) based on their survey work in the Walter F. George Lake area. Unlike the two chronological schemes outlined above, Knight and Mistovich's 15-phase chronology, spanning Paleo-Indian through historical times, focused on site components within the lower Chattahoochee River valley. Five phases (Shorter, Mandeville, Kolomoki, Quartermaster, and Late Weeden Island-Cat Cave) cover the Middle and Late Woodland periods. The Shorter phase (300 B.C.–A.D. 1), originally defined by Schnell and Knight (1978:12), is marked by assemblages with plain and check-stamped pottery (Knight and Mistovich 1984:217). The Shorter site, which is included in the seriation and other analyses that follow, was designated as the type site for the Shorter phase. Knight and Mistovich (1984:218) noted an increase in the number of Shorter-phase sites from the previous period and described the typical site type as small and seasonal. The nonmortuary platform mound at Shorter, built in at least two stages, “appears to be unique” for the period (Knight and Mistovich 1984:218). The Shorter phase ceramic content differs from Willey’s Deptford period, described above, in that the latter also should contain simple stamped wares. It is likely that the difference is one of time averaging; that is, the Deptford period covers more time and includes both Shorter and possibly early Mandeville phase ceramic wares.

The Mandeville phase (A.D. 1–350) was defined based on assemblages from the Mandeville site’s platform mound, described in the following section, and is distinguished from Shorter phase assemblages by the presence of Swift Creek Complicated Stamped, simple stamped, and several more minor types (Knight and Mistovich 1984:219). Knight and Mistovich (1984:219) noted an increase in the diversity of surface treatments among Mandeville phase pottery assemblages, a pattern that is confirmed in the analyses presented in Chapter 5. Like the Shorter site, Mandeville is thought to be unique in the area as a village-mound complex (Knight and Mistovich 1984:219). The remaining Mandeville phase sites identified by Knight and Mistovich (1984:219) “are small, probably seasonal levee and terrace occupations . . . [thus, they noted that] the basic settlement system remained unchanged from Shorter phase times.”

Knight and Mistovich (1984:219) described a stylistic gap, or missing link, between Mandeville and Kolomoki, the next phase in their sequence. The gap was described but not formally named because few if any assemblages within their area seemed to fit neatly in it. Nevertheless, the phase was thought to date between approximately A.D. 300 and A.D. 350. Other researchers have commented on the gap too. Kelly and Smith (1975:131), for example, mentioned that the assemblages from the Swift Creek type site mound, located on the Ocmulgee River in central Georgia, seemed to fall stylistically and in terms of type frequencies between the assemblages from Mandeville and those from the Kolomoki site (see also Smith 1998:118). More recently, Snow and Stephenson (1998:108) discussed the gap in relation to the ceramic assemblage from the Hartford submound, also on the Ocmulgee River (see also Stephenson *et al.* 2002:342). As discussed in Chapter 4, a handful of other sites from the Chattahoochee-Apalachicola area seem to fill the gap as well.

The Kolomoki phase (A.D. 350 and A.D. 500) is identified by the presence of Swift Creek Complicated Stamped. Related complicated stamped types, such as Blakely, and "a minority assortment of a very few early Weeden Island types" also occur in assemblages that date to this phase (Knight and Mistovich 1984:220). Like the gap mentioned above, the Kolomoki phase had few site assemblages Knight and Mistovich (1984:220) could confidently assign to it except for some from the Kolomoki site itself. The absence of Kolomoki phase sites, they noted, may indicate settlement moved "from the Valley into the hill hinterlands during this period" (Knight and Mistovich 1984:220). This is an interesting idea, particularly in light of the ceramic diversity and distance results presented in Chapter 5, and is a point to which I return in Chapter 6.

According to Knight and Mistovich (1984:220–221) the Quartermaster phase dates between A.D. 500 and A.D. 750 and represents a ceramic continuation from the preceding Kolomoki phase, with a notable increase in the Weeden island–series types occurring along with Swift Creek Complicated Stamped pottery and related complicated stamped types. As they noted, this culture-historical unit is equivalent to what some researchers consider Weeden Island I and predates the reintroduction of check stamping in the area (Knight and Mistovich 1984:221). The Kolomoki site has Quartermaster phase assemblages, but Knight and Mistovich discussed a number of other sites in the Walter F. George Lake area that also are assignable to this phase. Thus, the number of Quartermaster phase components is larger than the number of Kolomoki phase components, though “settlement . . . [in the valley is] no easier to characterize (Knight and Mistovich 1984:221).

The final Woodland-period phase defined by Knight and Mistovich (1984:221) is called Late Weeden Island-Cat Cave (A.D. 750–900), which they noted “is one of relative obscurity in the project area.” The marker type for this phase is Wakulla Check Stamped pottery but the type’s distribution, and hence the collections assignable to the phase, seems restricted to the south or “to grade out coming upstream” (Huscher 1959a:112; see also Schnell 1981:21). More recently, some investigators have suggested that this section of the lower Chattahoochee valley was abandoned prior to Mississippian-period settlement (Blitz and Lorenz 2006). This idea seems to be supported by the seriation presented in Chapter 4, which suffers from a lack of assemblages north of the most southerly stretches of the lower Chattahoochee River for the last three phases (identified as the late phases in Chapter 4).

The phase-based chronology outlined by Knight and Mistovich (1984) represented an important achievement for local archaeology. Knight and Mistovich avoided the pitfalls inherent in a single-site approach by considering assemblages from many sites on the lower Chattahoochee River, and, equally important, they avoided the temptation to uncritically import, i.e., through osmosis in the Willey and Phillips (2001:27) sense, the chronology already in place for the northwest Florida Gulf Coast, despite the clear Woodland-period ceramic connections between the Gulf Coast region to the immediate south and the interior stretches of the lower Chattahoochee-Apalachicola River. One of the outcomes of the following study is the demonstration, through seriation methods, that a single chronology can accommodate assemblages from the entire area. The success of the seriation presented in Chapter 4 also suggests that during the middle and most of the Late Woodland-period occupants of the area were part of a single historical tradition and lived within what Ford and other proponents of seriation referred to as a “local” area.

# CHAPTER 4. A CONTINUOUS CHRONOLOGY FOR THE WOODLAND PERIOD

Chronologies are necessary cornerstones to archaeological interpretations that consider change over time or require establishing contemporaneity among sites. As such, chronological inference is perhaps the most fundamental, and certainly the most essential, outcome of the archaeological research process. Although prevailing interpretations regarding prehistoric social organization, settlement patterns, social differentiation, craft specialization, plant and animal domestication, and the like, are subject to revision in light of new analytical methods or discipline-wide paradigm shifts, well-constructed artifact chronologies seem to persist, often changing only in the degree of temporal resolution. With the introduction of radiocarbon dating in the 1950s, relative chronologies could be anchored to a calendrical scale, though in practice this often involved little more than adjusting the calendar dates already assigned to longer time units, such as periods. In the Deep South, most regional ceramic chronologies were in place by the middle of the twentieth century, needing only to be rescaled as more radiocarbon dates were amassed, though as Gibson (1993:18) lamented, even today "most of southern prehistory is little more than ceramic history."

Most chronological efforts in eastern North America that preceded the radiocarbon-dating revolution involved the careful formulation of ceramic typologies and the creation of abstract time units through methods that used these ceramic types. Frequency seriation was one of the preferred methods for the chronological ordering of assemblages and sites prior to the advent of radiocarbon dating, but frequency seriation has seen fewer and fewer applications in the years following the dating revolution (O'Brien and Lyman 1999:v). Several archaeologists have discussed the pros and cons of the shift in dating methods at length (e.g., Trigger 1989:304–305). The ultimate outcome, however, seems to be that frequency seriation is no longer standard practice, being taught only in introductory archaeological courses within the context of *the way things used to be done*. This is an unfortunate condition. As demonstrated in this chapter, seriation methods still have a lot to offer even in light of absolute dating.

When contrasted with radiocarbon dating, the greatest advantage of seriation comes in the way in which it allows one to order assemblages continuously and, depending on the seriation method used, with considerable granularity, or a high degree of temporal resolution (*sensu* Plog 1974:44). Continuous, fine-grained chronologies allow the detection of continuous and fine-grained changes in other aspects of prehistoric life (Plog and Hantman 1990:440–441). Exploring some of these other changes is the goal of the chapters that follow. This chapter lays the groundwork in the sense of providing a continuous and high-resolution chronology.

In Section 4.1, I describe three seriation methods used by archaeologists to impart time to the archaeological record and present both hypothetical and real examples of the methods's applications. Sections 4.2 and 4.3 reiterate the tenants and requirements of frequency seriation, respectively. Section 4.4 presents a revised chronology for the study area, developed using frequency seriation and correspondence analysis. The relative sequence is compared to available radiocarbon dates in Section

4.5. The chapter concludes in Section 4.6 with a discussion of the significance of the results.

## 4.1 Seriation Methods in Archaeology

Seriation simply means the arrangement of something in a series "such that the position of each unit reflects its similarity to other units" in the series (Marquardt 1978:258). The method typically is used to order events, assemblages, objects, or attributes for the purpose of obtaining a chronology but in the absence of other evidence, such as stratigraphic or radiometric data, that might be called on to derive an order (Lyman *et al.* 1997). Assemblages can be seriated using statistical techniques, such as those that measure assemblage similarity, or they can be seriated by visual inspection of the presence and absence of pottery types, called occurrence seriation, or by the relative frequencies of pottery types, called frequency seriation (Lyman *et al.* 1998). As discussed above, the value of seriation is in the way in which it can monitor time continuously (*sensu* Plog 1974:44). If enough related assemblages of equal duration are chronologically ordered, the passage of time is monitored continuously, as is artifact-type change.

Seriation has deep roots in American archaeology (Lyman *et al.* 1997; Lyman *et al.* 1998; O'Brien and Lyman 1999). Leslie Spier (1917:281) was the first American archaeologist to apply the term *seriation* to a set of archaeological techniques, distinguishing between what he described as the "hypothetical seriation of . . . pottery techniques" of Kidder (1915) and the "hypothetical ranking of surface finds" of Kroeber

(1916). In this section I discuss three methods for seriating archaeological assemblages or objects.

### *Occurrence Seriation*

Occurrence seriation relies on the presence or absence of temporally sensitive artifact types or attributes, rather than patterns in relative frequencies, to derive an order among assemblages. Dempsey and Baumhoff (1963), who developed occurrence seriation, called this method contextual analysis and believed it minimized the effects of sampling error. The sole criterion of the occurrence seriation model is that each type must have a single, continuous distribution, meaning that types should not appear, disappear, and then reappear. The model also has been referred to as a two-way Petrie matrix, which is an ideal form of an incidence matrix in which "there is a single block of 1's with 0's to either side (except at the edges)" (Baxter 1994:118).

Although occurrence seriation may offset sampling error, this method also will likely produce chronological sequences that lack the level of temporal resolution potentially obtainable with frequency seriation (O'Brien and Lyman 1999:123–124). Whether this is the case depends, in part, on the classification of attributes or types used in the construction of the seriation. Types that are relatively short-lived but not brief enough as to lack any temporal distribution may in fact provide a high degree of temporal resolution in an ordering derived by their presence or absence among assemblages. Such may be the case with Swift Creek paddle stamps, which are believed to be far more short-lived than the Swift Creek Complicated Stamped type to which many Woodland-period sherds with these paddle-stamped designs are assigned. Recent and ongoing research (Stephenson and Smith 2008) using the occurrence of individual paddle-stamped designs among surface collected assemblages from Swift Creek sites in the Ocmulgee River valley indicates that the temporal resolution achieved by monitoring design presence and absence is comparable to that obtained through frequency seriation (Figure 14). At this time, the design dataset does not permit calculations of sherd frequencies needed for a frequency seriation, but anecdotal information from local researchers supports the relative order derived using design occurrences (Frankie Snow, personal communication 2008).

| | FS071 | FS140 | FS088 | FS058 | FS284 | FS144 | FS335 | FS339 | FS304 | FS327 | FS009 | FS321 | FS209 | FS375 | FS169 | FS270 | FS311 | FS160 | FS367 | FS325 | FS202 | FS212 | FS391 | FS208 | FS236 | FS004 | FS022 | FS265 | FS394 | FS356 | FS196 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Horse Creek | | | | | | | | | | | | | | | | | | | | | | | ■ | ■ | | | | ■ | ■ | ■ | ■ |
| Smith Field | | | | | | | | | | | | | | | | | | | | | | ■ | | | | ■ | ■ | | ■ | ■ | ■ |
| Milamo | | | | | | ■ | ■ | | | | | | | | | ■ | | ■ | | | ■ | ■ | | | ■ | ■ | ■ | | | ■ | |
| Lind Landing | | | | | | | | | | | | | | ■ | ■ | | ■ | | ■ | ■ | | | | | ■ | ■ | | ■ | ■ | | |
| Shelly Md | | | | | | | | | | | | | ■ | | | | | | ■ | | | | | | | | | | | | |
| Shelly Village | | ■ | | | | | | | | ■ | | ■ | ■ | | | | | | ■ | ■ | | | ■ | | | | | | | | |
| Hartford Vill | | | ■ | ■ | ■ | | | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | ■ | ■ | | | | | | | | |
| Bullard | | | | | | | | ■ | ■ | ■ | | | | ■ | | | | | | | | | | | | | | | | | |
| Westlake | | ■ | | | | | | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | | ■ | | | | ■ | | ■ | | | | | | | |
| Bridges Field | | ■ | | | | | ■ | | | | | | | | | | | | | | | | | | | | | | | | |
| Snow White | | ■ | ■ | | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hartford Md | ■ | ■ | ■ | ■ | | ■ | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solomon | ■ | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*Figure 14. Swift Creek design seriation for select sites in the lower Ocmulgee River valley of central Georgia (from Stephenson and Smith 2008). Designs reconstructed by Frankie Snow, of South Georgia College, are numbered and appear as column headings. Site assemblages form the rows. Black squares indicate a design's presence in an assemblage as determined by Snow. Most of the collections come from surface scatters and at least a couple of the sites may have multiple occupations, thus some of the apparent deviations from a perfect fit to the model likely reflect sampling error and a violation of the requirement of equal assemblage duration. The lines represent proposed phase breaks and are not important to the current discussion. A much larger seriation has been completed for the region based on all known and shared designs but is too large to present here.*

Suffice it to say, occurrence seriation is a much younger and far-less used seriation method than the others described here, but it is a seriation method that should not be ignored. Occurrence seriation is proving to be a valuable chronological tool for ordering Swift-Creek assemblages in the Ocmulgee region and will likely be useful in other instances in which quantitative ceramic inventories are not available (e.g. C. B. Moore's burial mound assemblages).

### *Frequency Seriation*

Frequency seriation (FS) is a technique that uses patterning in relative frequencies, or percentages, of artifact types (columns) to arrange assemblages (rows) in a sequence. The technique is based on a model of artifact-type change that stipulates how the pattern in type frequencies should behave through time—that is, each artifact type should display a unimodal frequency distribution when assemblages are arranged. Kroeber (1925:406), who used FS as earlier as 1915 (Kroeber 1916), described the technique as the "non-stratigraphical comparison of the frequency of several types of ceramic decoration." A perfect fit to the frequency seriation model is illustrated in Figure 15. The hypothetical and idealized dataset comprises six types (A to F) and 10 sites (S-1 to S-10) arranged such that each type has a unimodal and continuous distribution.

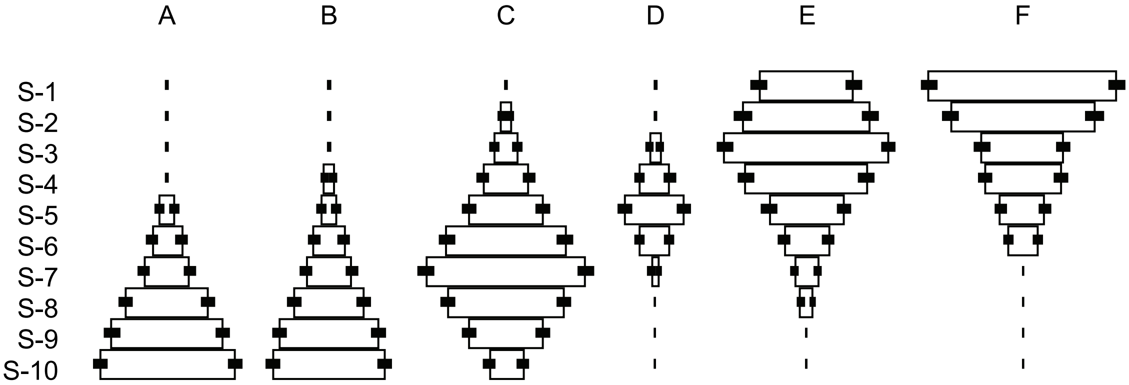


*Figure 15. Hypothetical frequency seriation.*

As with occurrence seriation, the direction of time's arrow must be determined from independent evidence. In practice, this independent evidence can be gathered from one or more stratigraphic sequences that show, for example, types A and B positioned below types D, E, and F. Independent evidence may come from radiocarbon dates that support the proposed sequence. Frequency seriation of ceramic assemblages requires the use of historical pottery types, or types whose distributions are unimodally distributed through time (Dunnell 1970:308; O'Brien and Lyman 1999:121). It is the historical nature of certain pottery types—this waxing and waning in popularity—that enables the ordering of multiple assemblages (see Popularity Principle below).

### *Correspondence Analysis*

Correspondence analysis (CA), also known as dual scaling (Nishisato 1980), reciprocal averaging (Hill 1973), and RQ-technique (Hatheway 1971), dates back to the 1930s as a method for the analysis of contingency tables. By the late 1960s CA was being used by ecologists in the analysis of species incidence and abundance datasets (Legendre and Legendre 1998:451; ter Braak 1985:859). Its use in the analysis of archaeological datasets is both more recent and, as Smith and Neiman (2007:55) point out, more rare, particularly among Americanists (see also de Leeuw 2007; Shennan 1997). Nevertheless, a number of case studies have shown that CA is as successful as frequency and occurrence seriation for deriving an order among archaeological assemblages that upon review of additional evidence can be inferred to be a chronology (Baxter 1994; Clausen 1998; Djindjian 1976, 1985; Duff 1996; Madsen 1988; Neiman and Alcock 1995; Neiman and Smith 2005; Robertson 1999; Ramenofsky *et al.* 2009; Smith and Neiman 2007). In fact, CA is formally, or parametrically, equivalent to frequency and occurrence seriation (Baxter 1994:119), a point that cannot be overstated.

CA is typically featured as an ordination technique “in nearly all presentations of CA to archaeological audiences” (Smith and Neiman 2007:55), where ordination simply means “the arrangement of units in some order” (Legendre and Legendre 1998:387), and ordination in reduced space means that the units "are positioned in a space that contains fewer dimensions than in the original data set" (Legendre and Legendre 1998:247). CA’s utility as a seriation technique, however, comes from the connection between CA and indirect-gradient analysis, where the gradient of interest in archaeology is time and artifact types are unimodally distributed across that gradient (Smith and Neiman 2007:55).

CA uses chi-square distance as the measure of distance between rows and between columns, a feature that makes it ideally suited to abundance and incidence datasets. Another useful feature of CA is its ability to measure associations between assemblages and types (rows and columns) simultaneously. This allows one to see which sites or types are contributing to variation and to what degree. Inertia, in CA, is the distance between a given row or column and the average row or column in a dataset. CA is said to be inertia maximizing, which in simple terms means that the first axis, or dimension, in a CA accounts for proportionally more of the inertia in a dataset than does any other axis (Baxter 1994). Clausen (1998:15–16) puts it somewhat differently, saying that “eigenvalues express the relative importance of the dimensions or how large a share of the total inertia each of them explains. The shares are calculated so that the first dimension explains most, then the second, and so on.” Given this, percent of total inertia becomes an important consideration when evaluating how many meaningful, interpretable, or statistically significant dimensions exist in a dataset (Bolviken *et al.* 1982).

We can see how a CA plot should be read if the underlying type percentages are continuously and normally distributed by returning to the hypothetical dataset used above in the frequency-seriation example. The plot of sites shown in Figure 16 reflects the so-called horseshoe, or parabola-like, shape typical of CA plots for sites or assemblages in which all types have underlying unimodal frequency distributions. Notice that the plot can be read from left to right by following each assemblage’s position along the x-axis, or dimension 1. The order of assemblages from left to right along the first dimension mimics the sequence of assemblages from bottom to top shown in the frequency-diagram in Figure 15. Unimodally structured data, or data with “a single natural gradient” (Madsen 1988:24; see also Hill 1974), produce a second dimension that is a quadratic function of the first in CA results. The third and remaining dimensions also approximate polynomials of the first dimension (Madsen 1988:24). Thus, dimensions 2 and higher carry no additional interpretable information. A plot of the types (Figure 17) also mimics the order shown in the frequency-seriation diagram in Figure 15. Type F, for example has the lowest CA dimension 1 score; whereas, Type A has the highest. If one were to order the assemblages and types using their respective positions along CA dimension 1 in a frequency-seriation diagram, the results would be identical to one ordered by hand using the seriation model as guide. Again, this pattern in CA space reflects the underlying Gaussian structure of the types but, as with the other seriation methods discussed here, whether or not the sequence as ordered along the first dimension aligns with time requires the examination of additional lines of evidence. If time is the major contributing factor to variation among assemblages, and assemblages are uniformly sampled across time, then CA dimension 1 scores will sort assemblages along a temporal gradient. It is this aspect of CA that makes the method a useful chronological tool.

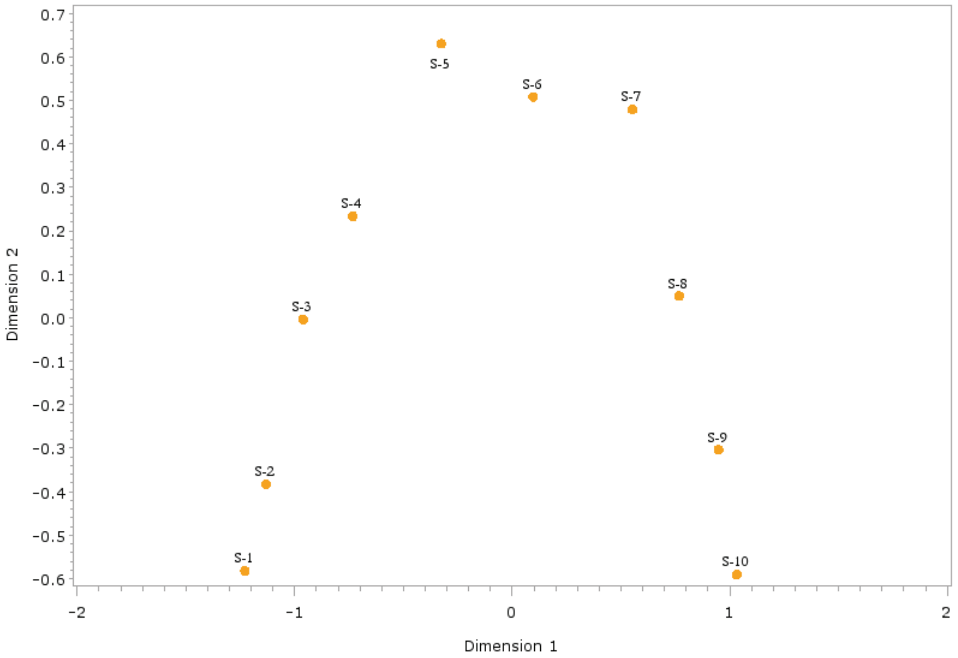


*Figure 16. Hypothetical plot of sites in CA dimensions 1 and 2.*

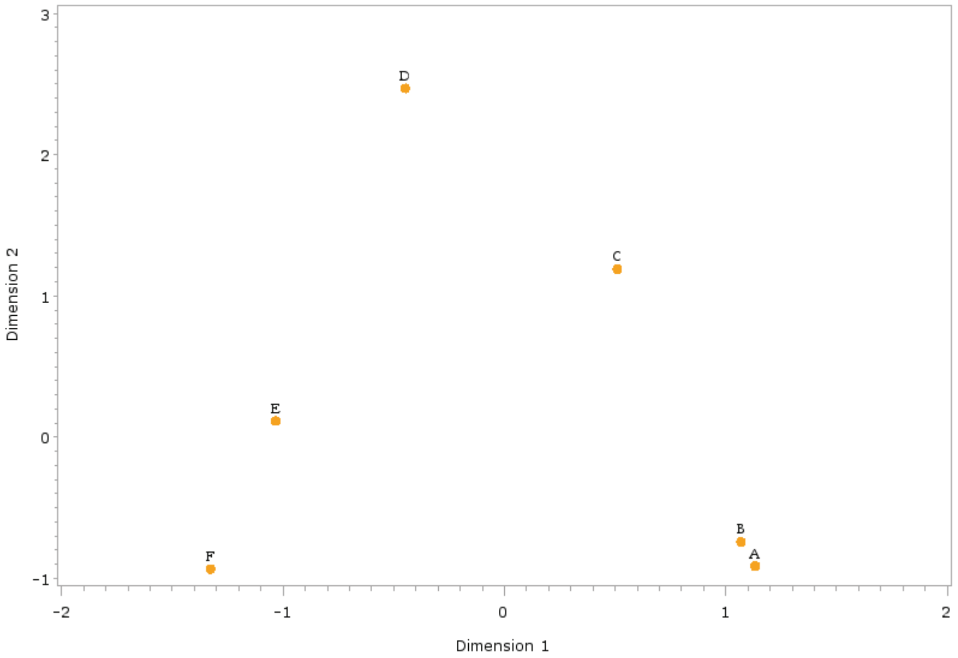


*Figure 17. Hypothetical plot of types in CA dimensions 1 and 2.*

The success of both frequency seriation and CA in deriving a temporal order among assemblages is potentially affected by a number of real-world situations. First, time is not always the major contributing factor to variation among assemblages. Whether or not this is the case depends, in part, on the classification used (temporally sensitive, or historical, types if one wants temporal resolution) but also on the amount of time represented among the assemblages (enough time must elapse for change to take place). Second, assemblages are not always uniformly sampled across time. Finally, unimodal distributions are not always temporal distributions; species-abundance distributions, for example, can be unimodal but, in those cases, unimodality more often is related to an underlying environmental or geographical gradient, not a temporal one.

### 4.2 Frequency-Seriation Model

The guiding tenant of frequency seriation is known today as the popularity principle (O'Brien and Lyman 1998:195–197; see also Lyman and O'Brien 2006). It holds that the relative frequencies of pottery types through time should exhibit smooth and continuous changes that approximate a normal curve. The rate of change must be gradual with no abrupt breaks in the sequence. This is the battleship-shaped, or unimodal frequency, distribution of Phillips et al.'s (2003:221) "popularity curves" that they expected their ceramic types to exhibit if the conditions and requirements of frequency seriation have been met. However, achieving a perfect fit, or a deterministic solution (Dunnell 2000), to the model is unlikely in reality. Deviations suggest violations in one or more of the conditions (see below).

## 4.3 Requirements of Frequency Seriation

An order produced using frequency seriation or correspondence analysis is not necessarily a chronology. As Dunnell (1970) and others (e.g., O'Brien and Lyman 1999; Phillips *et al.* 2003; Rouse 1967; Rowe 1961) have made clear, for a seriation to be a chronology, several conditions must be met. Each of the three requirements of frequency seriation serves to minimize other sources of variation that may confound temporal trends among the data. First, all assemblages used must be of similar duration (Dunnell 1970:311; Rowe 1961:327). This condition attempts to ensure that change is being measured continuously and acknowledges that variable site occupation can be an undesirable source of error. Second, assemblages must be from the same cultural tradition (Dunnell 1970:311; Rowe 1961:326). Third, assemblages must be from the same local area (Dunnell 1970:311). These last two conditions—same cultural tradition and same local area—are attempts to ensure that the only variation being measured is that which results from time's passage. In other words, by holding spatial and functional variation constant, we are in a better position to examine temporal variation. It was spatial variation, for example, that Ford (1952) was trying to control when he split Willey's northwest-Florida interdigitation into two parts, the Carrabelle area and the Gulf Breeze area. The concept of local area, however, is undeniably vague. Even Dunnell (1970), who has written extensively on archaeological systematics, struggled with answering the question of how to define a local area. His final conclusion was that, in order to be confident that the local-area condition has been met, a seriation should be compared to known radiometric dates and to seriations of other artifact types. In a recent case study, Lipo *et al.* (1997) sought to discern local areas empirically by generating seriation solutions that fit the seriation model perfectly (see also Lipo 2000). Their results revealed much smaller areas, possibly marking local-learning communities, than previously had been recognized in the Mississippi River valley, although they acknowledge the similarity between their areas and traditional phases.

## 4.4 A New Chronology for the Chattahoochee-Apalachicola-Gulf Coast

The following discussion of the seriation results begins with CA because the sequence presented in the frequency-seriation diagram in Figure 26 was developed using CA dimension scores, and the phases were defined based on the way assemblages grouped or separated along the CA axes. Thus, the sequence and the phases are not based solely on a subjective assessment of goodness of fit or assemblage distance but rather come directly from the CA results.

### *Regional Ceramic Dataset*

The analyses presented in this section and the one that follows are published in an article by Smith and Neiman (2007); the dataset has been revised only slightly since publication. It now includes 14 additional assemblages from five additional sites (8LI8, 8JA233, 8BY137, 8WA30, and 9ER103) and excludes assemblages from Swift Creek (9BI3) and Coahatchee (1CC53). The latter were removed to maintain the focus on the defined study area, as both sites are located well outside these limits. The interested reader is encouraged to consult Smith and Neiman (2007) to see how the sites excluded here fit into the regional chronology. The final alteration to the published dataset and analyses is the addition of seven nonmound assemblages from Mandeville (9CY1). These adjustments resulted in the inclusion of 32 sites and 99 assemblages, expanded from 29 sites and 84 assemblages included in the published article (**Error! Reference source not found.** and Figure 18).

**Table 2. References and Summary Context Information for Sites Included in this Study.**

| Site Number | Site Name | References | Contexts |
|---|---|---|---|
| 8BY137 | Bayview | Russo *et al.* 2006:Appendix II | Test Units |
| 8WA30 | Bird Hammock | Bense 1969:Table 2; Penton 1970:Table 7 | Excavation Units |
| 8LE148 | Block-Sterns | Jones and Tesar 1996:405 | Western Berm Features |
| 9CE16 | Box Springs |  | All Proveniences |
| 8JA19 | Butler | Bullen 1950:Table 1; White 1981:179 | Unidentified (J-17) |
| 8FR2 | Carrabelle | Willey 1973:49, 52 [1949] | Excavation Pits II and III |
| 8GU60 | Clark Creek | White 1994:Table 29 | Test Unit B |
| 8GU56 | Depot Creek | White 1994:Table 1 | Test Units |
| 9SE14 | Fairchild's Landing | Caldwell 1955:Figure 7A | Stratigraphic Block Excavation |
| 8BY73 | Fox's Pond | Bense and Watson 1979:92–93 | Excavation Units |
| 9CE4 | Halloca Creek | Chase 1957; Kelly and Chase 1957 | Main Excavation |
| 9SE33 | Hare's Landing | Caldwell 1978:50, 56 | Middens E and J |
| 8JA5 | Jim Woodruff | White 1981:169 | Unidentified (J-2) |
| 9ER1 | Kolomoki | Pluckhahn 1998, 2002, 2003; Sears 1956 | Excavations, Test Units, and Mounds |
| 9CY1 | Mandeville | Kellar et al. 1961:Tables; Kellar Manuscr. | Mound A and Off-Mound Units |
| 8WA8 | Mound Field | Willey 1973:62 [1949] | Excavation Pit I |
| 8GU38 | Overgrown Road | White 1994:Table 36 | Test Units and Features |
| 8BY10 | Parkers Branch | Willey 1973:237 [1949] | Surface Collection |
| 8BY24 | Pearl Bayou midden | Willey 1973:244 [1949] | Surface Collection |
| 9CE42 | Quartermaster | Beasely 2003:72–75 | All Proveniences |
| 8WA13 | Refuge Headquarters | Willey 1973:297 [1949] | Surface Collection |
| 1BR15 | Shorter | DeJarnette 1975:105 | Mound Excavation |
| 8GD13 | Sycamore | Milanich 1974:21 | Area IV (shell midden) |
| 8LI8 | Torreya | Percy and Jones 1976:120 | Surface Collection and Excavation |
| 8FR4 | Tucker | Sears 1963:17, 19 | Tests 9 and 10 |
| 8BY9 |  | Willey 1973:236 [1949] | Surface Collection |
| 9ER103 |  | Reid 1999:Tables 2 and 3 | Shovel Tests and Test Units |
| 8JA63 |  | Bullen 1958:Table 3 | Trenches and Features |
| 8JA233 |  | White 1981:243–244 | Surface and Shovel Tests |
| 9QU58 |  | Mistovich and Knight 1986:138–147 | Test Units |
| 9SE102 |  | White 1981:558–559 | Surface Collection |
| 9SW71 |  | Mistovich and Knight 1986:109–112 | Test Units |

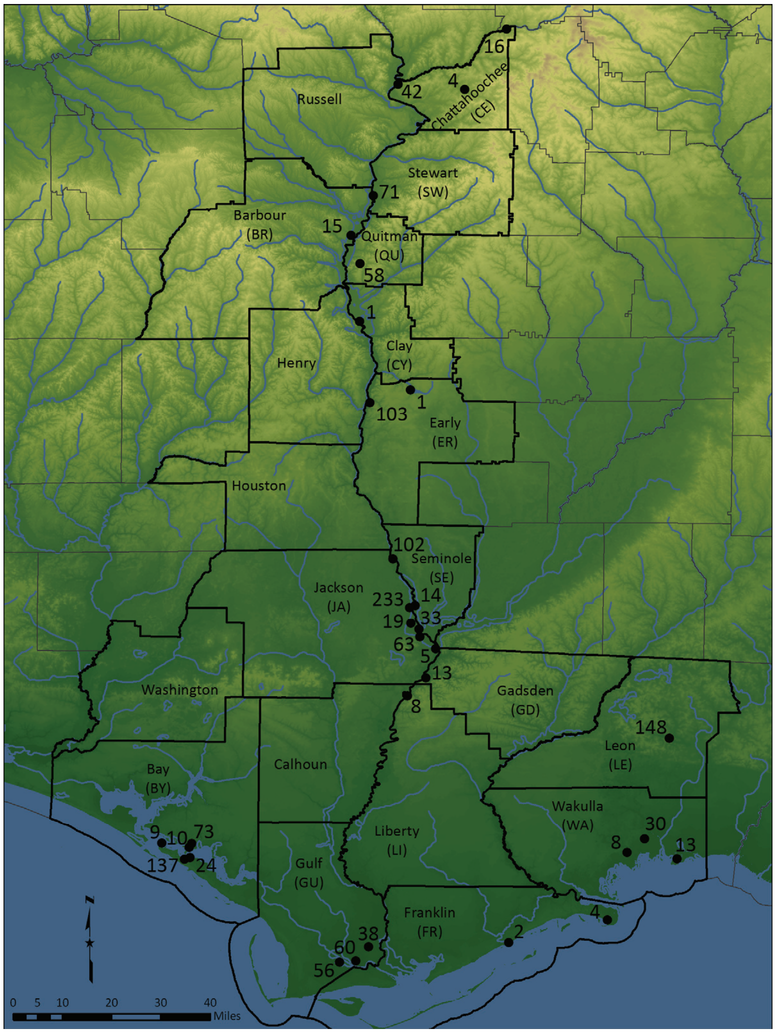


*Figure 18. Archaeological sites included in the study.*

Each of the 99 ceramic assemblages, created from work at 32 sites, is a set, or aggregate, of sherds from a given archaeological context (Grayson 1984:17). Though the decisions for creating assemblages (defining contexts) were analytical, they were not as systematic as one might hope. Defining the context in each case depended on site- and research-specific factors, which necessarily varied among cases given the variation in recovery methods, spatial coverage of excavations, and length and spatial extent of site occupations. As noted above, sample size was also a consideration in forming assemblages. Additional site-selection criteria can be found in Smith and Neiman (2007:51–54).

### *Results of Correspondence Analysis*

A CA plot of the first two dimensions is shown in Figure 19. Each dot represents the position of an assemblage in two-dimensional space in the analysis of the entire dataset. The lines represent divisions between assemblages in terms of phases defined in this and the CA that follows. The phases are constructed primarily for the purpose of communication but will also serve as analytical units in part of the analysis presented in Chapter 5. Phases used here are simply aggregates of assemblages that share similar relative frequencies in ceramic decorative modes. Unlike the hypothetical example described above, the pattern portrayed in this plot is not the typical horseshoe-shape expected when CA has recovered a temporal gradient in the first dimension, and the second dimension is simply a quadratic function of the first. Rather, Dimension 1 has captured variation among assemblages containing Wakulla Check Stamped (Hare's Landing, Late Weeden Island, and Sycamore phase assemblages) and all other assemblages (early and middle phases), as shown in the plot of ceramic types in Figure 20. The variation captured by Dimension 1 happens to be temporal in the sense that Wakulla Check Stamped is chronologically the most-recent pottery type used in the analysis, but Wakulla Check Stamped also happens to be the largest contributor to variation among all assemblages, accounting for 36.3 % of the total inertia captured by Dimension 1. Put differently, assemblages without Wakulla Check Stamped are less distant in terms of assemblage composition to each other than any is to Wakulla-bearing assemblages. Wakulla assemblages are outliers, in effect; thus dimensions 2 and 3 scores sort the remaining assemblages, those that do not contain Wakulla Check Stamped, along a temporal gradient (Figure 21).

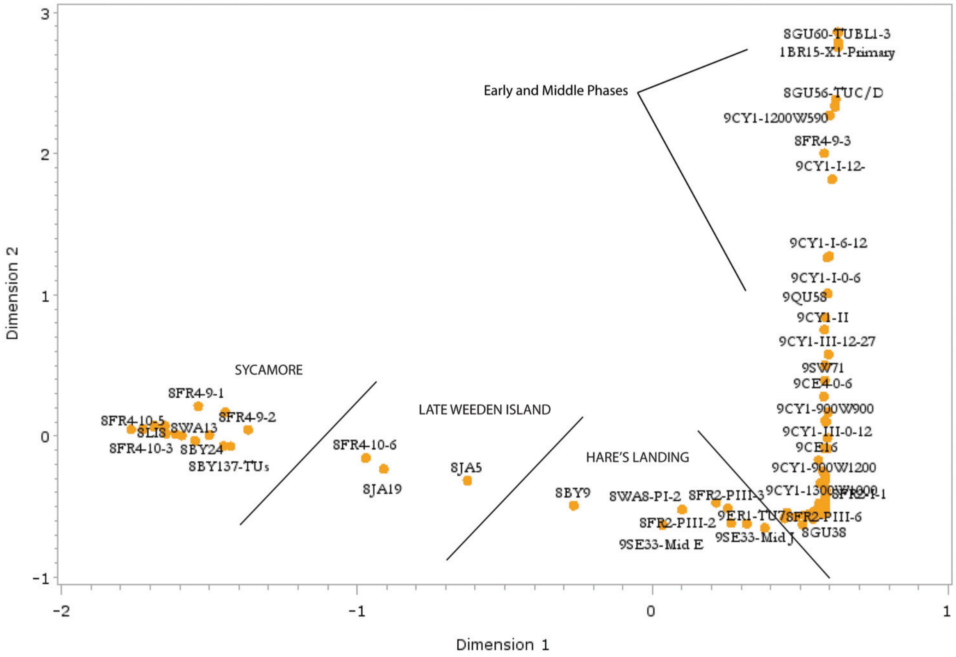


*Figure 19. CA row plot of dimension 1 and 2 for all assemblages*

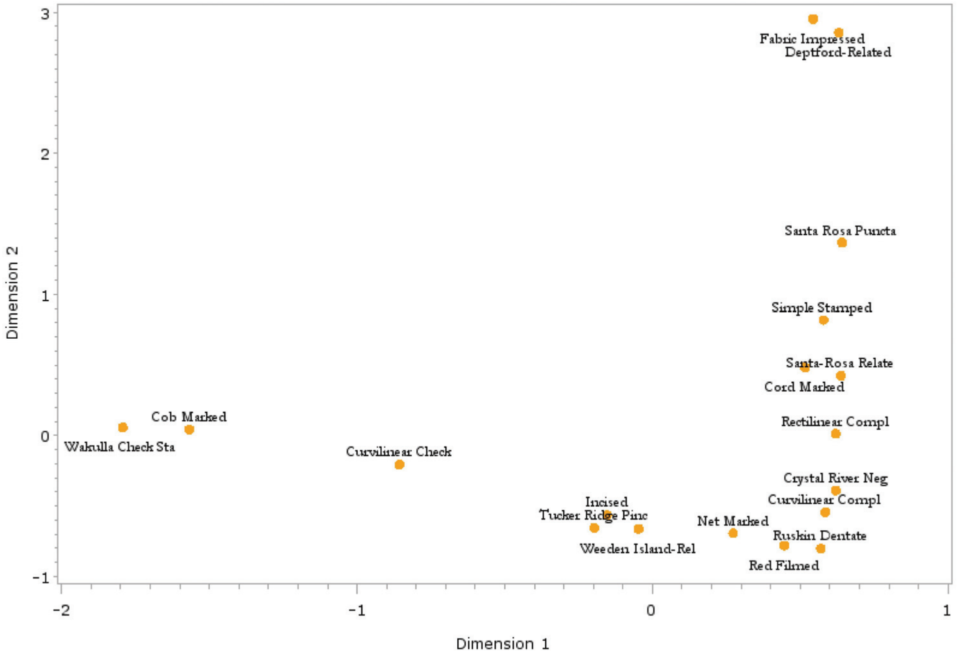


*Figure 20. CA column plot of dimension 1 and 2 for all assemblages.*

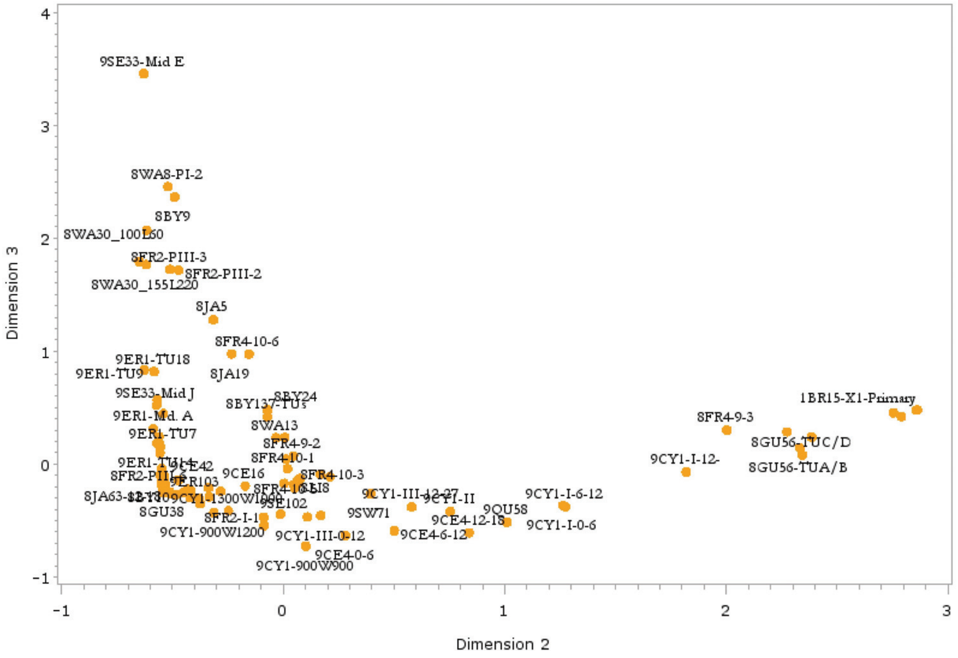


*Figure 21. CA row plot of dimension 2 and 3 for all assemblages.*

The statistical significance of each dimension can be measured by reference to the expectations of randomness using the broken-stick model (Legendre and Legendre 1998:837). Figure 22 illustrates the expected and actual relative interia values in a CA with 17 dimensions. Significant or interpretable dimensions are those with contributions to interia that exceed the expected contributions were the variation measured in the analysis randomly partitioned. In this case, the first three dimensions can be inferred to be significant based on their greater contributions to interia than expected under the null hypothesis. This interpretation is consistent with the initial reading of Figure 23 and 24, which suggests that the first dimension captures significant variation in a subset of assemblages, those bearing Wakulla Check Stamped, and the second and third dimensions measures a temporal gradient among remaining assemblages.

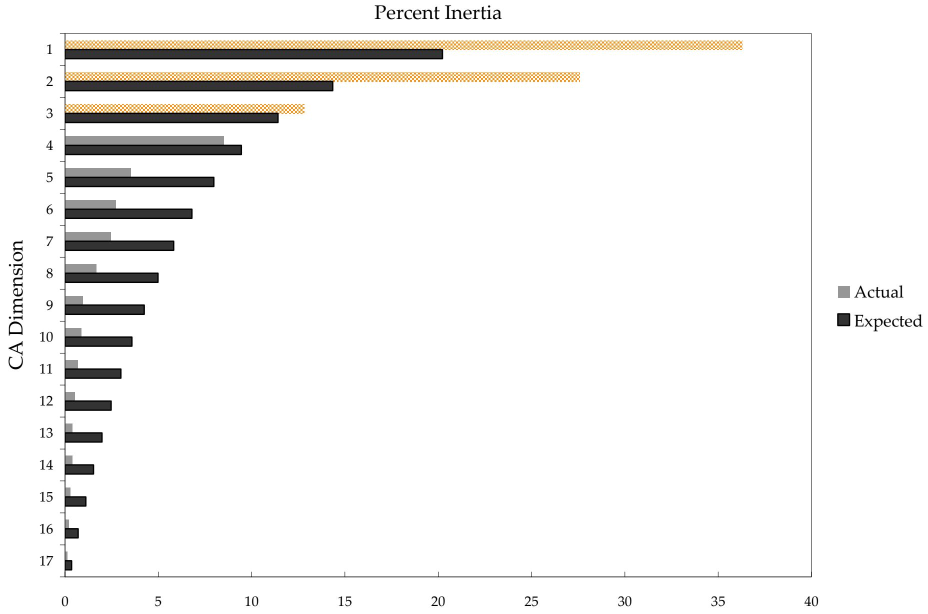


*Figure 22. Relative contributions to inertia for each of the 17 CA dimensions in the analysis of all assemblages (top-gray-bar). Expected contributions to inertia for each of 17 CA dimensions under the broken stick model (bottom-black-bar). In this analysis, the first three dimensions (top-orange-bar) contribute significantly more to overall variance than is expected under the null hypothesis.*

A second analysis was performed after removing assemblages that contain Wakulla Check Stamped (Figure 23). The plot now reflects the horseshoe shape indicative of underlying unimodal type distributions and suggests that a good fit to the frequency seriation model has been achieved. Confidence in the pattern is supported by comparing the actual relative inertia values to expected relative inertia values, shown in Figure 24, which indicates only the first two dimensions are statistically significant and, thus, require interpretation. As in the first analysis, phases are defined largely by the gaps in CA space and are noted on the chart by lines separating assemblage groups. The plot of the ceramic types, shown in Figure 25, indicates that time is captured by the first dimension with the earlier Deptford-related Check Stamped positioned on the right and the later Weeden Island–series types positioned on the left. Thus, time likely runs from right to left in both plots.

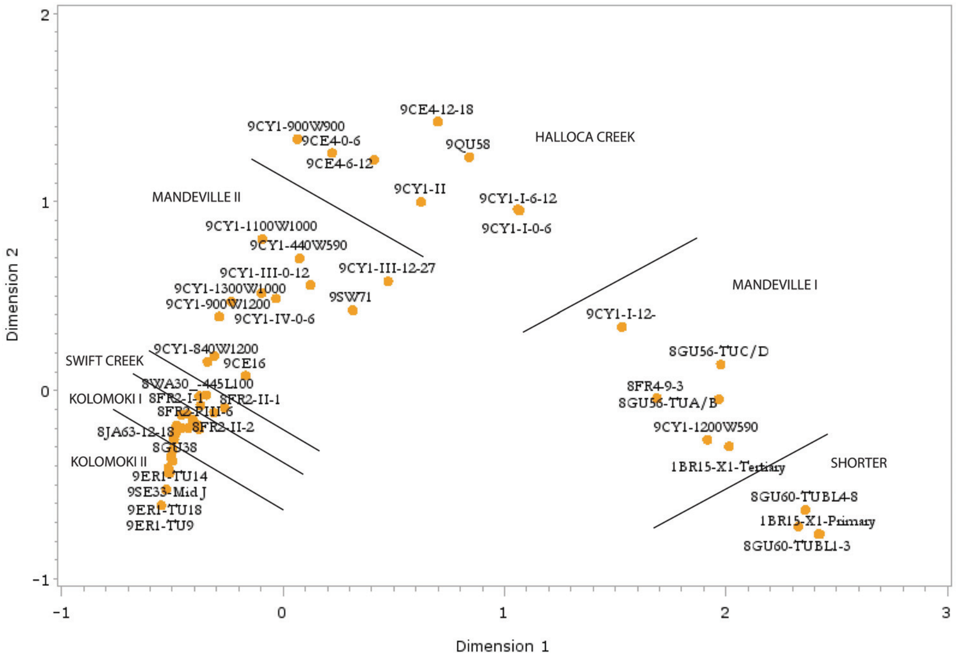


*Figure 23. CA row plot of dimension 1 and 2 for early and middle assemblages.*

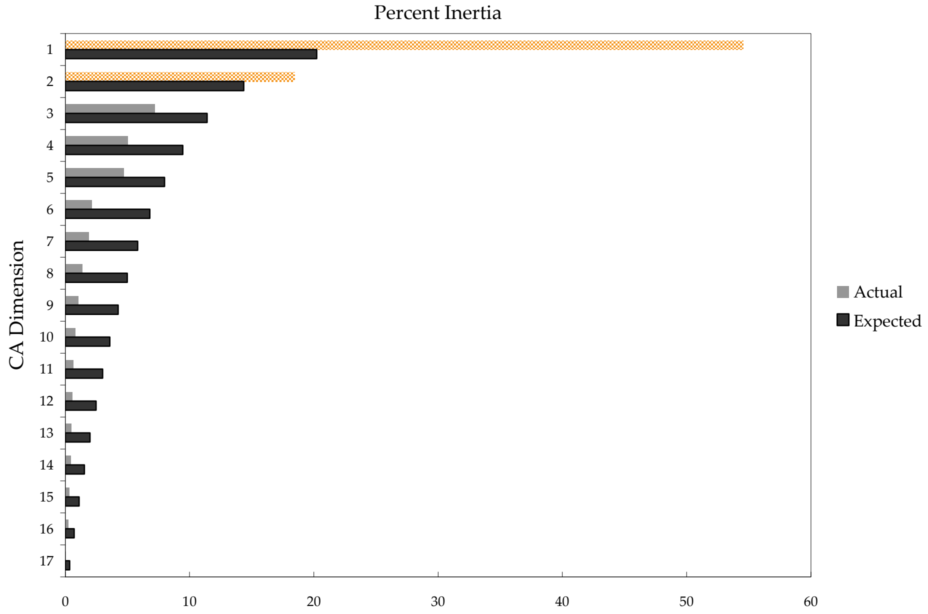


*Figure 24. Relative contributions to inertia for each of the 17 CA dimensions in the analysis of early and middle phase assemblages (top-gray-bar). Expected contributions to Inertia for each of 17 CA Dimensions under the broken stick model (bottom-black-bar). In the second analysis, only the first two dimensions (top-orange-bar) provide significant contributions to overall variance.*

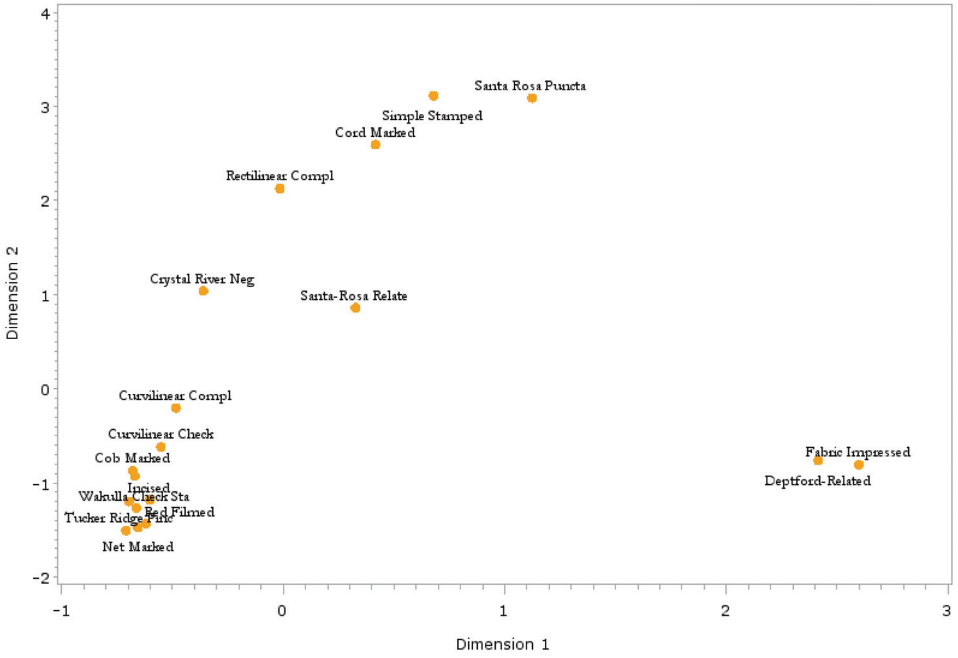


*Figure 25. CA column plot of dimension 1 and 2 for early and middle assemblages*

Gaps between assemblages reflect a violation of one or more conditions of the unimodal, or Gaussian-response, model (Smith and Neiman 2007:58). The gaps could be real in the sense that no assemblages or sites exist that would fill the gaps, a likely assumption given the long history of survey and excavation. If this were the case, the implication is that the region was periodically abandoned. Another possibility, potentially related to the first, is that “missing” assemblages do exist but that the sample limits imposed in the analysis excluded those assemblages that would have filled the gaps as a result of small sample sizes. If the samples were small because settlement was brief or ephemeral, then the region would appear to be periodically abandoned because the occupational signatures would be all but invisible archaeologically. But it could also be that the samples are small because, although survey coverage is extensive, excavation in the region has not been systemically pursued, targeting only the largest sites or those with stratigraphically informative sequences. Alternatively, the gaps could indicate pulses in the rate of ceramic change rather than pulses in the intensity of settlement. Unfortunately, the data needed to discriminate among these alternatives are not available at the present time.

### *Results of Frequency Seriation*

As discussed in Chapter 3, several researchers had been working on local chronologies for decades between the late 1930s and the 1960s. Caldwell (1978), for example, had established a stratigraphic sequence at Fairchild’s Landing, one that generally conformed to segments of the sequence that Willey worked out for the Florida

Gulf Coast. Kelly and team also had secured a stratigraphic sequence at Mandeville. Sears, who struggled with chronology building for his well-known site Kolomoki, is an interesting case in point. Sears (1956) used frequency seriation to order assemblages from Kolomoki. As he put it, “we have abandoned all hope of vertical stratigraphy . . . and have resorted to the application of seriation techniques . . . in order to achieve a valid chronology for the site” (Sears 1956:30). We now know his seriation was inverted (Knight and Schnell 2004; Pluckhahn 1998, 2003; Sears 1992), but this fact neither invalidates the utility of seriation nor negates what Sears set out to do with his seriation, which was to examine temporal changes in other aspects of pottery at Kolomoki.

Using his master seriation as the accepted site chronology, Sears graphically monitored changes in complicated-stamped rim form, land-groove width, vessel-base form, and “anything else which seemed to promise measurable change through time” (Sears 1956:31). He found that certain ceramic attributes did have temporal significance, as did some of the pottery types, such as Blakely Complicated Stamped, that he defined in an effort to refine the Swift Creek ceramic typology. This is all to say that frequency seriation is not new to the region, nor are the results presented here all that unexpected. What is novel is that the frequency-seriation diagram shown in Figure 26 represents the first graphically driven attempt to incorporate assemblages from all of the above-mentioned sites and, additionally, includes assemblages from many other sites. It represents the integration of ceramic data that Kelly *et al.* (1963:ii) lamented was not possible in the 1960s (see Section 2.3).

Initial attempts at a frequency seriation for assemblages relied on two observations or procedures: the permutation of assemblages by visual examination, such that type frequencies were unimodally distributed, and the examination of stratigraphic sequences at key sites for clues as to how certain type frequencies might behave through time. This is the same procedure Caldwell (1979), Sears (1956), and others (Willey 1973) used on a smaller spatial scale decades earlier. CA was initially enlisted to verify that the sequence was the best order one could arrive at, given the FS, or Gaussian-response model. CA was then used to rectify the sequence against subsequent additions to the dataset. Thus, the assemblage order shown in Figure 26 is the order of assemblages when sorted along their dimension 1 scores in the two CA attempts described in the previous section: the first CA dimension 1 scores were used to order the late assemblages and the second CA dimension 1 scores were used to order the early and middle assemblages. For purposes of space, types with only minor occurrences, such as Ruskin Dentate, are omitted from the diagram, even though they were included in the CA presented above and appear in the published version of the FS diagram (Smith and Neiman 2007:Figure 6). In cases where assemblages share stratigraphic relationships, these are maintained even if CA placed them close but out of stratigraphic order.

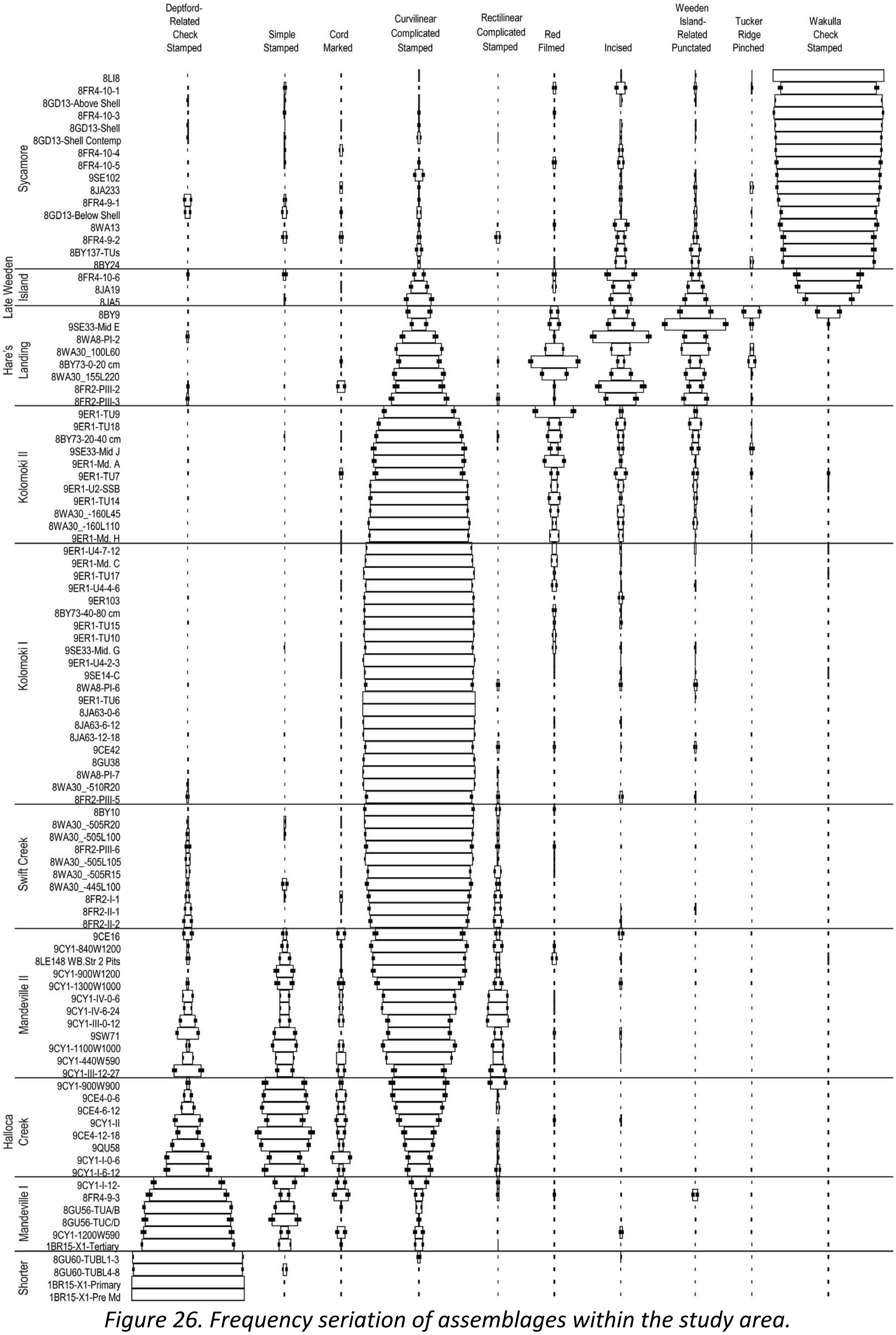


*Figure 26. Frequency seriation of assemblages within the study area.*

One obvious pattern that emerges from the diagram is the lengthy distribution (from bottom to top) of Swift Creek Complicated Stamped, called Curvilinear Complicated Stamped in the dataset (see Smith and Neiman 2007:49–50 for a discussion of the motivation and methods for aggregating competing typologies). This suggests that SCCS is a ceramic tradition and one that persists for the better part of a millennium. Weeden island–series types fluoresce as popularity in SCCS wanes, and both ends of the sequence are bracketed by the popularity in check-stamped surface treatment: Deptford-related Check Stamped for the early end and Wakulla Check Stamped for the later end. Overall, the sequence conforms in terms of ceramic content to both the Percy and Brose data divisions of the Weeden Island period and the Knight and Mistovich data scheme for the Middle and Late Woodland periods. The benefit here is in the graphical display of relative frequencies, which should provide researchers with a better sense of where new assemblages would be situated within the sequence. Phase-based groupings of the assemblages are presented in Figure 27 (see also Smith and Neiman 2007:Figure 11). It is clear from the chart that only a handful of ceramic decorative modes are dominant at various times throughout the sequence. These include, from earliest to latest, Deptford-Related Check Stamped, Simple Stamped, Curvilinear Complicated Stamped, Rectilinear Complicated Stamped, the Weeden Island series (Red Filmed, Incised, and Punctated), and Wakulla Check Stamped. The remaining decorative modes or ceramic types have little influence on relative frequencies, occurring only as minor wares.

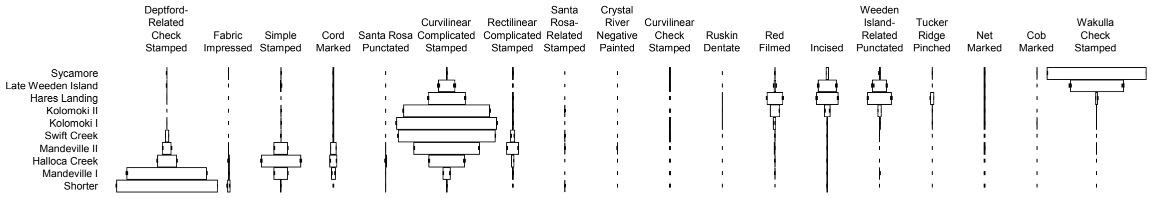


*Figure 27. Phased frequency-seriation diagram.*

## 4.5 Radiocarbon Dates for the Assemblages

Given our prior understanding of ceramic frequency change through time gleaned largely through the stratigraphic situations at several sites included in the sequence above, it is clear enough that the seriation as presented in Figure 26 and Figure 27 is a chronology. However, a database of regional radiocarbon dates is available, and a subset of these dates, 30 in all, can be tied directly to assemblages used in the seriation (Table 3), presenting an opportunity to evaluate the sequence against absolute time. The majority of dates come from only two sites, Mandeville (9CY1) on the lower Chattahoochee River with 12 dates and Sycamore (8GD13) on the lower Apalachicola River with five dates. The remaining sites have three or fewer dates associated with assemblages that contributed to the seriation. As mentioned in Chapter 1, no radiocarbon dates have been obtained for assemblages that fall into the Hare's Landing and Late Weeden Island phases, and the same is true for assemblages that fall into the Swift Creek phase. No radiocarbon dates for Shorter phase assemblages were available either until Keith Stephenson, at the Savannah River Archaeological Research Program, obtained three dates from the Shorter Mound in 2007 as part of an on-going research agenda aimed at securing absolute dates from Woodland-period contexts in the Deep South (Stephenson *et al.* 2002; Stephenson and Snow 2004). Two of the three dates are included here, as the samples come from mound assemblages used in the seriation .

**Table 3. Radiocarbon Determinations and Associated Calibrated Age Ranges.**

| Site No. | Lab No. | RCY B.P. | Max. cal age-Min. cal age (2σ) | Context | Reference | CA Phase |
|---|---|---|---|---|---|---|
| 8GD13 | I-7258 | 955±85 | A.D. 899–1256 | Area I, House, Inside Pit | Milanich 1974:35 | Sycamore |
| 8GD13 | I-7252 | 1090±85 | A.D. 711–1155 | Area I, House, Outside Pit | Milanich 1974:35 | Sycamore |
| 8GD13 | I-7253 | 1090±85 | A.D. 711–1155 | Area I, House, around hearth | Milanich 1974:35 | Sycamore |
| 8GD13 | I-7255 | 1055±85 | A.D. 775–1167 | Area I, House, Outside FP | Milanich 1974:35 | Sycamore |
| 8GD13 | I-7256 | 1125±85 | A.D. 680–1040 | Area I, House, Inside FP | Milanich 1974:35 | Sycamore |
| 9ER1 | Beta-161790 | 1290±60 | A.D. 649–879 | Test Unit 18, Feature 34 | Pluckhahn 2002:27 | Kolomoki II |
| 9ER1 | Beta-164309 | 1360±50 | A.D. 597–774 | Mound H, Feature 2 | Pluckhahn 2002:27 | Kolomoki II |
| 9ER1 | Beta-121909 | 1660±50 | A.D. 256–535 | Test Unit 3, a pit | Pluckhahn 1998:150 | Kolomoki I |
| 8JA63 | M-396 | 1600±250 | 166 B.C.–A.D. 951 | Unidentified | Crane and Griffin 1958:1101 | Kolomoki I |
| 8GU38 | Beta-25771 | 1650±50 | A.D. 258–538 | Test Unit 1, Feature 4 | White 1992:24 | Kolomoki I |
| 9CY1 | M-1045 | 1460±150 | A.D. 245–889 | Md A, Layer IV | Kellar et al. 1961:81 | Mandeville II |
| 9CY1 | M-1044 | 1420±150 | A.D. 260–963 | Md A, Layer III | Kellar et al. 1961:81 | Mandeville II |
| 9CY1 | UGA-9B | 1806±65 | A.D. 5–331 | Animal Bone, Md A, Layer III | Smith 1975:175 | Mandeville II |
| 9SW71 | DIC-3270 | 1740±60 | A.D. 135–416 | Feature 1 | Mistovich and Knight 1986:98 | Mandeville II |
| 9CY1 | UGA-2B | 1840±70 | A.D. 22–379 | Layer II | Smith 1975:175 | Halloca Creek |
| 9CE4 | M-1046 | 2020±150 | 393 B.C.–A.D. 325 | Pit 3 | Kellar et al. 1961:81 | Halloca Creek |
| 9QU58 | DIC-3268 | 2010±50 | 165 B.C.–A.D. 82 | Feature 1 | Mistovich and Knight 1986:137 | Halloca Creek |
| 9QU58 | DIC-3269 | 2090±60 | 353 B.C.–A.D. 51 | Feature 1 | Mistovich and Knight 1986:137 | Halloca Creek |
| 9CY1 | UGA-4B | 1640±65 | A.D. 251–556 | Md A, Layer IA | Smith 1979:186–187 | Halloca Creek |
| 9CY1 | UGA-5B | 1705±70 | A.D. 137–533 | Md A, Layer I | Smith 1979:186–187 | Halloca Creek |
| 9CY1 | UGA-6B | 1580±65 | A.D. 268–616 | Md A, Layer I, 6–12" | Smith 1979:186–187 | Halloca Creek |
| 9CY1 | UGA-7B | 1810±70 | A.D. 65–389 | Feature 3, Layer I, below 12" | Smith 1975:174 | Mandeville I |
| 9CY1 | M-1042 | 1960±150 | 360 B.C.–A.D. 382 | Feature 3, Layer I, below 12" | Smith 1975:174 | Mandeville I |
| 9CY1 | UGA-1B | 1800±65 | A.D. 78–385 | Postmold, Layer I, below 12" | Smith 1975:174 | Mandeville I |
| 9CY1 | UGA-3B | 1775±120 | 19 B.C.–A.D. 540 | Feature 1, Layer I, below 12" | Smith 1975:174 | Mandeville I |
| 9CY1 | M-1043 | 1030±150 | A.D. 689–1261 | Feature 1, Layer I, below 12" | Smith 1975:174 | Mandeville I |
| 8GU56 | Beta-26898 | 2010±100 | 353 B.C.–A.D. 231 | Test Unit C, Level 3 | White 1994:198 | Mandeville I |
| 1BR15 | Beta-230758 | 2100±50 | 351 B.C.–A.D. 5 | Feature 12, Primary Mound | Unpublished | Shorter |
| 1BR15 | Beta-230757 | 1740±50 | A.D. 140–412 | Feature 15, Pre-Mound | Unpublished | Shorter |
| 1BR15 | Beta-230756 | 1990±40 | 92 B.C.–A.D. 121 | Sooted Sherd, Pre-Mound | Unpublished | Shorter |

### *Comparison of Radiocarbon Dates with Seriation Results*

Figure 28 shows the calibrated radiocarbon-date ranges for samples that can be either directly or indirectly linked to the ceramic assemblages used in the regional seriation. The dates are ordered by the position of the associated assemblage in the regional seriation, with the oldest assemblages, measured by ceramic content, positioned on the left and the latest assemblages positioned on the right. The phase to which each assemblage was assigned in the analysis above is also marked in italics in Figure 29. The only obvious outlier in the entire dataset is M-1043, from the Mandeville site (9CY1). The dates that fall between those from 9QU58 and those from Sycamore (8GD13) reflect overall agreement in the sequence derived using seriation and the calibrated absolute dates, except for two of the three dates from Mandeville (M-1044 and M1045) that are positioned to the right of 9QU58. However, all of the dates from assemblages positioned before or to the left of 9QU58 are puzzling in that the dates have later distributions than one would expect given the seriation results, with the possible exception of the date from 8GU56 (Depot Creek) and one of the three dates from 1BR15 (Shorter). Since the majority of these puzzling dates are from Mandeville, it is more than temping to do what many researchers have done in the past: ignore most if not all the dates from the platform mound samples at 9CY1. It is with great reluctance that I take the same course here, as many of the dates appear to have later distributions than they should have on the basis of ceramic content, if the seriation is to be taken as one continuous chronology. Disregarding most of the dates from Mandeville's Mound A is arguably at least a reasonable decision when one considers that the dates are not internally consistent either—that is, many of the dates are not distributed in relation to the stratigraphic positions of the dated samples. In section 6.3, I reconsider the dates and address specific issues with the radiocarbon dataset, including the reliability of dates obtained from developing labs, before implementing a method that excludes dates using objective criteria.

One final point is that the date ranges for Kolomoki II and Sycamore-phase samples, though internally consistent, do not allow very much time for the ceramic change documented in the assemblages assigned to the two intervening phases, Hare's Landing and Late Weeden Island, to have taken place. As inferred from Figure 29 and discussed below, the rate of ceramic change may have been faster during Mandeville I and Halloca Creek. It is also possible that the rate of ceramic change increased during Hare's Landing and Late Weeden Island, given the patterning in dates just described. If additional dates support this interpretation, the implication is that increased interaction, as described and documented in the following chapter for Halloca Creek and Hare's Landing phases in particular, precipitated an increase in the ceramic-decorative turnover rate. This preliminary conclusion has some intuitive support and will be revisited in the final chapters. Clearly, though, increasing the radiocarbon dataset needs to be a priority if we are to pursue this interpretation further and make better sense of the series of dates from Mandeville, undoubtedly an important site in the sequence.

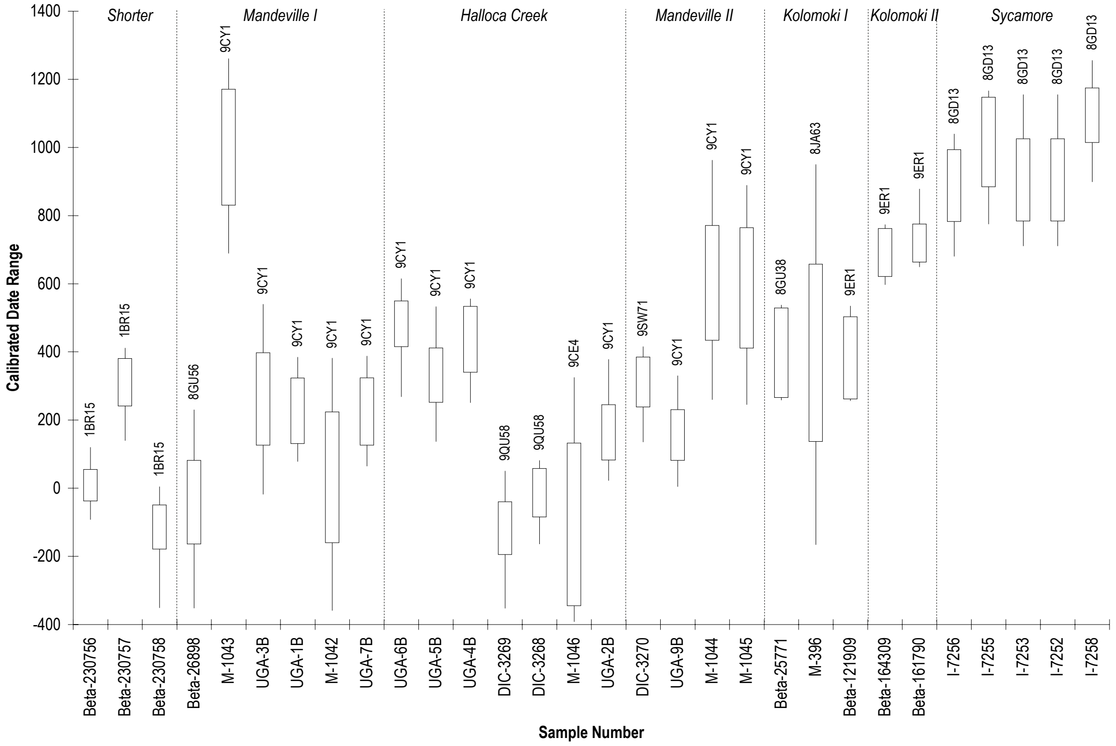


*Figure 28. Calibrated radiocarbon dates for the study area. The white bars represent the 1-sigma calibrated date ranges, and the thin lines represent the 2-sigma calibrated date ranges.*

A comparison of the calibrated radiocarbon dates to CA Dimension 1 scores of middle and late assemblages, as presented above, further suggests the trend just noted (Figure 29). If CA Dimension 1 scores are correctly viewed as direct measures of ceramic-assemblage distance along a relative but temporal gradient, then it appears that the absolute rate of ceramic change was faster during Mandeville I and Halloca Creek phases. In other words, the relative pace of ceramic change may have been faster than the tick of the absolute clock, as measured by the calibrated radiocarbon dates, for these two phases. This inference has implications for how we bracket our phases in absolute time: the phases probably should not be arbitrarily divided into 100-year or so segments. Rather, Shorter, Mandeville I, and Halloca Creek phase-based ceramic change may have taken place over the course of less than 300 years, perhaps 200 B.C. to A.D. 100, whereas, the ceramic change measured by FS and CA for several later assemblages may be spread across several hundred years, if not almost a millennium, from ca. A.D. 100 to A.D. 1000. This inferred pattern regarding the rate of ceramic change also has implications for the interpretations concerning pulses in interregional social interaction that I will describe in Chapter 5. Briefly, the apparent increase in rate of ceramic change may be correlated with an increase in interregional interaction documented for the earliest phases described here.

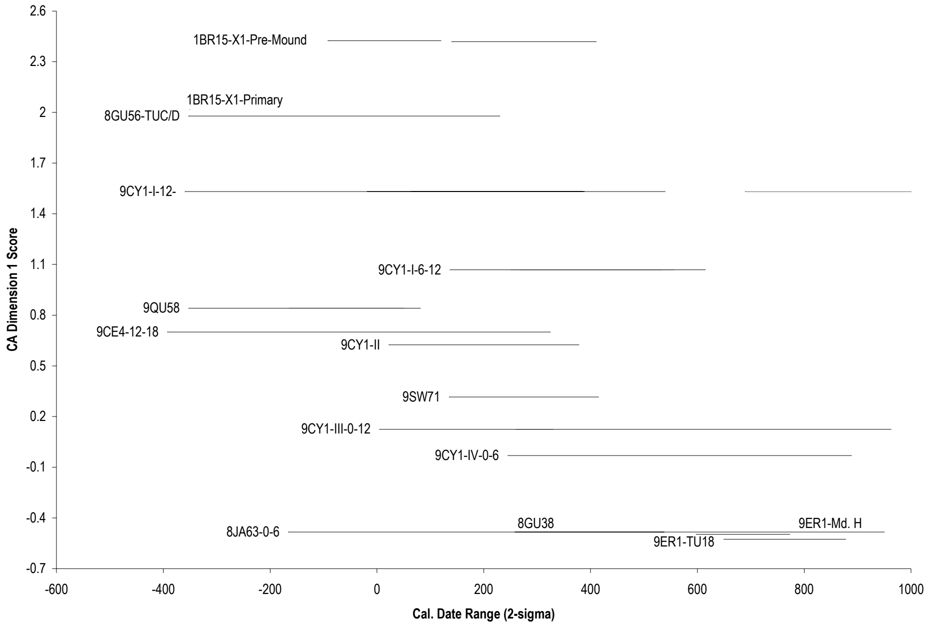


*Figure 29. Calibrated radiocarbon-date ranges plotted against CA dimension 1 scores. The ranges are represented by a 2-sigma distribution. In some cases, more than one date exists for a single assemblage, as in 9CY1-I-12- and 9QU58. These dates share the same CA dimension 1 score and are plotted along the same y-axis. Difficulties of plotting prohibit the identification of individual dates. CA dimension 1 scores used in the figure can be found in Appendix 2.*

## 4.6 Discussion

The primary practical benefit of the chronology presented above is that it rectifies and refines the competing sequences presented in Chapter 3, and it does so in a way that makes clear the temporal distributions of the major ceramic decorative modes. The chronology suggests that efforts to subdivide SCCS into more temporally sensitive types may not be necessary. It also demonstrates that SCCS is a long-lived decorative tradition but one that nevertheless conforms neatly to a historical model of change. The results suggest that Woodland-period ceramic decorative modes (*sensu* Dunnell 1971:159) work well for chronological purposes but do not exclude the possibility that other ceramic decorative change may also monitor time's passage equally well.

Now that a regional-scale chronology has been developed that incorporates a number of assemblages from a number of sites and clearly and continuously documents one-thousand years of ceramic change, temporal changes in other aspects of pottery and in other artifacts within these assemblage can be examined. Many potential avenues for future work have narrow relevance, but this is not to say that these are fruitless endeavors. Others potentially have broader significance. Lingering issues regarding changes in other aspects of Swift Creek pottery include identifying the formal nature of the earliest pottery assignable to the Swift Creek type. For example, are scalloped and notched rims really indicative of an early Swift Creek? The idea that scalloped rims can serve as temporal markers for early Swift Creek developed from work at the type site in the Ocmulgee River valley (Kelly and Smith 1975) and was perpetuated by Willey (1973), who was personally familiar with these depression-era excavations. At the time, pottery from the lowest levels of the mound at the Swift Creek type site did represent some of the earliest examples of Swift Creek pottery. But the chronology presented in this chapter indicates that there are much earlier examples of complicated stamped pottery that merit examination as to rim construction. Resolving this issue is important, particularly if we continue to call on marker types or single attributes to date sites with minimal ceramic assemblages. Other lingering questions include how vessel form and volume change through time. If vessel-form variation increases, as I suspect it does, what are the implications for changes in cooking and consumption practices? Does an increase in vessel-form variation coincide with an increase in the use of public spaces at domestic sites? We can begin to address these questions systematically by targeting assemblages dated in the seriation presented above.

Ceramic-sociology studies suggest interval-scale ceramic attributes might better capture social organization (Plog 1978). With the new chronology, we are in a position to revisit the collections used in this study, take measurements, and compare patterning in these with the results described below. Does attribute-level variation, other than that of surface treatment, exhibit similar temporal trends in intra-assemblage diversity and interassemblage distance? Or do the patterns differ? With fine-grained chronological control, questions of broader anthropological interest also can be better addressed. Questions include how people situated themselves on the landscape, both within groups of households and between groups of households; when villages appeared; and how changes in subsistence strategies articulate with shifting patterns of residential mobility.

# CHAPTER 5. CULTURAL TRANSMISSION

One of the greatest impediments to archaeological progress in this and other regions is the lack of detailed, regional-scale chronologies (see Plog 1983:135–136 for a discussion of study-area size in relation to “regional-scale” chronology building). As discussed in Chapter 4, one high-resolution Woodland-period chronology is now available for the lower Chattahoochee-Apalachicola and neighboring Gulf Coast region. It is now time to make good on the claim that a greater understanding of the past is attainable when one has accurately measured time’s passage—part and parcel of the call for “better controlled data” (Dunnell 1978:192). In this particular study, the greater understanding that is sought concerns Woodland-period interaction, which here is taken to mean social learning, or cultural transmission, among local-learning communities. Fluctuations in the extent of interaction, however construed, are thought to contribute to certain aspects of material-culture variation, with the timing for a peak in interaction that corresponds to the Middle-Woodland Hopewell horizon. This study presents an opportunity to further evaluate the temporal trajectory of among-population social learning. Here I seek to describe changes in the levels of cultural transmission during the Woodland period—before, including, and beyond the period during which Hopewellian-type trade goods appear in archaeological contexts. More specifically, the goal of this chapter is to call on a set of evolutionary models of social learning to adequately account for ceramic-decorative variation in surface treatment.

Accomplishing this goal requires the use of theoretically informed models that allow us to make predictions regarding the ways in which ceramic variation should be patterned both within and among sites or assemblages under specific (model-controlled) conditions. Theory allows us to populate the models, that is, to identify which dimensions of variation are important, how this variation is to be measured, and what the outcomes of those measurements mean (Neff 1993:24). Models have played an important role in archaeological inquiry at least since the latter part of the twentieth century (Winterhalder 2002:203–204), and they play an essential role here.

In the 1980s, Americanist archaeology witnessed a rise in the use of heuristic models developed to account for ceramic, but specifically stylistic, variation. Though some of these models offer the same predictions for stylistic variation as the models used in the analysis here, they differ in terms of theoretical approach. These traditional models are informed primarily by observations from ethnographic and ethnoarchaeological case studies and are intuitively evaluated for goodness of fit. The theoretical approach taken here, however, derives from cultural evolutionary theory, where “evolution is a . . . theoretical framework for those whose ultimate goal is the explanation of . . . change” (Tschauner 1994:77) and “cultural evolution refers to the changing distributions of cultural attributes in populations” (Bentley *et al.* 2004:1443; Shennan 2008:76). Evolutionary models, unlike the earlier heuristic models, require explicit descriptions of causal mechanisms, making it possible to generate testable predictions and to evaluate goodness of fit between model and data without resorting to intuition (Neiman 1990:54).

The applicability of evolutionary theory and models to archaeological data is discussed in Section 5.1. In Section 5.2, I describe the two evolutionary models used here. Both are derivatives of models used in population-level genetic research and have been modified for and evaluated against discrete-trait ceramic data by Neiman (1995). The first model considers the effects of sampling error in finite populations, or drift, on archaeological measures of within-assemblage diversity. The second considers the effects of drift on archaeological measures of among-assemblage distance. I then present an analysis of Woodland-period ceramic diversity and interassemblage ceramic distance and evaluate the results against the modeled predictions. Points of departure from the models are discussed in Section 5.3 as a way of introducing Chapter 6.

## 5.1 Modeling Variation in the Archaeological Record

Two important goals of archaeology are to establish the spatial and temporal patterns of variation in material culture and to explain changes in such variation by invoking the interplay of cultural and natural processes operating within past societies (Lyman and O'Brien 1998). The first half of the twentieth century witnessed strides towards achieving the first goal, marking the era during which archaeologists successfully formulated culture histories for particular regions by harnessing temporal variation in artifacts. The second half of the twentieth century saw an increasing concern both with explaining the temporal variation documented by culture historians and with measuring additional dimensions of variation and understanding the cultural sources of variation that had previously been unrecognized or ignored (Caldwell

1959:304). A key focus for archaeologists at this time was elucidating, often through ethnographic work, exactly how intergroup communication, cultural relatedness, and other aspects of human behavior shape material culture similarity (Braun and Plog 1982:512; Conkey 1978, 1980, Longacre 1964, 1970; Sackett 1985, 1986; Whallon 1968; Wiessner 1984, 1985; Wobst 1977;see also Hegmon 1992, Plog 1978; Rice 1987).

Evolutionary models developed within the last decade or so rely on mathematical formulas and computer simulations to understand how changes in certain parameters shape discrete-trait frequencies and continuous-trait means and variances across generations. The main goal of these efforts has been to determine "whether it is possible to distinguish [among] different [evolutionary] mechanisms on the basis of archaeological data" (Shennan 2008:79). By employing mathematical and computer-simulation models, researchers can isolate specific forces to examine and make key alterations to those parameters in subsequent models to understand how these forces act on variation. Models, in effect, become "a representation of the essential aspects of a . . . system" that we seek to understand (Eykhoff 1974). As Neiman (1995:29) explains, scientific models "portray the dynamic consequences of the operation of a relatively small set of evolutionary mechanisms that can explain unique historical trajectories."

Critical parameters often considered in these models include local-population size, within-population innovation rate, and the presence or intensity of between-population learning. Thus, one can explore the question, what impact does an increase in the size of the local-learning population have on trait diversity or on the means and variances of a given continuous trait through time, holding innovation rate constant? If the size of the local-learning population and the *in situ* innovation rate are both fixed, how does between-population learning shape within-population diversity and between-population distance in a suite of discrete-trait frequencies? Evolutionary models developed within the last decade seek to understand how alterations in these key parameters shape the frequencies of variants or trait means and variances over time.

### *Modeling and Key Evolutionary Case Studies*

Many studies published over the last two decades seek to model social learning and compare those models to archaeological data. Some studies focus on modeling the effects of drift among hypothetical populations (Bentley *et al.* 2004; Kohler *et al.* 2004; Neiman 1995; Shennan and Wilkinson 2001); whereas, others draw attention to particular learning biases or transmission pathways (Mesoudi and O'Brien 2008a, 2008b) and to errors made in the process of copying (Hamilton and Buchanan 2009; Eerkens and Lipo 2005). These studies also differ in terms of what they model as changing under the specified conditions of transmission. As mentioned above, changes both in the frequency of discrete traits and in means, variances, or some other statistical summation in continuous traits have been modeled and evaluated against archaeological data.

Eerkens and Lipo (2005:321–322), for example, focused on simulating the temporal trajectory of cumulative error associated with replicating metric information in three learning contexts and then compared their simulated results to two archaeological datasets. Initially, they modeled copying error in parent-to-child learning, or vertical transmission. Their computer simulations showed that, in the absence of among-lineage learning, the coefficient of variation (CV), a “measure of variation across populations,” increased (Eerkens and Lipo 2005:322); that is, copying error was amplified over time causing individual lineages to diverge from one another in terms of the metric value being transmitted from one generation to the next. Second, they modeled copying error in the context of a learning bias to copy the average value across all lineages of the previous generation rather than the value of one’s parent, one expression of conformist transmission, and varied only the strength of the bias (Eerkens and Lipo 2005:323). In line with intuition, the stronger the bias to conform, or copy the average, the lower the overall CV among lineages and the faster the CV stabilized from one generation to the next. Finally, they simulated the effects of a prestige-biased learning strategy in which in each generation a prestigious individual is selected at random as the bearer of the metric trait to copy. The probability that the prestigious individual is copied is proportional to the strength of the bias, which is varied in different simulations (Eerkens and Lipo 2005:325). They found the behavior of CV over time under their model of prestige-biased learning was similar to the behavior of CV under their model of conformist transmission.

Building on the work of Eerkens and Lipo (2005), Hamilton and Buchanan (2009) more explicitly develop what they refer to as the accumulated copying error (ACE) model and the biased accumulated copying error (BACE) model. However, rather than modeling the behavior of the CV, they model changes in a continuous-trait measurement, its mean, and its variance (Hamilton and Buchanan 2009:57–58). In the simple ACE model, only stochastic (copying and structural) errors are introduced into the equation, and there is no accommodation for learning among lineages. In simulating this model, they found that the mean decreased over time and, yet, the variance increased (Hamilton and Buchanan 2009:59). In the BACE model, they add a biased-learning strategy in the form of a probability of copying the mean of the previous generation. Although the means respond the same under both the ACE and BACE models, their simulations show that the variance does not. Under the BACE model, as the biased probability increases the variance stabilizes at a faster rate from one generation to the next (Hamilton and Buchanan 2009:60).

Using the mathematical models of Neiman (1995), which are discussed in detail below, other researchers have examined the temporal trajectories of discrete-trait frequencies (Kohler *et al.* 2004; Shennan and Wilkinson 2001). In both case studies just cited, the authors found their archaeological data did not conform to the modeled expectations in which discrete-trait frequencies fluctuate through time only in response to sampling error. Rather, they supposed some form of biased-social learning accounted for the patterns among their data. I return to a discussion of their case-study implications in section 5.3.

## 5.2 Drift, Innovation, and Effective Population Size: a Random-Copying Model

Drift, or sampling error in finite populations, is a relatively straightforward process to model and, as such, can serve as a null hypothesis against which one can test real world data (Bentley *et al.* 2004:1443; Bentley *et al.* 2007:152; Kohler 2004:109;

Shennan 2008:82). For this reason, drift was one of the earliest evolutionary processes to be examined against an archaeological dataset (Neiman 1995). A drift model is a likely point of departure for this study, where the interest is in documenting changes in the nature and extent of among-group social learning through time, a process typically but vaguely construed as interaction. It is also appropriate, given the ceramic-frequency dataset available here, to choose models that monitor changes in the frequency of discrete traits.

Kimura (1968) introduced the neutral theory of evolution to molecular biology and spent the remainder of his career defending it through mathematical modeling and real-world testing. His theory met with some controversy because Kimura afforded a superior role to drift over selection-driven forces in shaping observed genetic variation, where the latter (selection) prior to 1968 had been viewed as the prime mover of genetic change. Dunnell (1978) can be credited with affirming the importance of neutrality in shaping cultural variation, though almost two decades would pass before models exploring the effects of neutrality in socially transmitted variation would be developed and tested against archaeological data.

To this end, Neiman (1995) focused on modeling the effects of innovation and drift on selectively neutral, or adaptively equivalent, variability. Stochastic sorting, or drift, is the sampling error that accompanies transmission of neutral variants in finite populations and is a process that has been shown to occur within both biological and cultural evolution. The effects of sampling error are cumulative over time, giving a Markov property to variant frequencies. Neiman demonstrated through computer simulation that drift destroys within-group variation, and he likened the temporal pattern of simulated drift within lineages to the battleship-shaped curves exhibited by artifact types in frequency seriations. This was an important realization in that it offered for the first time an explanation, independent of the post hoc explanation of type popularity, for the success of frequency seriations. In other words, drift is the cumulative, population-level evolutionary process that accounts for the battleship-shaped curves of ceramic chronologies.

Neiman also showed that the strength of drift increases as population size decreases. He argued that innovation, unlike drift, increases variation, or the number of extant variants (Neiman 1995:14). In the context of the social-learning process, innovation can take the form of *in situ* innovation, or individual learning, where individuals chose to tweak an existing recipe for making or outfitting something, thus adding to extant variation. Alternatively, innovation can represent social learning from new models, a process often ambiguously construed as interaction or diffusion or identified as the residual effects of trade in archaeological interpretations of past behavior.

It should be clear from this brief outline of the model that “drift and innovation are opposing forces” (Neiman 1995:14): the former (drift) winnows neutral variation whereas the latter (innovation) increases it. Based on mathematical and simulation modeling of drift and innovation, Neiman argued that measures of neutral variation, of which diversity is an estimate, can be used as proxy measures of social-learning rates among groups and/or effective population size, where the effective population size differs from actual group size to the extent that not every individual serves as a model from which others learn (if, for example, not everyone is a potter or some potters are more influential than others). To convert the model from theoretical description to a mathematically tractable formula, such as a diversity index, Neiman let an estimate of homogeneity, $\hat{F}$ , be roughly equal to the inverse of twice the effective population size, $N_e$, times the innovation rate, $\mu$, plus one:

$$\hat{F} \cong \frac{1}{2N_e\mu + 1} \tag{1}$$

where $2N_e\mu$ is a parameter Neiman (1995:14) referred to as theta, $\vartheta$. As Neiman (1995:14) pointed out, this result is useful because the homogeneity of a population can be estimated “empirically as a function of a relative frequency of variants in it,”

$$\hat{F} \equiv \sum_{i=1}^{k} p_i^2 \tag{2}$$

where $p_i$ “is the relative frequency of the i’th variant in the population” and represents “the probability of choosing a given variant at random” (Neiman 1995:14). Equation 1 and Equation 2 are equal by definition, being estimates of the same parameter, and, though the former equation (1) is theoretical, the latter (2) can be directly measured. Neiman (1995:17–18) assumed the *in situ* innovation rate was constant, such that changes through time in the estimate of $\hat{F}$ register changes in the effective population size and/or changes in the levels of intergroup transmission. All other things being equal, larger populations have, potentially at least, higher effective population sizes, and increases in intergroup transmission also yield increases in the estimate of $\hat{F}$ within a group. Thus, within-group homogeneity (or its reciprocal, within-group diversity) in neutral variants is a function of population size and the rate of intergroup transmission. Higher values for either the effective population size or the rate of intergroup transmission or both should yield lower within-group homogeneity values, or higher within-group diversity values, in neutral variants. In Neiman's words, "changes in population size and/or innovation rate [read intergroup transmission], which causes alterations in variant frequencies, will be mirrored by changes in mode frequencies and . . . in diversity measures computed from them" (Neiman 1995:15).

### *Measuring Intra-Assemblage Diversity: Simpson's Diversity Index*

As just described, Neiman (1995) provided theoretical justification for using measures of homogeneity or diversity to infer pulses in intergroup transmission and/or group size, but diversity itself is not a novel quantification measure used in archaeological research (e.g., DeBoer and Moore 1982; Dickens and Fraser 1984; Leonard and Jones 1989). DeBoer and Moore (1982:152–153), for example, examined the diversity in rim bands on private- and public-use ceramic vessels among the Shipibo-Conibo and found that diversity appeared to scale with public exposure; that is, their research returned higher diversity measures among vessels taken to corporate gatherings compared to those vessels made exclusively for household use. Drawing on information theory, Dickens and Fraser (1984:150–151) suggested that increases in ceramic decorative diversity reflected increases in interregional interaction in the Deep South because ceramic decoration carried a diverse constellation of information important in the context of increased intergroup contact (see also Dickens 1980).

Often diversity is discussed in terms of variability or its reciprocal, homogeneity (Braun 1977; Conkey 1980; Wallace 1983; Whallon 1968), but, as Jones and Leonard (1989:2) point out, diversity is not synonymous with variation. Rather, diversity is an estimated measure of variation defined as “the nature or degree of apportionment of a quantity to a set of well-defined categories.” So, how is diversity measured?

It is useful here to review some key points in the quantification of diversity. First, many indices of diversity combine richness and evenness in a single measure, where richness refers to the number of types or classes within a group and evenness refers to the distribution of proportions among the types or classes within a group (Jones and Leonard 1989:2). Second, diversity measures come with a set of prerequisites for the data, namely unambiguous classification of the types, where the types come from the same taxonomic level, and representative samples from the population. Both of these requirements appear to be met in the current case, given the successfully constructed seriations presented in Chapter 4. A related point regarding classification is one raised by Neiman (1995:18): typological variants chosen for this type of analysis should not have obvious engineering fitness differences. If they do, then diversity is likely measuring something other than $N_e$, the effective population size, and $\mu$, the innovation rate. Just as Neiman suggested that engineering differences were unlikely to be built into his classification, where the 26 decorative modes were alternatives that varied along a single dimension, a similar argument can be made here, where a comparable suite of decorative modes (e.g., simple stamped, check stamped, punctated) forms the basis for the classification. Finally, the issue of diversity and sample size, first raised by

Grayson (1981) for faunal assemblages, also appears not to be of great concern here probably because of the conservative sample-size restrictions (ca. 80+ sherds) placed on the dataset from the beginning.

Simpson's Diversity Index, or Simpson's D, is an often used measure of diversity in archaeological research. Simpson's D captures both evenness and richness of types in assemblages in a single measure. This means that assemblages with the same number of types (same absolute richness) can have different diversity scores if the type proportions are not equally distributed between the assemblages (different absolute evenness), for example, if one assemblage has proportionately more of a given type than the other assemblage. Simpson's D is calculated by taking the reciprocal of the sum of squared proportions of the types in a given assemblage:

$$D = \frac{1}{\sum_{i=1}^{k} p_i^2} \tag{3}$$

where p is "the relative frequency of the i'th variant in the population" (Neiman 1995:14). Equation 3 is the reciprocal of Equation 2 such that changes in *D* approximate changes in theta, $\vartheta$. Recall that Neiman (1995) identified $\vartheta$ as $2N_e\mu$, or twice the effective population size times the innovation rate. So, changes in the diversity index should register changes in either the effective population size or in the innovation rate or both within groups, where the innovation rate is largely a function of the absolute number of intergroup transmission episodes, assuming as Neiman did that *in situ* innovation is constant through time and across space. Equation 3 is used in the following analysis.

## Intra-Assemblage Diversity Results for the Study Area

The dataset used in this analysis is the same one used to create a chronological sequence for the region. The gross-scale decorative types, such as simple stamped, curvilinear complicated stamped, and red filmed, used to construct the chronology are used in the analysis of both intra-assemblage ceramic diversity and interassemblage ceramic distance. The phase groupings developed in Chapter 4 also are used here to evaluate temporal trends in diversity and distance measures. Shown in Figure 30 is a plot of intra-assemblage diversity scores and phase means for each assemblage in the dataset grouped into 10 phases and ordered along the x-axis in terms of the seriation results, with 1 representing Shorter, the earliest phase, and 10 representing Sycamore, the latest phase. Thus, time runs from left to right. Each circle is an assemblage's diversity score, and each triangle is the diversity score mean for a phase, calculated by summing the individual diversity scores within a phase and dividing the sum by the number of assemblages in the phase.

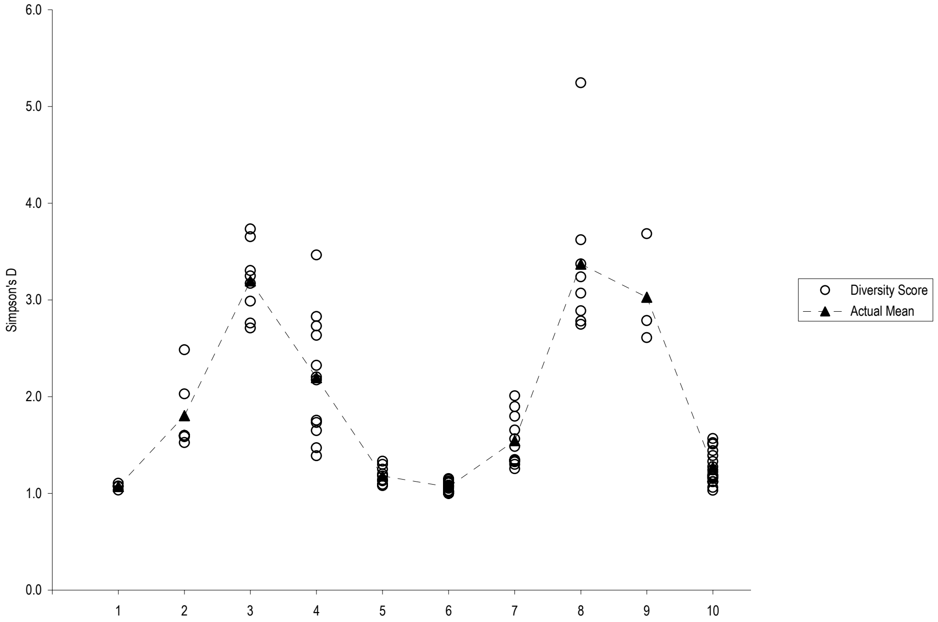


*Figure 30. Assemblage diversity scores and phase means by phase.*

The results show two clear peaks in ceramic diversity punctuated by periods of very low ceramic decorative diversity, with very few assemblages that fall outside these general temporal trends. The continuous pattern reflected here is very clearly mimicked on the FS diagram presented in the previous chapter and reflects the fact that FS and CA have captured the historical continuity of ceramic decorative change among assemblages. On the far left of the chart are assemblages that fall into the Shorter phase (labeled ‘1’). These collections are marked primarily by Deptford-related Check Stamped, which is the dominant surface treatment for the Shorter phase. From here, diversity increases through time until it peaks with assemblages that date to the Halloca Creek phase (labeled ‘3’). The subsequent drop in diversity culminates in a virtual bottoming out of decorative diversity among assemblages that date to the Kolomoki I phase (labeled ‘6’), which comprises ceramic assemblages that are dominated by SCCS to the exclusion or near-exclusion of all other decorative modes. Ultimately, though, diversity increases again, reaching a second peak with assemblages that date to the Hare’s Landing phase (labeled ‘8’) before dropping again at the close of the Woodland period (Sycamore, labeled ‘10’), with assemblages that are dominated by Wakulla Check Stamped.

Another way to examine the trend is to bootstrap means and confidence limits for the diversity estimates on pooled assemblages by phase. Bootstrapping has the advantage of placing confidence limits on the estimated phase means. The bootstrapping approach used here performs 1000 resamples with replacement using Proc IML code written by Neiman in a SAS environment. Figure 31 shows bootstrapped means and confidence limits for each of the 10 phases. Like the analysis of all assemblages, these results show two peaks in the diversity of ceramic decorative modes interspersed by periods of relatively low ceramic decorative diversity. The Shorter phase, dominated by a check-stamping mode of surface treatment, is shown to the far left and is characterized by very low diversity. Diversity increases with Mandeville I, as simple stamping, cord marking, curvilinear complicating stamping are introduced. Diversity first peaks in the Halloca Creek phase, with all of the above surface treatments plus rectilinear complicated stamped and Santa Rosa Punctated present in the assemblages. A decrease in diversity occurs during Mandeville II and bottoms out again in the Swift Creek and Kolomoki I phases. By Kolomoki II, however, a suite of decorative modes identified as Weeden Island begins to appear in assemblages with some frequency; thus diversity increases, reaching a second peak in the Hare’s Landing phase.

Decreased diversity characterizes the Late Weeden Island phase, which is marked by the return of check stamping as a surface treatment (Wakulla Check Stamped) and a decline in abundance for all other modes of surface treatment. With the final phase, Sycamore, assemblages again are characterized almost exclusively by check stamping.

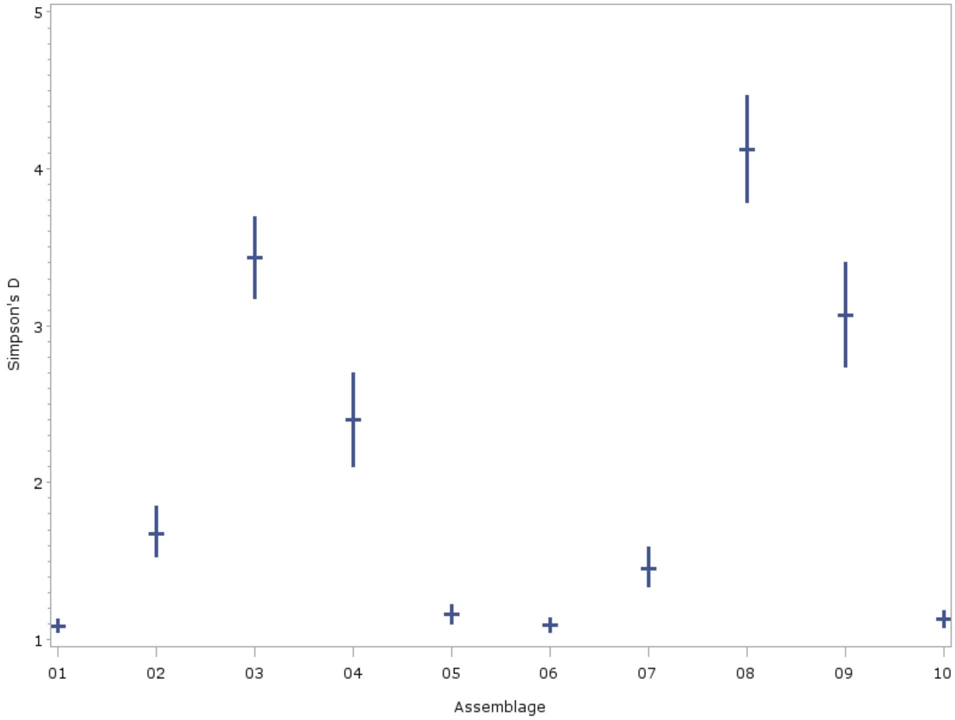


*Figure 31. Simpson's diversity bootstrapped means and confidence limits by phase: 01=Shorter; 02=Mandeville I; 03=Halloca Creek; 04=Mandeville II; 05=Swift Creek; 06=Kolomoki I; 07=Kolomoki II; 08=Hare's Landing; 09=Late Weeden Island; 10=Sycamore. The horizontal bar marks the bootstrapped mean and the vertical bar is the standard deviation based on 1000 sampling runs with replacement.*

The first peak occurs during the Halloca Creek phase, which probably dates between A.D. 1 and A.D. 100 (or A.D. 200, depending on how one interprets the few available radiocarbon dates) and coincides temporally with what Caldwell and others have labeled the Hopewell Interaction Sphere, a period of marked interregional interaction centered on the Midwest but with far-reaching connections. Archaeologists working at sites on the Chattahoochee River have long recognized material evidence for a heightened level of interaction during the Middle Woodland period and have suggested that during this time the Chattahoochee and Apalachicola rivers served as a major north-south conduit for the movement of people, goods, and ideas (Sears 1962; Caldwell 1978). Independent material evidence for interregional interaction is seen in the recovery of exotic materials and unusually decorated pottery from sites such as Mandeville, a Middle Woodland multimound site on the Chattahoochee River. Given that several assemblages from substantial pre-mound stage (9CY1-I) and the initial occupation of the platform mound (9CY1-II) at Mandeville fall within the Halloca Creek phase and contribute to a high mean diversity score for the phase, one might be inclined to conclude that diversity actually *is* measuring peaks in interaction.

Although this episode of increased ceramic decorative diversity is interesting and merits further examination, what is equally intriguing is the period of lowest ceramic decorative diversity marked by assemblages that fall into the Kolomoki I phase, which likely dates between A.D. 400 and A.D. 500 and contains some but not all of the excavated assemblages from the Kolomoki site (the remaining assemblages from Kolomoki fall into the Kolomoki II phase). The assemblages that date to the Kolomoki I phase contain large percentages of Swift Creek Complicated Stamped to the exclusion or near exclusion of other decorative modes. By Kolomoki I, the earlier simple stamping and check stamping modes have disappeared, and the Weeden Island series incised, punctated, and red-filmed types either do not occur at all or occur in very small percentages in the very latest assemblages in the phase.

The second peak in diversity occurs during the Hare's Landing phase, which contains eight assemblages from six sites and is marked by the largest percentages of decorated Weeden Island series pottery seen during the 1000-year sequence. No radiocarbon dates exist for material associated with any of the assemblages in this phase. But, based on the absolute dating of earlier and later assemblages, the Hare's Landing phase probably dates between A.D. 700 and A.D. 800 and is situated squarely within the Late Woodland period. Independent material evidence for interregional interaction during this time is more opaque than it is for the Halloca Creek phase. What additional evidence does exist comes largely from burials mounds, excavated by C. B. Moore, which are more or less in close proximity to domestic assemblages used here, although establishing the temporal relationship between mounds and domestic occupations is often difficult. If the Hare's Landing phase does mark a second period of increased intergroup transmission, it certainly has not captured the widespread attention of Southeastern archaeologists in the same ways as its earlier counterpart, associated with the Hopewell Interaction Sphere. That is, the nature of interaction for this second period, perhaps marked by increased and prolonged extra-regional communication, has not received the level of investigation given the earlier period. If the interpretation of increased interregional communication during the Hare's Landing phase holds up under additional testing, future research should focus on discerning the routes of interaction, as these appear to be different, i.e., not north-south or Gulf Coast-

Midwest, from those documented for the Halloca Creek phase. Obviously, more radiocarbon dates from assemblages within this period need to be secured in order to better situate the Hare’s Landing phase in absolute time. We will see in Chapter 6 that absolute dates are needed to explore another important trend: a period of relative drought between A.D. 675 and A.D. 710 that may correspond to the decline in Weeden Island pottery following the Hare’s Landing phase.

### *Measuring Interassemblage Distance: Squared Euclidean Distance*

In another contribution, Neiman (1995:21) provided a model using a measure of interassemblage distance by which trends in diversity can be checked. Using computer simulations for a two-group model and a variance-covariance matrix for larger group numbers, he showed that drift coupled with low intergroup transmission rates “causes . . . groups to diverge until an equilibrium between-group distance is reached” (Neiman 1995:23). As intergroup transmission rates increase, however, the time to between-group distance equilibrium decreases. Thus, drift causes groups to diverge, but divergence is offset by the rate of between-group transmission. These results indicate that both “distance and diversity are functions of the products of the same parameters: the effective population size and the intergroup-transmission rate” (Neiman 1995:25). Intergroup distance should decrease as intergroup-transmission rates increase; whereas, intra-assemblage diversity should increase as the levels of between-group learning increase or as the effective-population size increases. According to the models, distance and diversity should be negatively correlated across assemblages if the variants are neutral.

In Neiman's study, interassemblage distance was estimated by calculating the squared Euclidean distance between pairs of assemblages:

$$d_{ij}^2 = \sqrt{\sum_{k=1}^{n}(x_{ik} - x_{jk})^2} \qquad (4)$$

where $x_{ij}$ are relative frequencies of types, not type counts.

Equation 4 is used below to calculate interassemblage distance between pairs of assemblages in the Chattahoochee-Apalachicola-Gulf Coast dataset. But in order to compare directly intra-assemblage diversity estimates and interassemblage distance, one final calculation is required, the mean squared Euclidean distance:

$$\overline{d}_i^2 = \sum_{j=1}^{n} d_{ij}^2 / (n-1), i \neq j \qquad (5)$$

which is simply the sum of squared Euclidean distances for a given assemblage (the distance score for each paired comparisons between a given assemblage and all others) divided by the number of assemblages minus 1 (an assemblage compared to itself adds nothing to the sum because it is always zero).

### Interassemblage Distance Results for the Study Area

Based on Neiman's models, the expectation is that the two peaks in ceramic decorative diversity will register as two periods of low interassemblage distance, whereas, the periods of low decorative diversity will be marked by high interassemblage distance as groups become more insular in their daily interactions and their ceramic trajectories diverge over time. Shown in Figure 32 is a plot of interassemblage distance scores and phase means for each pair of assemblages in the dataset grouped by phase. The scores are ordered along the x-axis in terms of the seriation results, with 1 representing Shorter, the earliest phase, and 10 representing Sycamore, the latest phase. Thus, time runs from left to right. Each circle is an assemblage pair's distance score and each triangle is the distance mean for a phase, calculated by summing each paired distance score within a phase and dividing the sum by the number of assemblages in the phase.

The pattern through time in interassemblage distance is remarkably similar to the one just described for intra-assemblage diversity. The results show two periods of marked increase in interassemblage distance. Contrary to expectations, however, interassemblage distance is highest among assemblages that date to the Halloca Creek and Hare's Landing phases and lowest among assemblages that date to the Shorter, Kolomoki I, and Sycamore phases. Modeled within a theory of neutral-trait transmission, interassemblage distance should be greatest during periods of relative isolation and lowest during periods of increased interregional interaction and should be negatively correlated with intra-assemblage diversity. Figure 33 shows the relationship between the phase means for intra-assemblage diversity and interassemblage distance. Clearly, the trends in the two measures mimic one another. As described above, when ceramic diversity increases so too does interassemblage distance and vice versa.

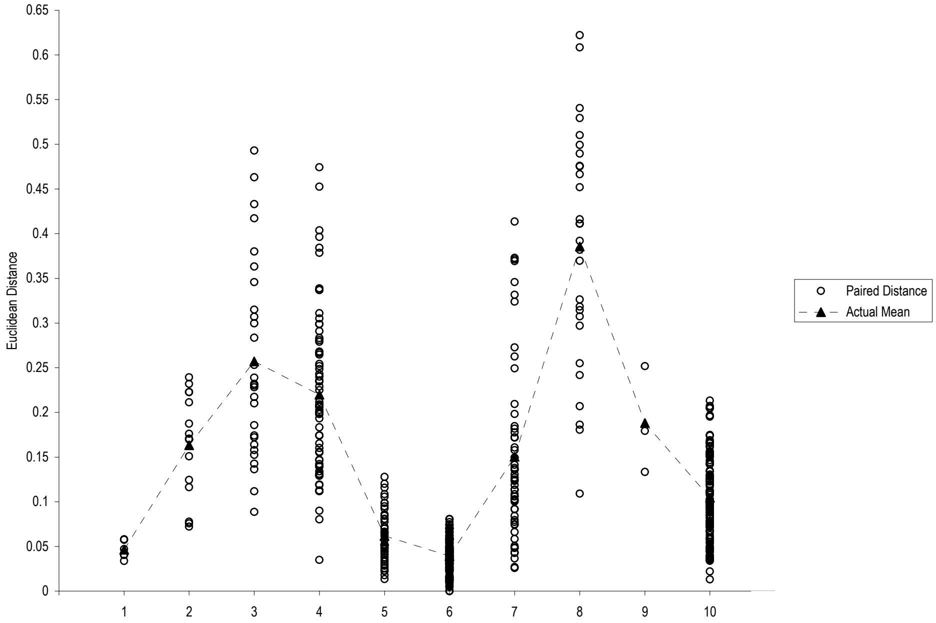


*Figure 32. Interassemblage distance scores and actual means by phase.*

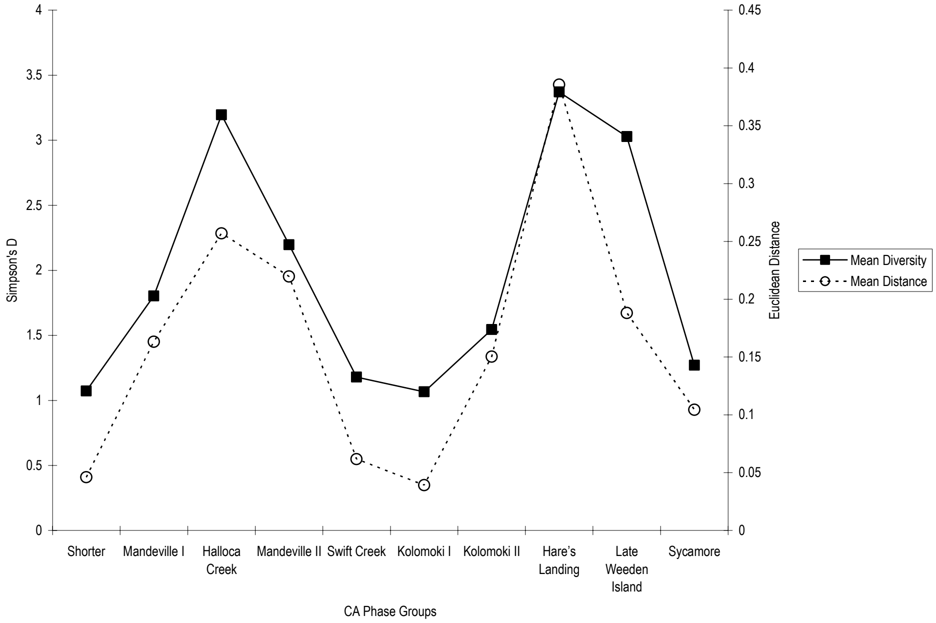


*Figure 33. Interassemblage distance and intra-assemblage diversity means by phase.*

## 5.3 Discussion

Thus far, only the phase means and global, or temporal, trends in distance and diversity have been examined. Given the models for distance and diversity, however, one would expect assemblages with high diversity scores within a given phase to have lower distance scores when compared to other assemblages in the same phase. Neiman (1995:26–27) suggested a way to explore the relationship between these two measures, holding time constant, is to examine the residuals, calculated by subtracting the phase mean from each assemblage's score or, in the case of distance, the mean squared Euclidean distance—Equation 5—for each assemblage. Residuals should remove any nonlinear global trends in the data. The residuals for each of the two measures are shown in Figure 34 and 35. Clearly, there are some assemblages with high and low residuals, meaning that their scores are higher or lower than they should be given the phase to which they date. A plot of the diversity and distance residuals, Figure 36, shows the residuals are weakly but positively correlated ($r = .24$, $p = .02$). However, outliers do exist, and there is a hint of possible negative correlations in the two sets of residuals among some assemblages. By removing 25 outliers (Figure 37), those with diversity residuals > .4 or < .4 or distance residuals > .04 or < .04, an even stronger and more significant positive correlation is obtained ($r = .57$, $p = .00$). As described below, it is clear that the residuals are best examined within phases and that the strong positive correlation shown in Figure 36 is capturing the strong trends exhibited within the Shorter, Kolomoki I, and Sycamore phases but is masking or excluding (as outliers) divergent trends in other phases.

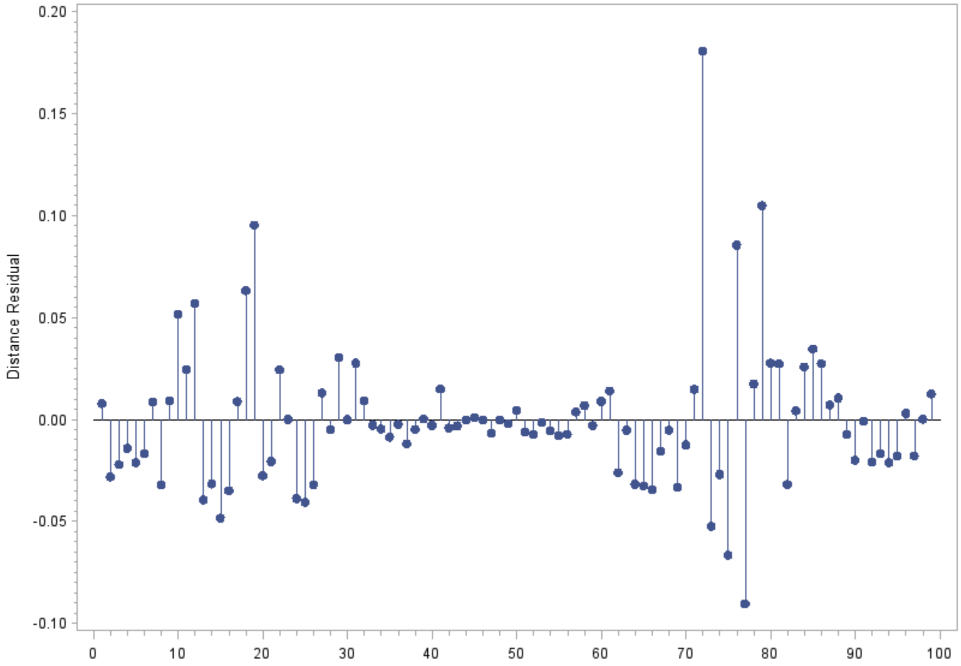


*Figure 34. Interassemblage distance residuals for each assemblage.*

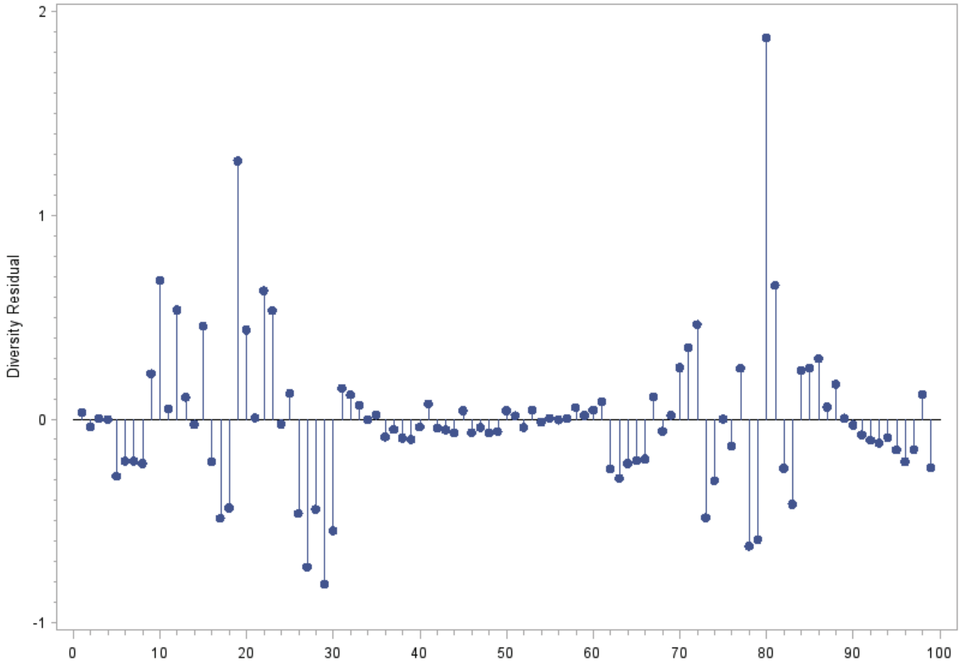


*Figure 35. Intra-assemblage diversity residuals for each assemblage.*

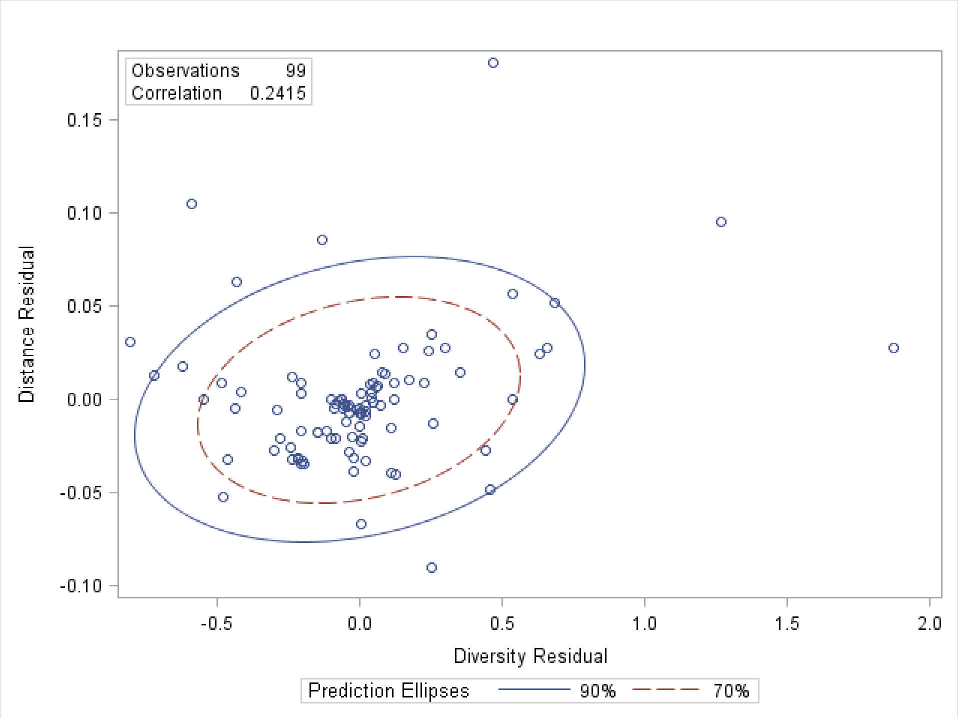


*Figure 36. Plot of diversity and distance residuals. Each circle represents an assemblage's diversity and distance residuals. The Pearson's r correlation coefficient is .24 (p = .02) for the entire dataset, suggesting a weak but positive relationship between diversity and distance residuals.*

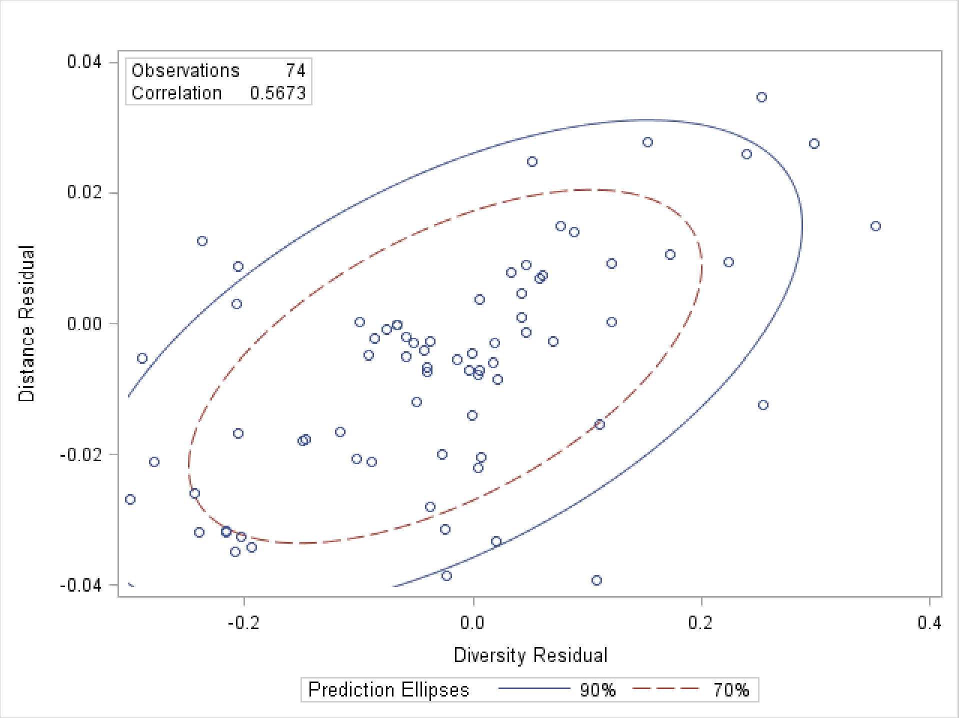


*Figure 37. Plot of diversity and distance residuals with outliers removed. The Pearson's r correlation coefficient is .57 (p = .00), suggesting a significant and positive relationship between diversity and distance when the 25 regional-scale outliers are excluded.*

So, how are the residuals within a particular phase correlated? Residuals for intra-assemblage diversity and interassemblage distance within each phase should be negatively correlated if these data fit Neiman's model. Given that negative correlations among residuals may exist for some subset of assemblages, as seen in Figure 36, it seemed pertinent to examine the residuals by phase. This step proved to be informative. Table 4 summarizes two correlation coefficients, Pearson's *r* and Kendall's *tau*, for each of the 10 phases. The numbers in parenthesis represent the counts and scores once five within-phase outliers were removed. Outliers were identified using the univariate Tukey (1977) method, where outliers are measures less than the 25th percentile minus 1.5 times the interquartile range (IRQ) or greater than the 75th percentile plus 1.5 times the IQR. The sole outlier for the diversity residuals aggregated by phases is shown in Figure 38, and the four phase-level outliers for the distance residuals are shown in Figure 39.

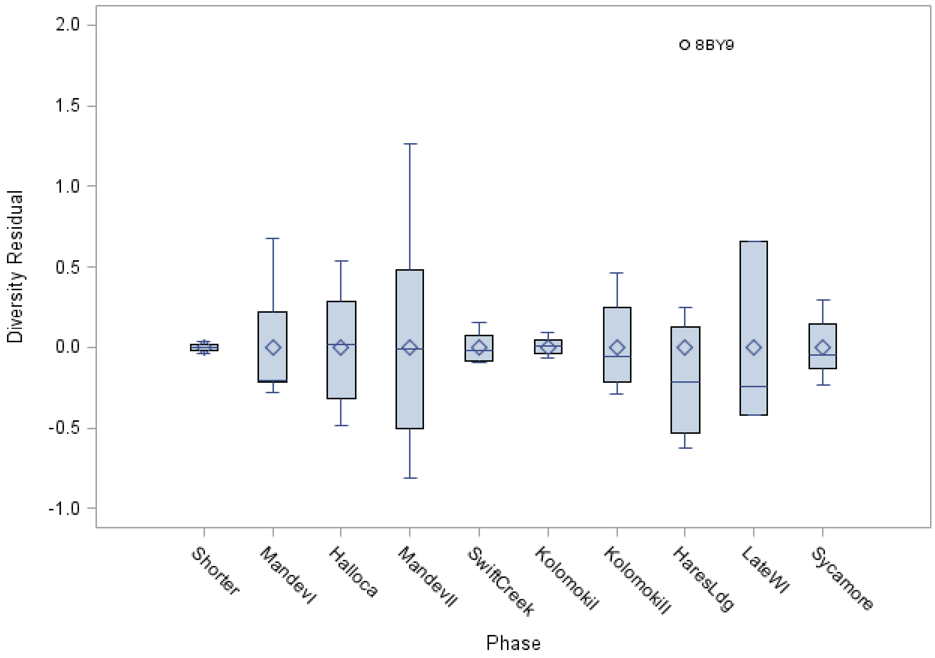


*Figure 38. Diversity residuals box plots by phase.*

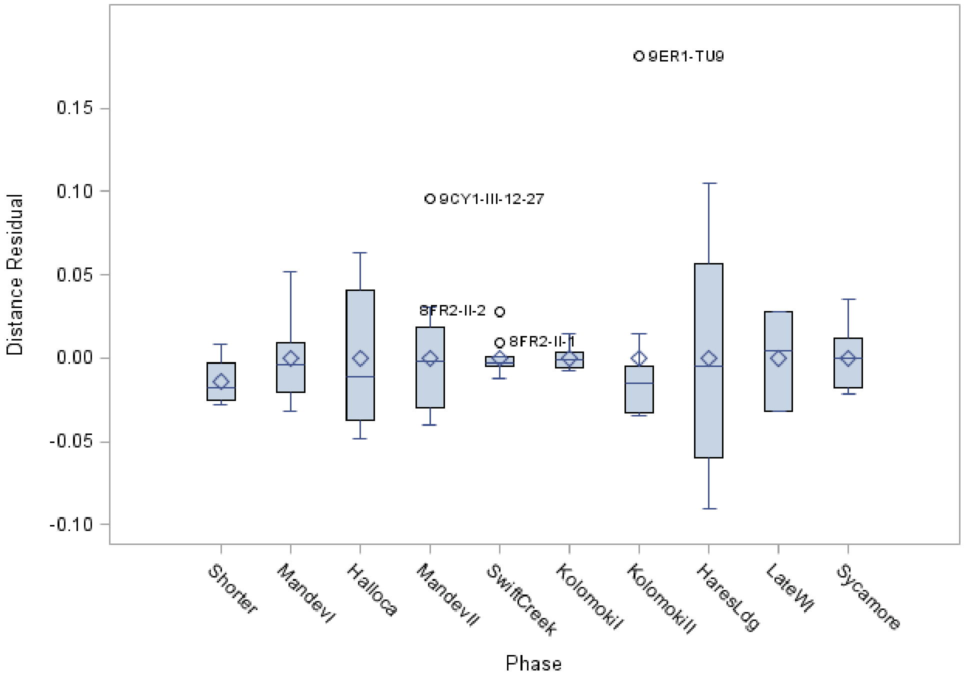


*Figure 39. Distance residuals box plots by phase.*

As shown in both Table 4 and Figure 40, Pearson's *r* and Kendall's *tau* provide similar measures of the correlations by phase, although in a couple of cases one coefficient was statistically significant whereas the other was not (e.g., Swift Creek and Hare's Landing phases). Five phases (Shorter, Mandeville I, Kolomoki I, Kolomoki II, and Sycamore) have assemblages with positively and significantly correlated distance and diversity residuals. The Swift Creek phase also has a positive and significant correlation (Pearson's *r* = .69, *p* = .03) between residuals when all 10 assemblages that date to the phase are included, but the correlation becomes negative, though not significant, when two outliers (from 8FR2) are removed. The Hare's Landing phase is the only one that exhibits a statistically significant negative correlation (Kendall's *tau* = -.52, *p* = .10) when a single outlier is removed (from 8BY9). It would appear that the Hare's Landing phase conforms to Neiman's model predictions (Figure 41). The Halloca Creek phase may also conform to the model. The univariate Tukey (1977) method did not identify any outliers for the phase, but visual inspection of the plot shown in Figure 42 suggests one assemblage (9CY1-I-0-6) falls outside the bivariate point cloud. As shown in Figure 43, when this assemblage is excluded, the correlation among residuals becomes negative and significant (Pearson's *r* = -.65, *p* = .11; Kendall's *tau* = -.52, *p* = .10). For the two phases with the highest intra-assemblage diversity scores and interassemblage distances scores (Halloca Creek and Hare's Landing), those assemblages with higher diversity than average for the phase have lower than average assemblage distances to other sites within the phase, when the mean trend of high distance also is removed. Alternatively, those assemblages with low intra-assemblage diversity scores within Halloca Creek and Hare's Landing phases have high distances among other sites within the given phase, when time is held constant.

**Table 4. Correlation Coefficients for Residuals by Phase.**

| Phase | No. of Sites | No. of Assemblages | Pearson's *r* | Kendall's *tau* |
|---|---:|---:|---:|---:|
| Sycamore | 8 | 16 | **.70** | **.42** |
| *p-value* | | | **.00** | **.02** |
| Late Weeden Island | 3 | 3 | .69 | .33 |
| *p-value* | | | .51 | .60 |
| Hare's Landing | 6 (5) | 8 (7) | -.05 (-.54) | -.29 **(-.52)** |
| *p-value* | | | .90 ( .21) | .32 **( .10)** |
| Kolomoki II | 4 | 11 (10) | **.69 ( .59)** | .31 ( .16) |
| *p-value* | | | **.02 ( .07)** | .19 ( .53) |
| Kolomoki I | 11 | 21 | **.64** | **.30** |
| *p-value* | | | **.00** | **.06** |
| Swift Creek | 3 | 10 ( 8) | **.69** (-.21) | .24 (-.21) |
| *p-value* | | | **.03** ( .61) | .33 ( .46) |
| Mandeville II | 4 | 12 (11) | .39 (-.23) | .00 (-.20) |
| *p-value* | | | .21 ( .50) | 1.00 ( .39) |
| Halloca Creek | 3 | 8 (7) | -.16 (**-.65**) | -.21 |
| *p-value* | | | .71 (**.11**) | .45 |
| Mandeville I | 4 | 6 | **.90** | **.87** |
| *p-value* | | | **.01** | **.01** |
| Shorter | 2 | 4 | **.88** | .67 |
| *p-value* | | | **.12** | .17 |

*Numbers in parenthesis represent values with phase-level outliers removed.

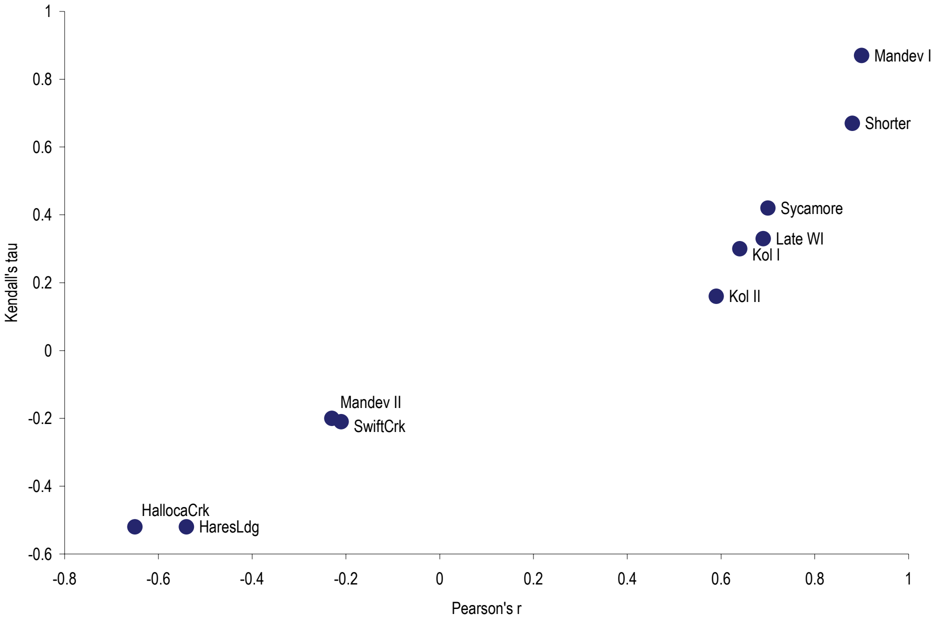


*Figure 40. Plot of correlation coefficients for residuals with no outliers.*

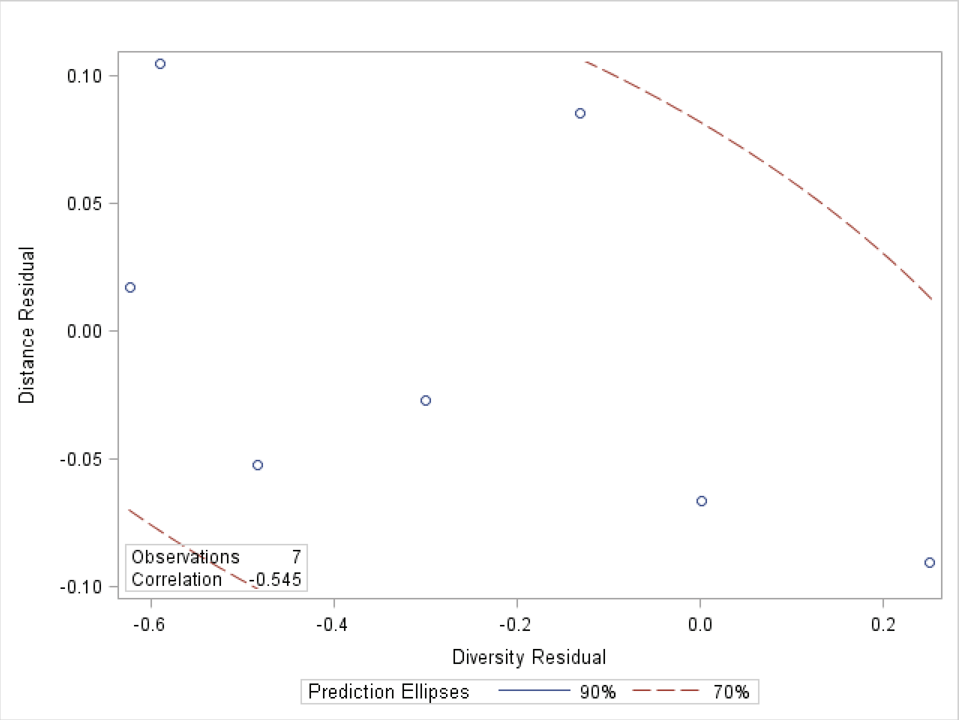


*Figure 41. Hare's Landing phase assemblage diversity and distance residuals. The Pearson's r correlation coefficient is -.54 (p = .21) with the outlier removed. Kendall's tau coefficient is significant at -.52 (p = .10).*

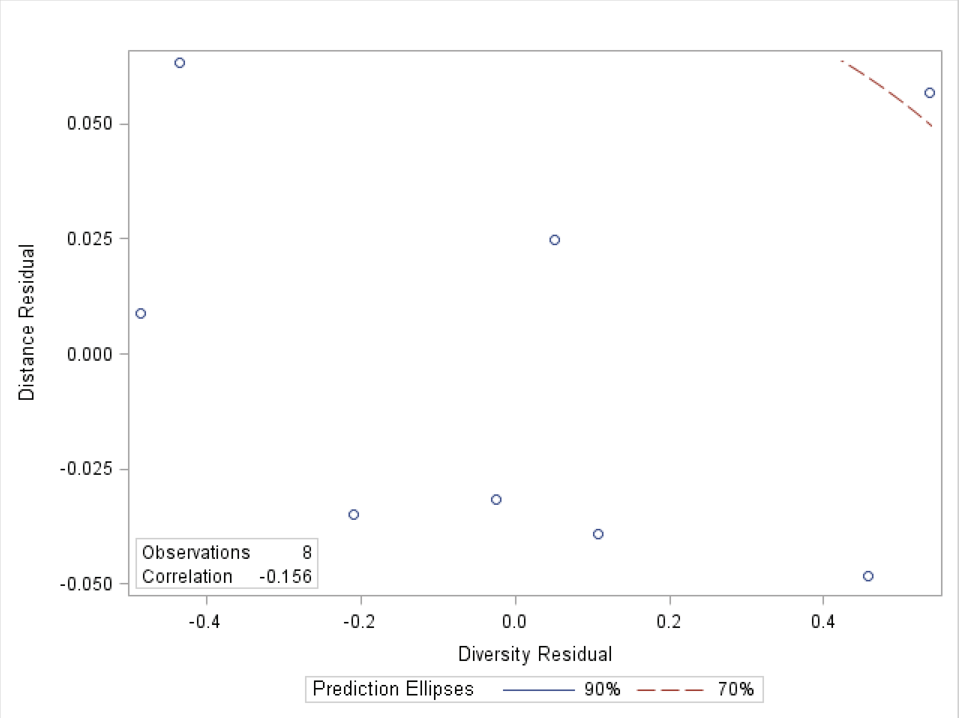


*Figure 42. Halloca Creek phase assemblage diversity and distance residuals.*

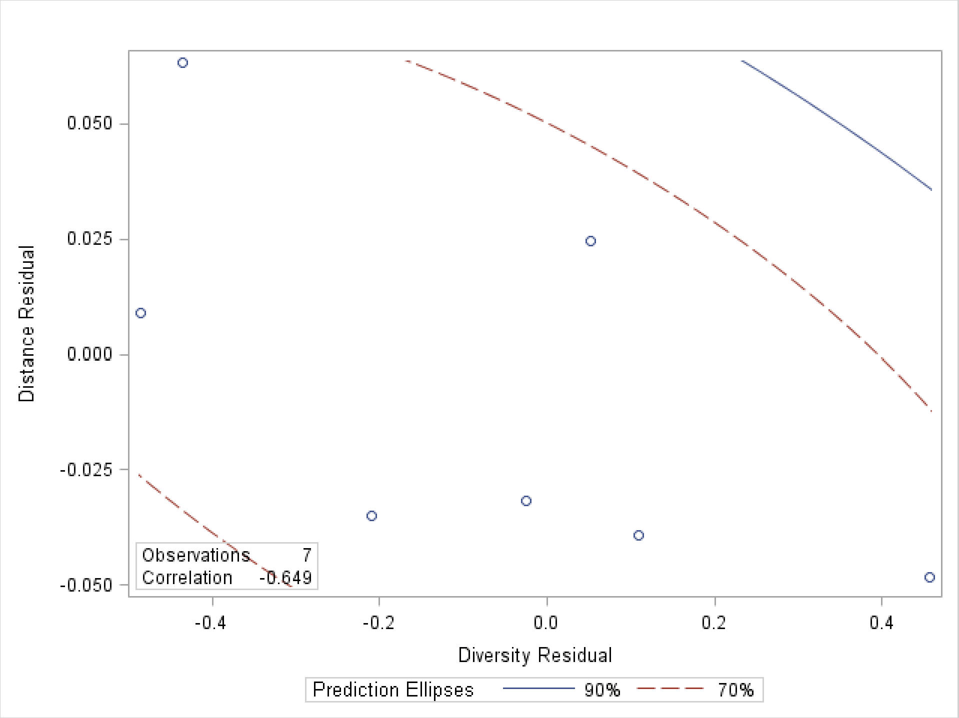


*Figure 43. Halloca Creek phase assemblage diversity and distance residuals. The Pearson's r correlation coefficient is -.65 (p = .11) with the outlier removed.*

Although the samples are small, the trend within Halloca Creek and Hare's Landing is clear and markedly different from the phases with strong and positive correlations, as shown in Figure 44 for the Kolomoki I phase. The Kolomoki I phase assemblages register overall low distance and low diversity measures, but when time is held constant, by calculating the residuals, the pattern that emerges is at odds with the models described by Neiman. For Kolomoki I and the other phases with low distance and low diversity means (namely, Shorter, Mandeville I, Kolomoki II, and Sycamore), assemblages with higher-than-average (for the phase) diversity scores also have higher-than-average distance scores, whereas assemblages with lower-than-average diversity scores have lower-than-average distance scores (see Appendix 10 for additional plots). This trend is the opposite of what is predicted by the models developed within the theoretical framework of unbiased social learning of neutral traits.

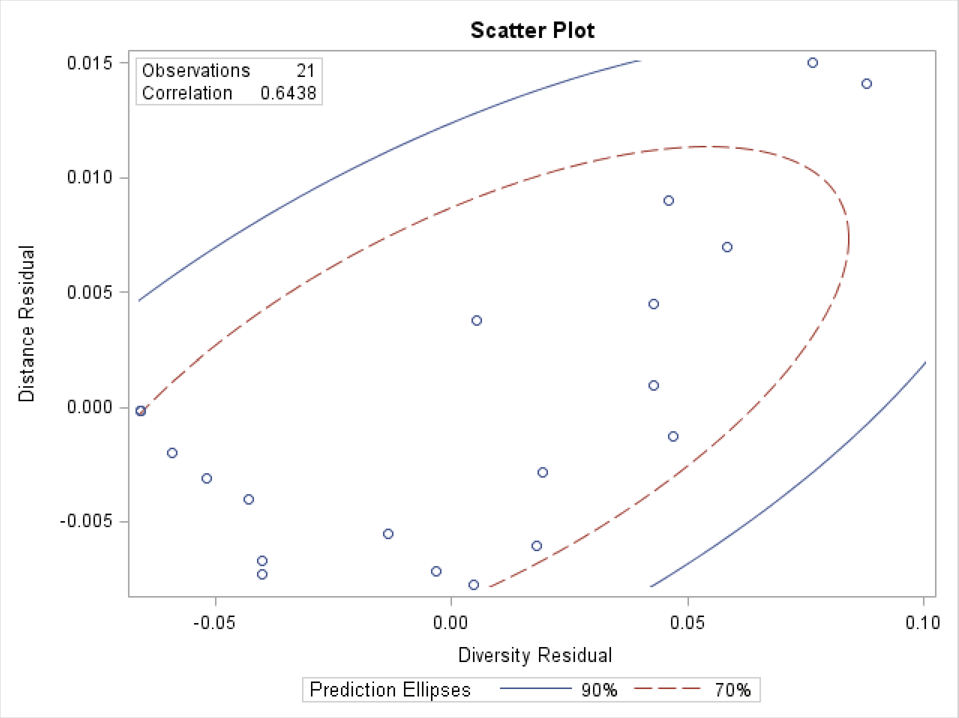


*Figure 44. Kolomoki I phase diversity and distance residuals. The Pearson's r correlation coefficient is .64 (p = .00), indicating a significant positive relationship between diversity and distance within the Kolomoki I phase.*

To recap, Neiman's model predicts what happens to variant frequency distances between groups and variant diversity within groups when two or more groups learn from each other and the acquired variants are neutral with respect to adaptive value. As levels of intergroup learning increase, the distribution of neutral- and learned-variant frequencies between groups should become similar (low intergroup distance) at the same time as the available and selected suite of neutral variants increases within groups (high intragroup diversity). Alternatively, as levels of intergroup learning wane, the distribution of learned-variant frequencies should become dissimilar (high intergroup distance), whereas the number of available variants should decrease (low intragroup diversity) as reduced interaction deceases the effective population size (the teacherstudent population), causing the diversity-winnowing effect of drift to be stronger. These expectations were shown to hold for the Midwest ceramic dataset in which Neiman’s model was originally tested. The same results were expected for the Deep South dataset used here.

The periods of isolation as measured by the interassemblage distance scores are the same ones that appear to be the periods of greatest interregional interaction as measured by the diversity scores. Were one to consider only the measure of intra-assemblage diversity, the interpretation would be that the periods of greatest interaction are found during the Halloca Creek and Hare’s Landing phases, with the intervening phases marked by reduced interaction, or intergroup learning. Alternatively, were one to consider only interassemblage distance, the interpretation would be reversed, with the Halloca Creek and Hare’s Landing phases marking periods of significant isolation between groups and Shorter, Kolomoki I, and Sycamore phases marking periods of increased intergroup learning. Clearly, both interpretations cannot be correct. The nagging question is this: what is wrong with the model; that is, what are the additional forces apparently at work that are not included in Neiman’s model?

The temporal trend indicates that interassemblage distance and within-assemblage diversity are positively and significantly correlated, when the residuals are estimated and the data are examined within phases in order to hold time constant, both Halloca Creek and Hare’s Landing assemblages appear to fit the neutral model as explicated by Neiman. There is some independent support for an interpretation that both of these periods are notable for increased intergroup transmission. Some of this evidence was described above. Briefly, the residents of sites that date to the Halloca Creek phase, at Mandeville in particular, are clearly participating in widespread interregional trade, as the assemblages possess a number of traits indicative of Hopewellian influences, including but not limited to nonlocal copper ornaments, blades, and ceramic figurines. Although Hare's Landing phase sites could also be marked by wide-reaching connections, this notion has not been explored or argued to any great extent in the published literature, though I suspect it would not be difficult to make such an argument from the archaeological record. I return to this point in Chapter 7. For most periods, however, the assemblages do not conform to modeled expectations. The following chapter focuses on explaining these deviations by examining additional factors that might shape diversity and distance in heretofore unmodeled ways.

# CHAPTER 6. RESIDENTIAL MOBILITY AND AGGREGATION

We saw in the preceding chapter that the phases marked archaeologically by material indicators of widespread interregional connections are the same ones that fit the diversity and distance expectations of the neutral theory of cultural transmission. But some phases did not conform to the models of intra-assemblage diversity and interassemblage distance. So, where do we go from here? As Gremillion (2002a:143) recently noted, “it is possible to learn much from the failure of models.” Though she was referring to specific instances in which foraging models do not hold, her statement is applicable here as is her suggestion to strategically “probe the model’s failures by manipulating constraints and variables” (Gremillion 2002a:142). This is the goal of Chapter 6: to account for the phases in which the data do not fit the models.

Neiman (1995:26) proposed a couple of reasons why archaeological data might not conform to the expectations he outlined. The first concerns the variants: the variants chosen for the analysis might not be neutral with respect to selection. If this were the case here, one would expect none of the results to conform to the modeled expectations unless there were pulses in the extent to which selective forces were at play. Several of the decorative variants, especially the Curvilinear Complicated Stamped variant, cross cut phases that do and not fit expectations, and yet, nothing in the FS and CA results presented in Chapter 4 suggests these variants are alternating between selection-driven and neutrality-driven distributions. The pattern is more consistent with the behavior of stochastically shaped variation—the battleship-shaped curves—as modeled by Neiman (1995:10–13) and others. Thus, it is unlikely that the variants examined here are at times shaped by selection and at times driven by drift.

The second potential issue concerns the models themselves: some additional force, behavior, or process is operating that was not considered in the original drift-effective population size-intergroup transmission formulation. In thinking through what this new element might be, it is useful to be explicit about the two aspects to the lack of fit that call for explanation. First, mean diversity and distance are correlated over time. Any explanation proposed must account for the concomitant increases and decreases through time in both measures. Second, within some phases diversity and distance residuals are positively correlated such that assemblages with higher-than-average diversity also have higher-than-average distance and vice versa. This lack of fit occurs within the low diversity-low distance troughs, recalling that the high diversity-high distance peaks have negatively correlated residuals and in this way fit the modeled predictions. Any process that seems to account for the first deviation from the models may or may not explain the second deviation. The challenge here is to construct a historical narrative, or propose a set of hypotheses, that accommodates both the peaks and troughs and the within-phase positive correlations in the troughs. But the challenge does not end here. One must also look for independent data that can speak to the proposed conditions. There are several intricate parts to the story that follows. Some parts are supported by independent evidence. Other parts, though they cannot be evaluated at this time, offer avenues for future research.

Chapter 6 is organized into three main sections. In Section 6.1, I argue that the first departure from the models is the result of fluctuations in mobility and population size operating in tandem. Changes in the degree of residential mobility seem to explain the increases and declines in interassemblage distance but this process alone does not, intuitively at least, account for the concomitant increases and decreases in intra-assemblage diversity. However, the latter measure would be affected by fluctuations in group size, recalling that drift, which winnows variation, is stronger is smaller populations. As discussed in Section 6.1, a host of studies suggest mobility and population size are not independent of one another, so it is not unreasonable to suggest that both are simultaneously driving the patterns in diversity and distance. The peaks in diversity and distance, I suggest, are registering peaks in residential stability and population size, whereas the troughs are registering increases in mobility made possible through decreases in overall population size and smaller residential group size. In Section 6.2, I discuss some of the consequences of decreased population size and concomitant increased mobility, namely the need for groups to aggregate periodically to renew social ties, select mates, and the like. Episodic aggregation during periods of increased residential mobility would result in high intra-assemblage diversity at aggregation sites and at the same time would produce higher interassemblage distance among aggregation and non-aggregation sites. Thus, an aggregation-dispersal residential strategy would account for positive correlation in distance and diversity residuals apparent in the troughs. I also discuss what this sort of episodic aggregation would look like in the archaeological record and suggest at least one site, the enigmatic

Kolomoki site, as a possible location for seasonal aggregation during the middle period (Kolomoki I phase) of increased mobility.

Finally, in arguing that an increase in mobility and a concomitant decrease in population may be the salient elements contributing to one of the deviations from the distance and diversity models presented in Chapter 5, the question arises regarding the causes for shifts in both the prevailing residential strategy and population size. In Section 6.3, I consider one potential cause for pulsed increases in mobility and decreases in group size by examining the climatological evidence for regional and episodic drought. The expectation here is that the initial declines in diversity and distance, which are first seen in the Swift Creek and Late Weeden Island phases, map onto periods of drought. Mobility was a strategy that served to buffer groups against depreciating habitat quality, specifically, and climatic unpredictability, generally. But prolonged periods of drought might also precipitously drive down populations and, thus, open up territories that were previously occupied, giving rise to increases in mobility. We will see in Section 6.3 that a drop in the number of sites at ca. A.D. 400 within two well-surveyed sections of the study area support the inference for the first decline in population. We also will see that, as expected, both Swift Creek and Late Weeden Island phases are marked by significant episodes of drought.

## 6.1 Hunter-Gatherer Mobility and Population Size

Hunter-gatherer foraging strategies and the adaptively related condition of residential mobility stand as two of the most well-researched topics in archaeology and have been a significant focus of ethnoarchaeological studies (e.g., Berelov 2006; Binford 1980, 2001; Grove 2009; Kelly *et al.* 2005; Mannino and Thomas 2002; Pickering 2003; Sellet *et al.* 2006; Winterhalder 2001). These topics are afforded prominence in our discipline largely because for the vast majority of human prehistory, people lived in mobile hunter-gatherer groups (Lee and Daly 1999:1–2).

Kelly (1983:277) describes mobility as the "seasonal movement of hunter-gatherers across a landscape." In contrast, sedentism is the appropriate descriptor when all or part of a group are residentially stationary year-round (Kelly 1992:49). Seasonal movement can take many forms but, as mobility is linked to resource acquisition, mobility strategies are thought to be structured often to maximize food returns for effort expended in a given environment (Kelly 1983:277–279). Seasonal and year-to-year variation in mobility is considered "a response to fluctuating environmental variables that affect the prevailing resources" (Kelly 1983:279). The linkages between foraging strategies, environmental circumstances, and other aspects of human behavior, such as coresident group size and settlement patterns, form the basis of research in optimal foraging theory (Winterhalder *et al.* 1981: 13). What emerges clearly from the body of research on hunter-gatherer mobility is the idea that residential mobility "is universal, variable, and multidimensional" but also that mobility is often difficult to monitor in the archaeological record (Kelly 1992:43).

### *Residential Mobility in the Study Area*

In southeastern North American, during the final pre-contact, or Mississippian, period, residential groups appear to have been relatively stable from season to season, though the extent to which residential stability was ever the norm is debatable for groups living on the coast proper (see Crook 1986, 2008; Larson 1980 for convincing arguments in favor of pre-contact, seasonally mobile hunter-gatherer-agriculturalists on the southern Atlantic Coast). Increased residential stability in this part of the world is correlated with, though not necessarily caused by, a growing dependence on domesticated maize, for which there is much direct and indirect evidence. But, it is also clear that the vast majority of Archaic-period groups were mobile as were their Paleoindian ancestors, although the extent to which Archaic people, particularly those who built mounds, moved about on the landscape is a current debate (Sassaman 2004:231; see also Johnson 1994:99–126).

This leaves the Woodland period, at least within the study area, in a gray zone. The inclination, it seems, is to situate the Woodland period in a “middle range” (Sassaman 1995:178). Take Caldwell (1958) for example, who freely discussed the Archaic period in terms of mobility but failed to clearly characterize Woodland-period peoples in terms that would suggest either residential mobility or stability. It is interesting to note that Caldwell (1958:13–14) does infer a reduction in mobility among those Archaic groups who developed what he characterized as a *specialized shell fish economy*:

> “It seems clear that the peoples who come to depend upon shellfish, and whose skill in hunting is attested by thousands of deer and other

> bones, had been partly freed from the necessity of continually moving in search of food. They probably moved in season, but not constantly.”

Does Caldwell assume that by the Woodland period a significant degree of residential stability had been achieved? It is hard to say. Referring to the extended distribution of Deptford simple stamped and check stamped pottery, Caldwell (1958:49) suggests “a strand-looping kind of existence [for Deptford people] . . . although sites [bearing this pottery] extend up the rivers for a considerable distance inland” leading him to infer “a single interaction area corresponding to the ceramic province,” though in this case it is not clear what he means by interaction. In fact, a cursory review of the regional literature does point to one trend: “panregional [ceramic or lithic] similarity” (Sassaman 1995:179) is commonly explained in terms of mobility for pre-Woodland groups and in terms of interaction for Woodland-period groups, a trend that may be rooted in Caldwell’s own work but may also relate to the technological innovation of ceramic production that suggest some relative reduction in mobility. Clearly, however, mobility during the Woodland period in the Deep South, even today, is a frustratingly under-researched topic despite the widespread attention given to prehistoric mobility strategies throughout the discipline and a renewed interest in the local manifestations of Woodland-period life.

Despite a lack of specific research aimed at addressing mobility, Woodland-period people in the Deep South in general, and in the study area in particular, likely *were* mobile hunter-gatherer-collectors or foragers, whose subsistence centered on collecting freshwater and marine shellfish, fishing in rivers and coastal waters, hunting deer and other mammals and amphibians, and gathering nuts and berries (Anderson

1998:284–285; Belovich *et al.* 1982:420; Gremillion 2002b:Figure 22.3; Milanich 1994:144). In the Midwest, however, a significant degree of residential stability is inferred for the Middle Woodland period, a trend thought to be an outcome of an increased reliance on pre-maize cultigens (Asch *et al.* 1979; Braun 1987; Charles 1992; O'Brien 1987). So, how would mobility impact the diversity and distance models described above? Neiman's models assume the assemblages were created by residentially stable groups because this is simpler to model and because it was arguably applicable to his archaeological test case. His models did not explicitly consider how mobility would shape intra-assemblage diversity and interassemblage distance. However, within the Deep South, the degree of residential mobility—measured in terms of how often people moved but also how far—likely was not constant throughout the Woodland period. An increase in residential mobility, again expressed either as more frequent or farther movement, potentially would cause deviations from the models outlined and tested in the previous chapter. In short, whereas, in the Midwest, assemblages from different locations were likely created by different residentially stable groups, in the Deep South, assemblages from different locations may have been, at times, created by the same residentially mobile and probably highly fluid groups (*sensu* Kelly 1992:47).

Intuitively, at least, the hypothesized deviations fit the actual pattern observed among these data. It is beyond the scope of this dissertation, and, frankly, my current skills, to add mobility to the computer and mathematical models developed by Neiman (1995), though other researchers are beginning to model the impact of immigration and migration on culturally transmitted variation (Boyd and Richerson 2009; Richerson and Boyd 2008). Nevertheless, it still may be fruitful to consider the impact mobility would have on the outcome of the measures of diversity and distance and draw some general conclusions and pose hypotheses that can be explored in future research.

Fluctuations in residential mobility would seem to undermine a key assumption of Neiman's models: that the archaeological assemblage represents the material remains of a single deme, or local learning population. When mobility becomes a factor shaping the distribution of decorative variants across space and through time, several sites or assemblages may represent a single deme. It makes intuitive sense that increases in mobility would cause decreases in interassemblage distance between sites or assemblages that mimic the decreases shown to exist under increasing intergroup transmission between residentially stable populations. But, unlike increases in intergroup transmission, increases in mobility would not impact intra-assemblage diversity in any predicable way. So, we must look for additional processes or forces that may also be influencing diversity.

### *Population Density in the Study Area*

If mobility is a key process influencing departures from the modeled expectations of interassemblage distance, it appears not to have been constant throughout the Middle and Late Woodland periods. That is, during the phases that better conform to the model (the Halloca Creek and Hare's Landing phases), a greater degree of residential stability likely had been achieved than in the intervening phases (see Section 7.2). But, if increased mobility is driving drops in interassemblage distances, what is shaping the concomitant drops in intra-assemblage diversity?

In the introduction to Chapter 6, I suggested that population size may be the factor shaping diversity. As Binford (2006:6) clearly demonstrates using ethnographic data from hunter-gatherer societies, “population density and mobility are strongly related” and are, in fact, negatively correlated among groups “with population densities of less than nine persons per 100 $km^2$,” the definition Binford (2006:5) offers for mobile hunter-gatherers. Below this density threshold, larger populations move fewer kilometers per year compared to smaller populations (Binford 2006:7–8). Above this threshold, kilometers moved annually remain under 150 km for aquatic resource-dependent cases (Binford 2006:9). For terrestrial plant-dependent cases, after densities reach about 20 persons per 100 $km^2$, kilometers moved annually is constrained to that of aquatic resource-dependent cases (Binford 2006:10). Binford (2006; see also Binford 2001:310–314) demonstrated a relationship between population density and mobility among hunter-gatherers that archaeologists had long suspected: “the number of people on a landscape significantly affects which strategies and tactics people may use to make their living on that landscape” (Kohler and Sebastian 1996:598).

Recall that diversity is a function of twice the effective population size times the innovation rate. Effective population size is not equivalent to population size, but barring selection against multiple teachers or role models, effective population size should scale with group size. Holding the *in situ* innovation rate constant, increases in the effective population size (the teachers or role models) within a group should lead to increases in intragroup diversity. In smaller populations, however, drift is a strong agent that acts to winnow variation. In the context of the current study, as mobility and population density co-vary negatively, a drop in population density would both reduce diversity through the process of drift and allow for more mobile resource procurement and residential strategies, which would have the practical effect of reducing intersite distance. If population decline is attributable to climatic forces, then mobility may also be seen as a necessary response to resource stress. It is exactly this interplay of population size (and probably also co-resident group size) *and* mobility that I suggest is driving the increases and decreases in diversity *and* distance through time, with two population “crashes” (during the Swift Creek and Late Weeden Island phases) that lead to or make possible increases in mobility in the intervening Kolomoki I, II, and Sycamore phases.

But two questions remain. First, to what can we attribute population declines and concomitant increases in residential mobility? This question will be addressed in Section 7.3 by examining site density and climate data sets. Second, when time is held constant (as it is in the diversity and distance residual plots), phases with low diversity and distance (the troughs) contain some assemblages with higher diversity and higher distance than is expected for the phase and vice versa, hence the positive correlation in residuals. To what is this pattern attributable?

## 6.2 Aggregation: An Outcome of Increased Mobility

The positive correlation in residuals evident in the troughs of low distance-low diversity appears to be more difficult to explain given our current understanding of the archaeological record than the long-term trend in diversity and distance. Additional data that address regional-scale spatial variation in co-residential group size (inferred from site size), resource-exploitation intensity or diet breadth, site-occupation intensity, seasonality, intracommunity organization, intra and intersite functional variation, and the like would, no doubt, help shed light on the observed ceramic patterns. For now, we must be satisfied with proposing one possible agent: an aggregation-dispersal residential pattern that differs from the modal residential strategy of greater stability in the high diversity-high distance periods.

As the models described above and the independent data presented below suggest, the Swift Creek phase is marked by regionwide population decline followed closely by an increase in residential mobility (and an overall decrease in co-residential group size) during the Kolomoki I phase. This suggests a more dispersed settlement pattern ca. A.D. 400 that continued for some time. Residential mobility and settlement dispersal, as adaptive strategies, solve resource-procurement problems and may do this better than other residential strategies in certain environmental and subsistence contexts, but dispersed mobility present other problems, namely the continued need among groups to share information, select mates, and form or bolster social ties that make sharing information and selecting mates easier to achieve. Annual but short-lived co-residential aggregation on a scale considerably larger than the mobile residential unit is one means of overcoming these additional problems.

I suggest that, unlike the large semipermanent aggregates of the Southwest, aggregation in the Deep South occurred annually or semiannually and did not result in permanent or long-term residence at the sites of aggregation, at least during the Kolomoki I phase. In terms of the distance and diversity measures, these aggregation sites should be marked by higher within-assemblage diversity and higher between-assemblage distance than their contemporary dispersed counterparts from which the annually aggregate population is drawn. The contrast in diversity and distance between aggregated and dispersed settlements has two potential causes. First and more likely here, aggregation sites might exhibit higher diversity and higher distance because of a greater diversity in social and functional or ritual activities that take place at such sites. Second, aggregation sites by their very definition here are sites to which people return annually or semiannually to conduct social business. As such, the assemblages generated at these locations should be more time averaged (and, hence, more diverse) because of repeated occupation than the assemblages created at dispersed settlements in which smaller groups of people reside before moving on. Unfortunately, examination of the archaeological contexts that rank high among the diversity and distance residuals, within the low distance-low diversity troughs, did not reveal any interpretable patterns either supporting or discounting the first proposition. That is to say, assemblages from large sites such as Kolomoki rank higher than average *and* lower than average during the low distance-low diversity phases rather than exclusively higher than average, as one might expect of an aggregation site. However, composition of the ceramic assemblages (the ceramic types) in the troughs that are above average in diversity and distance suggests time-averaging may be the factor driving these measures. These assemblages are comprised of types whose mode occurs either slightly earlier or slightly later than the dominate Swift Creek Complicated Stamped.

Both intrasite and intersite functional variation in activities and assemblage duration need to be explored further. In doing so, additional assemblage-specific data should be examined for independent trends that would favor one or the other possibility, or both. Future work also should focus on developing additional explanations that would account for the patterns in the troughs. But, residential aggregation during the periods of increased mobility should not be discounted outright. Aggregation has many interesting social implications and potential correlates in the archaeological record. Given that Kolomoki is the largest site within the study area, and may in fact be the largest pre-Mississippian site in the East, it is clearly one place to look for evidence of aggregation. Kolomoki may also provide additional clues regarding the reduction in mobility which may have reached a second climax in the Hare’s Landing phase (see Chapter 7).

## 6.3 A Search for Independent Evidence

As mentioned at the beginning of this chapter, some parts of the Woodland-period historical narrative that emerge from this research are hypotheses at best. In archaeology, hypothesis testing can be accomplished by establishing a set of predictions about how other, independent, data sets should behave if the proposed scenarios are correct characterizations of past behavior. In essence, we must look for independent evidence to support our claims. In this section, I examine two lines of independent evidence. First, settlement data from two local reservoirs offer an independent measure of population size that should support the new inferences derived from deviations in the diversity and distance models. Second, a climate record for the Deep South offers an opportunity to examine a causal mechanism for one of the trends, a decline in population during the Swift Creek phase and again during the late Weeden Island phase, which led to increased mobility and an aggregation-dispersal residential strategy.

### *Survey Data on Site Densities*

As mentioned throughout, several modern surveys have been conducted within the study area in conjunction with federal efforts to inventory archaeological resources in order to better manage site impact along reservoirs banks and in public-use areas (Belovich *et al.* 1982; Knight and Mistovich 1984; White 1981). In each case, researchers attempted to use survey results to examine changes through time in site density or population dynamics. For the Walter F. George and Andrews Lake surveys, the results are reported as comparable measures calculated as the number of components per period or phase divided by the number of years per period or phase (Belovich *et al.* 1982:475; Knight and Mistovich 1984:231), although Belovich *et al.* (1982) used a coarser-grained chronology than Knight and Mistovich (1984). They each caution against reading too much into the measure. Belovich *et al.* (1982:474) acknowledge “sites must reflect considerable differences in function, season, size, duration, and intensity of occupation" not considered in a measure of the number of components. Knight and Mistovich (1984:230) suggest, as a population model, the "figures are interesting to look at if they are based on a sufficiently detailed chronology and a site sample of fair size" but should not be taken too seriously. The numbers from both reports are reproduced here in graph form (Figure 45).

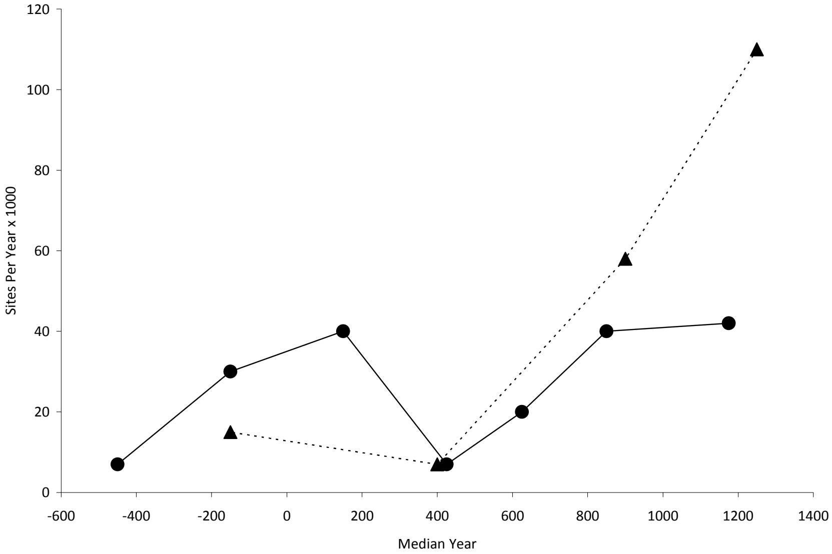


*Figure 45. Site estimates from the Walter F. George Lake (circles) and Andrews Lake (triangles) surveys. Data for Walter F. George Lake from Knight and Mistovich 1984:231. Data for Andrews Lake from Belovich et al. 1982:475*

Even in light of the caveats identified by the authors, these data are, in fact, interesting to look at in so much as they appear to provide independent support for at least the earliest inferred decline in population (ca. A.D. 380 in the Swift Creek phase), which, I have suggested, precipitated an increase in residential mobility. Knight and Mistovich (1984:230) describe the trend in the following way:

> “there appears to be a clear early Middle Woodland surge, culminating in a Mandeville phase peak. . . . This is followed by a fairly dramatic drop in site frequency during the Kolomoki phase. Again the same phenomenon is . . . probably also [present] in the Andrews Lake data, where Belovich et al. (1982:475) identify only three “Late Swift Creek-Early Weeden Island” components (these apparently would correspond to our Kolomoki and Quartermaster phases combined).”

What the data do not speak to is the permanency of occupation following the decline in the number of sites. An increase in the number of sites following ca. A.D. 400 could reflect a rebound of the population through time, but it could also reflect an increase in the frequency with which groups moved around the landscape. The data on site size, intrasite spatial patterning, storage-feature size and density, and the like needed to sort this out are not readily available but probably could be compiled from existing survey and site reports. It also will be important to revisit the survey data from all three major projects within the study area in an effort to recode the sites in terms of the newly refined phases, those described in Chapter 5 and aligned against absolute time as in Section 6.3 (to follow). The hypothesized second decline in population in the late Weeden Island phase might become apparent if these data were cast against a finer-grained chronology.

### *Climate Trends in the Woodland Period*

A host of recent studies present convincing evidence for temporal and causal links between multidecadal scale and longer climate shifts and human adaptive responses to those shifts that altered the social landscape in archaeologically detectible ways (Benson 2007; Benson *et al.* 2009; Jones and Schwitalle 2008; Kohler *et al.* 2008;

Zhang *et al.* 2008). Increased research in this area is driven by an increase over the last decade in the quantity and quality of paleoclimatic records (Charman *et al.* 2006). In the Deep South, however, few records cover the time period of interest here and most of those that are available lack the fine-grained temporal resolution needed to examine climate change on a scale of less than a century. Tree-ring data are the only available paleoclimate data that provide the appropriate temporal resolution required for the current study.

The Palmer Drought Severity Index, or PDSI, is a composite measure of water availability that takes into account the condition of soil moisture, which itself is affected by temperature and precipitation (Cook and Krusic 2004 and Cook *et al.* 2004). These factors, when combined, are a better predictor of tree growth than is any one measure alone (Speer *et al.* 2009:510; Henderson and Grissino-Mayer 2009:38). As such, tree-ring width data from climatically sensitive tree species can be used to reconstruct past PDSI values. PDSI values are "a well-known and widely used measure of drought and wetness" (Cook et al. 1999:1145) and are reported on a scale centered on 0. PDSI values above 1 indicate wet regimes, with values above 4 indicating severe conditions, while PSDI values below 1 indicate dry regimes, with values below 4 also indicating severe conditions. Although PDSI values have been used by climatologists since the 1960s, only recently have attempts been made to extend those values back in time in order to evaluate paleoclimate.

A decade ago, Cook *et al.* (1999) used point-by-point regression (PPR) to reconstruct PDSI values at 155 equally spaced grid points across North America interpolated from 425 unevenly spaced but climatically sensitive tree-ring chronologies. Their work was based on earlier efforts of Karl and Koscielny (1982), who had interpolated a 60-point grid of PDSI values from statewide temperature and precipitation averages during the modern period. For each grid locale, Cook *et al.* (1999:1147) implemented a 450-km search radius, or neighborhood, for usable tree-ring chronologies and produced a set of test statistics to validate the results.

In their 1999 paper, Cook *et al.* dealt with period from 1700 to 1978, but more recent work has produced interpolated PSDI values that reach much farther back in time, depending on the available tree-ring chronologies in the neighborhood of a given grid point. These data are available on line (Cook *et al.* 2004, 2008). Two grid points, 230 and 231, occur within or near the study area (Figure 46) and have PDSI reconstructions that begin at A.D. 365 (Figure 47 and 48). These data present an opportunity to compare changes in drought and wetness to changes in the archaeological record that are inferred to reflect shifts in settlement, subsistence, and population dynamics.

Although several tree-ring chronologies exist in the Deep South, only a couple of sequences actually begin earlier than ca. A.D. 800. The closest ones to the study area are ancient bald cypress sequences from the Black River locale in North Carolina, some 500 miles northeast of Grid Point 231 (Stahle *et al.* 1988); they are some of the oldest tree-ring sequences in eastern North America (Edward Cook, personal communication, 2009). Despite their distance from the study area, these tree-ring sequences and the PSDI reconstructions on which they are based can be used as proxies for Woodland-period paleoclimate because, as Karl and Koscielny (1982) suggest and Cook *et al.*

(1999:1147) confirm, “drought (in the U.S.) is a regional- or mesoscale phenomena.” One climate zone highlighted in the Cook *et al.* (1999:1154) analysis maps onto the Southeast region. Therefore, although one would hope ultimately to increase the tree-ring samples that inform the reconstructions for the period and locations considered here, the current reconstructions should adequately and with some fidelity capture the decadal and multidecadal trends in paleoclimate of the lower Chattahoochee-Apalachicola region.

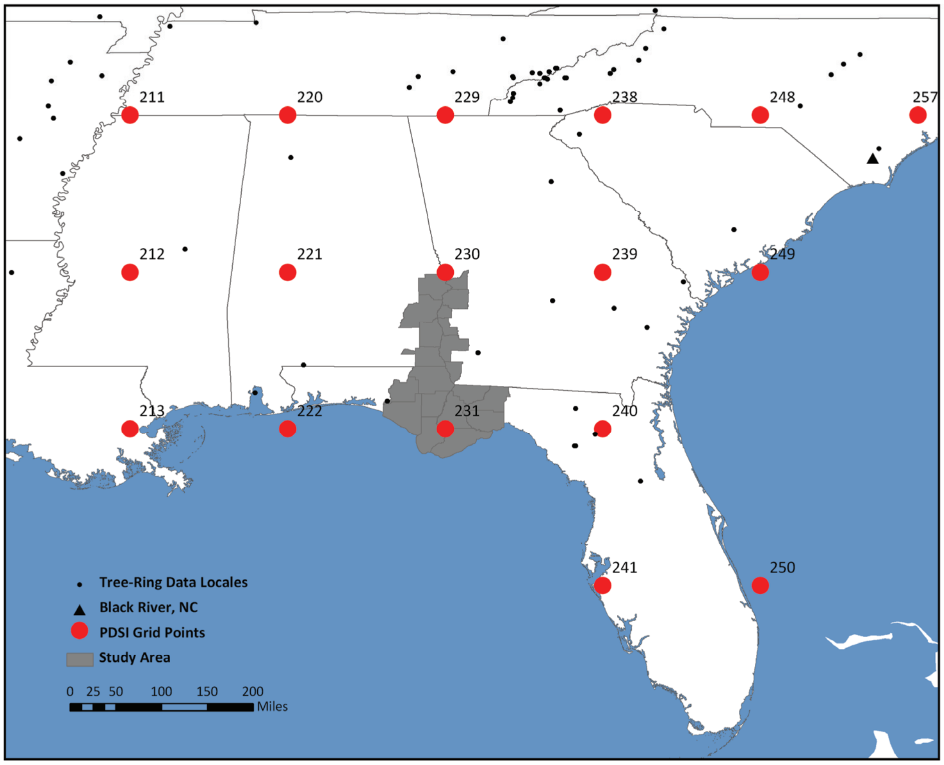
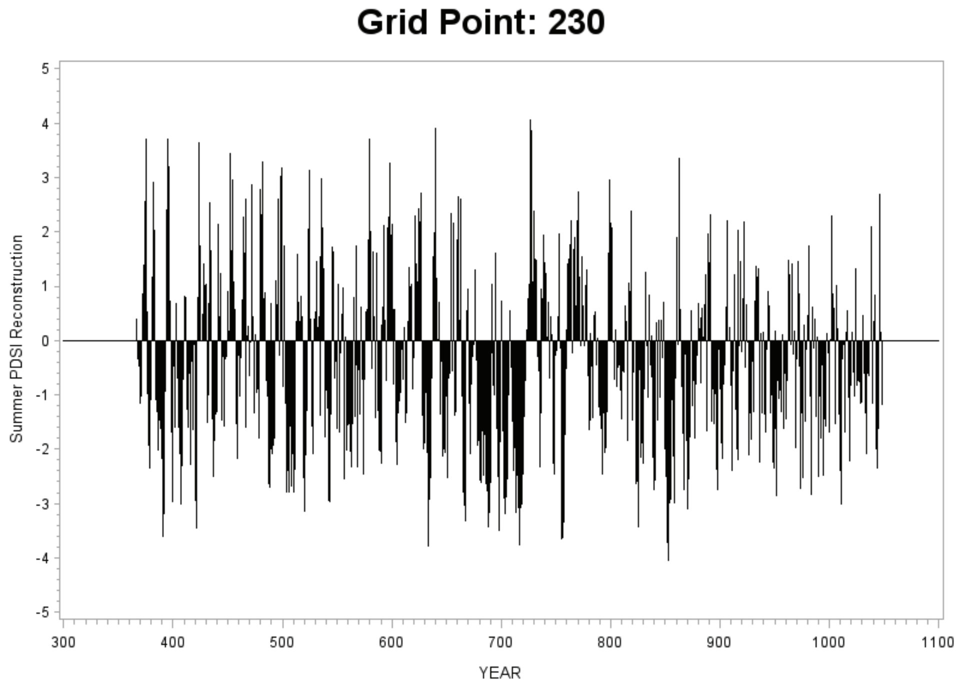
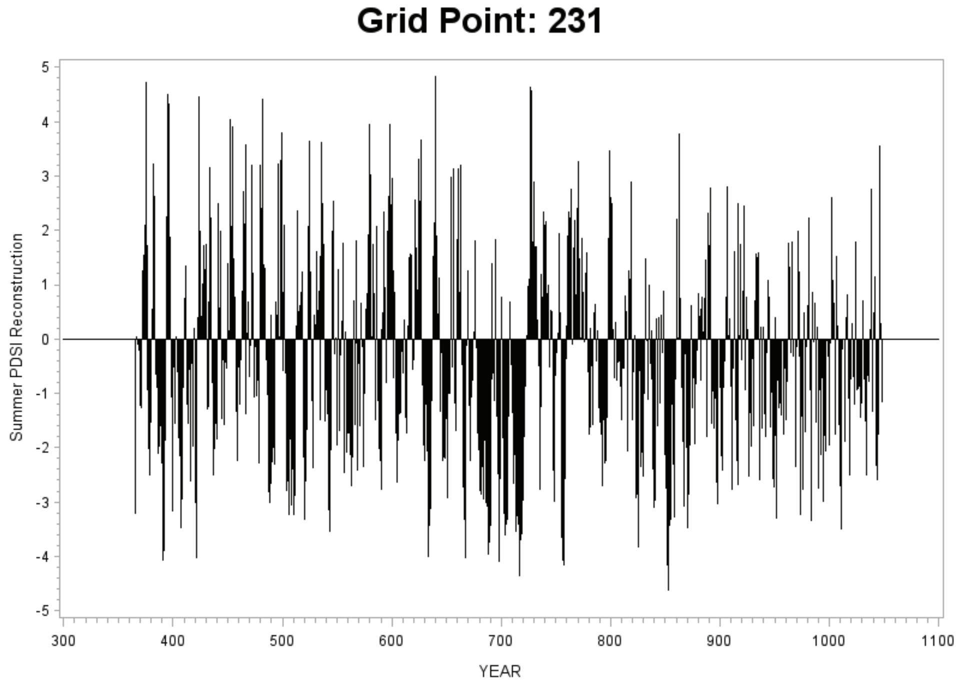


*Figure 46. PDSI reconstructions for the Deep South (Cook and Krusic 2004, 2008).*



Source: The North American Drought Atlas Cook and Krusic (2008)

*Figure 47. PDSI reconstruction for grid point 230.*



Source: The North American Drought Atlas Cook and Krusic (2008)

*Figure 48. PDSI reconstruction for grid point 231.*

The PDSI reconstructions show considerable year-to-year variation, but persistent interannual trends above and below a PSDI of 0 can be seen in the above figures. One way to capture these longer temporal trends is to smooth the data based on some predefined criteria. Most studies that use PSDI data calculate simple moving averages, or low-pass filters (e.g., Benson *et al.* 2009; Herweijer *et al.* 2006) and cubic splines (e.g., Stahle *et al.* 1988) to smooth the data across the time period of interest. Here, I use the loess function in SAS to calculate smoothed, or predicted, values. Loess, or locally weighted polynomial regression, is mathematically more robust and computationally more involved than moving averages and cubic splines, in part because loess does not give equal weight to all point values within the neighborhood of the target point. Rather, points closer to the target point are given more weight in the regression than points farther away. The function "Proc loess**"** uses a tricube weight function to assign a weight to each point in the local neighborhood. The smoothing parameter, or neighborhood value, was selected using an automatic method called the $AIC_C$, or corrected Akaike information criterion, a common parameter selection method in regression analysis. In the case of Grid Point 230, the $AIC_C$ produced a smoothing parameter of .081, or 55 points out of 684 in the local neighborhood of a given point. For Grid Point 231, $AIC_C$ identified .084 as the global minimum, or 57 points out of 684 in the local neighborhood. Smaller smoothing parameters reduce the number of local neighbors and more closely mimick the annual variation present in the actual reconstructed data. Larger smoothing parameters include more local neighbors but risk masking the bi-decadal variation of interest here. Temporal trends of less than a decade or two, while potentially relevant in prehistory, are virtually impossible to compare to the archaeological record given the nature of our time-averaged assemblages. Climatic trends of greater than a century or so also are potentially relevant but risk cross cutting the archaeologically defined phases. Thus, selection of the smoothing parameter is an important consideration not only in terms of mathematical robusticity but also in terms of archaeological inference.

The average smoothed PDSI value across the period is -.42 for Grid Point 230. Smoothed subperiods whose intraperiod average is significantly above or below the overall average, marked by a solid line, are denoted by bars along the x-axis in Figure 49 and 50. Significance in this case is measured with a *t*-test between the overall smoothed mean and each subperiod smoothed mean. Recall that the Late Woodland period as defined here begins at A.D. 400. Thus, the climate record begins at the close of the Middle Woodland period. Clearly, for much of the early Late Woodland period averages remain above the mean, and for much of the late Late Woodland period shorter periods of either above or below average precipitation are the rule. However, four periods of prolonged and notable lower than average rainfall mark the sequence. Only three will be discussed, as the fourth falls at the tail end of the time period of interest. The first, with a smoothed average of -.62, is early in the Late Woodland period, from A.D. 388 to A.D. 420, a period of 33 years. The second prolonged drought occurs between A.D. 659 and A.D. 724, a 66-year period with an average smoothed PSDI value of -1.18. The third and longest period runs from A.D. 811 to A.D. 891, or 81 years, and has a smoothed and statistically significant average of -.83. Grid Point 231 reveals a very similar temporal trend in reconstructed and smoothed PDSI values (Figure 50). Interpolated maps show some of the spatial patterns in drought highlighted by the analysis (Figures 50–53).

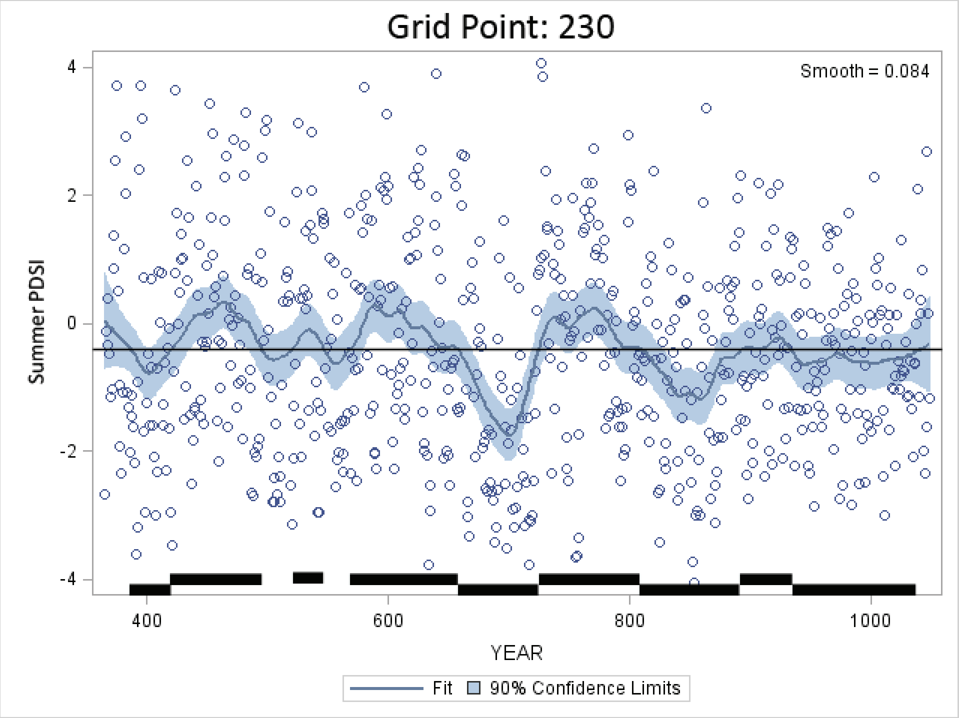


*Figure 49. PSDI reconstruction with loess smoothing for grid point 230.*

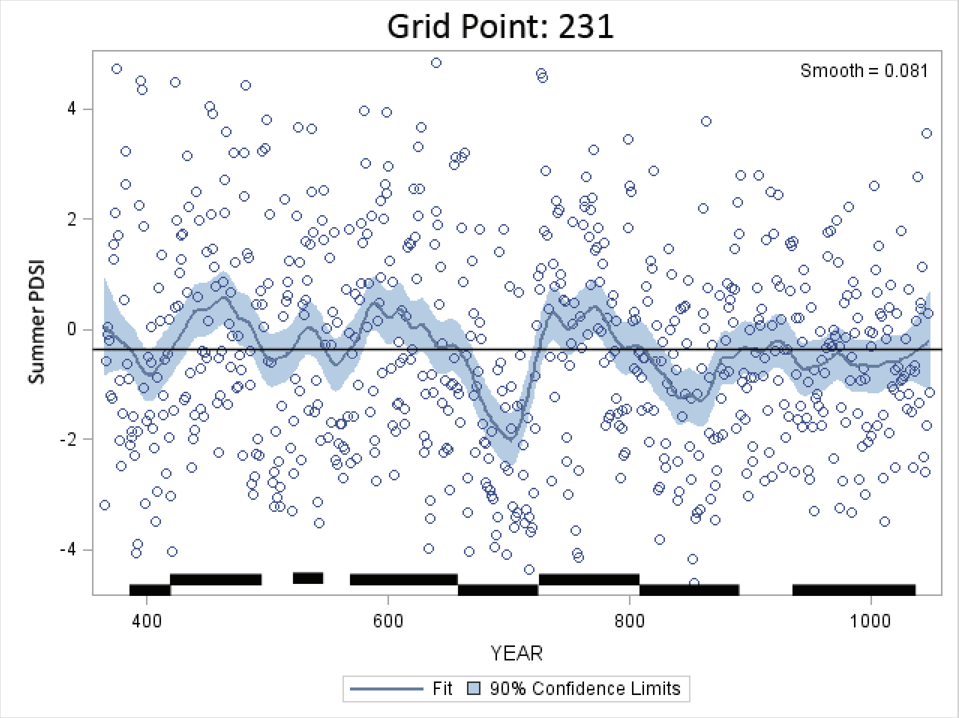


*Figure 50. PSDI reconstruction with loess smoothing for grid point 230.*

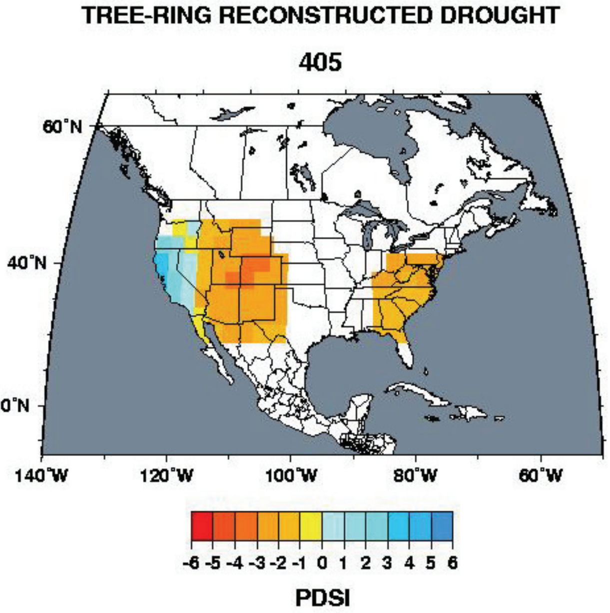


*Figure 51. Tree-ring reconstructed drought for A.D. 405 (Cook and Krusic 2004).*

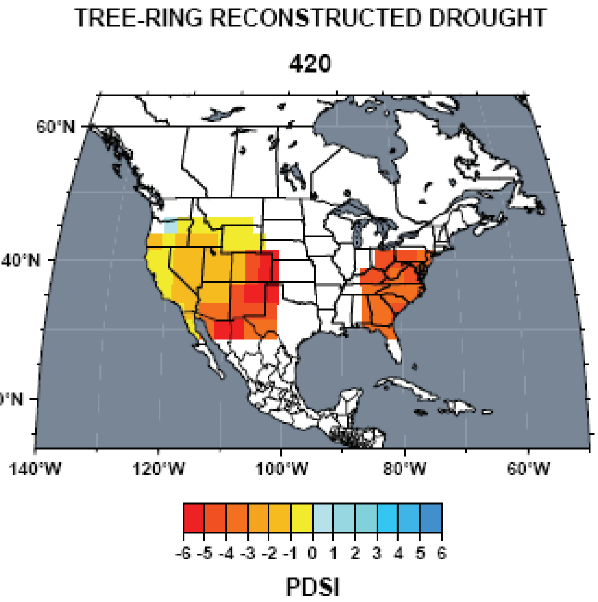


*Figure 52. Tree-ring reconstructed drought for A.D. 420 (Cook and Krusic 2004).*

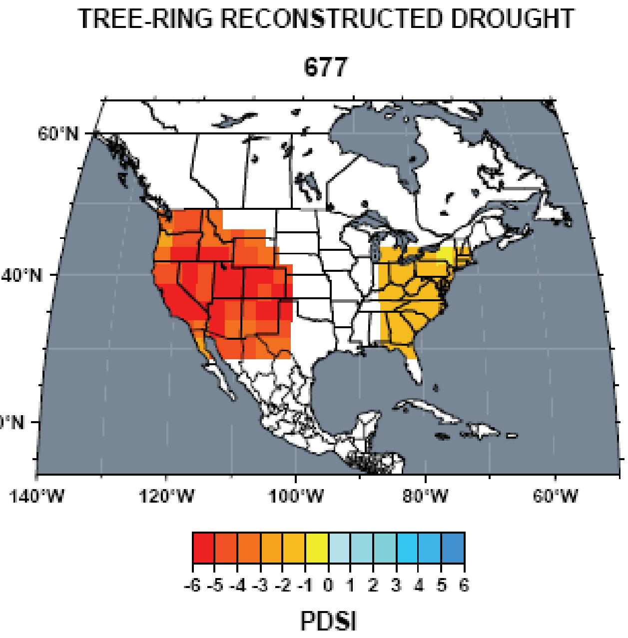


*Figure 53. Tree-ring reconstructed drought for A.D. 677 (Cook and Krusic 2004).*

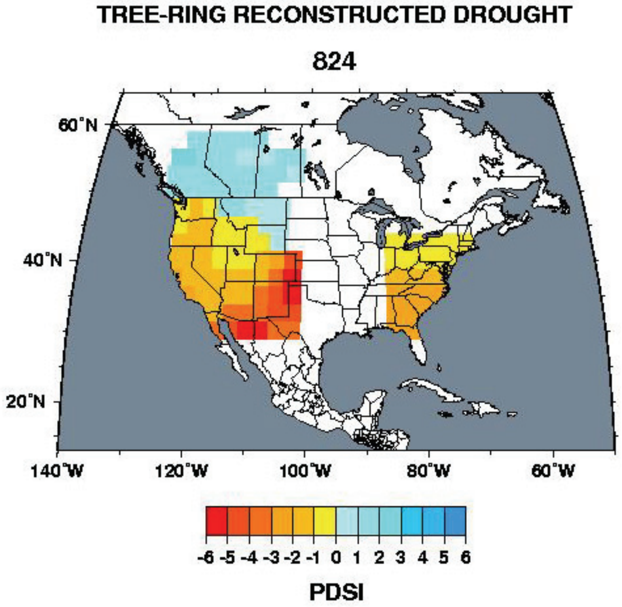


*Figure 54. Tree-ring reconstructed drought for A.D. 824 (Cook and Krusic 2004).*

### *Rectifying the Ceramic, Radiocarbon, and Climate Datasets*

The drought-severity index, described above, highlights four prolonged periods (> 25 years) of statistically significant below-average rainfall, based on local weighted smoothing of the reconstructed PDSI data. The first occurred at the end of the Middle Woodland period, ca. A.D. 388 to A.D. 420, and the second and third occurred during the Late Woodland period, ca. A.D. 659 to A.D. 724 and ca. A.D. 811 to A.D. 891, respectively. The fourth occurs at the close of the Late Woodland period, ca. A.D. 934–1039. The next step is to see if the periods thought to be marked by increased mobility correspond to the climatic changes, such that the latter could be hypothesized to have precipitated the former. However, reconciling these potentially important climatic episodes with the ceramic dataset is not straightforward because one dataset charts change on an absolute time scale whereas the other charts change on a relative time scale. In order to make such comparisons a reality, the ceramic chronology must be scaled in relation to absolute time (e.g., Knight *et al.* 1999).

The easiest way to approach the effort is to compare the published phase date ranges to the climate data. But this approach, though expedient, is not very robust in this particular case. With the exception of the Kolomoki site and its associated site-specific phases (Pluckhahn 2003), the published Middle and Late Woodland–period phase dates were last evaluated more than 20 years ago, and they were not considered against any formal seriation model, although ceramic seriation no doubt played some role in establishing the phases (Mistovich and Knight 1986). We have at our disposal now a ceramic seriation based on a formal model of temporal change and an inventory of 33 radiocarbon dates that can be more or less associated with the ceramic assemblages used in the seriation. In this section I use the former (ceramic chronology) to inform the latter (radiocarbon chronology) by calling on Bayesian statistics that will allow us to invoke our prior knowledge of the archaeological record. This procedure accomplishes two goals. First, the method allows for the detection of outliers in the radiocarbon dataset, i.e., it identifies those radiocarbon dates that do not agree with the relative order of the phases they are supposedly dating. Second, once the most probable outliers are identified and either removed or down-weighted, the method produces posterior distributions for the radiocarbon dates using prior knowledge of the relative chronology. The information is used to calculate boundaries for the phases, and the new phase boundaries are employed to refine the regional ceramic periods listed in Table 1.

Before discussing the methods, a few additional comments regarding the radiocarbon dataset are necessary. First, the dataset is strongly weighted to interior riverine and wetlands sites, i.e., no Gulf Coast site or assemblage dates are available that can be directly tied to the ceramic seriation. This is a serious shortcoming but one that cannot be rectified at present. Clearly, future efforts should focus on obtaining samples from assemblages that come from coastal contexts, such as those sites included in the seriation from St. Andrews Bay. The dataset also is weighted strongly toward dates from a small number of sites. Of the 32 sites included in the regional seriation, only 10 have dated samples that can be confidently matched with seriated assemblages. Among these, Mandeville (9CY1) holds the lion's share of the radiocarbon dates (15 out of 33). As mentioned in Chapter 4, several phases either have no representative radiocarbon dates—Swift Creek, Hare's Landing, and Late Weeden Island phases—or have dated samples from only one site within the phase—Shorter, Kolomoki II, and Sycamore phases. The ideal dataset for this type of analysis would be a large number of radiocarbon dates, probably at least 45 (Ottaway 1986:736–737), from a geographical and temporal cross section of sites using the ceramic seriation to guide selection of sites and contexts. These caveats must be considered and make any interpretations that hinge on absolute dating of the phases hypotheses at best. That said, it is too tempting not to try to make some sense of the radiocarbon dataset in its current state. If the results come close to the expected patterns, where the inferred ceramic chronology and the climatic record show some accord on the basis of the current dataset with all its weaknesses, then the call for more and better data can be made with strong justification.

Only one date (M-1043) among the 33 total dates in the set is obviously an extreme case, being between 800 and 1,000 radiocarbon years too recent for the context, thus I remove it. A second date (I-7258) comes from an apparent composite sample of nuts and seeds, and possibly maize kernels, from a refuse filled pit inside the domestic structure at Sycamore (8GD13) (Milanich 1974:15). Given the lack of published information on the date, such as whether or not the date reported represents the measured age or the corrected age, an important consideration if the composite sample actually contained corn as the feature did, I exclude the date. Excluding M-1043 and I-7258 leaves a sample of 31 dates that can be associated with the ceramic assemblages used to build the regional chronology. Among those remaining, several dates appear to be either slightly too early or slightly too late given their assemblage's relative position in the seriation, causing some overlapping of date ranges between assemblages assigned to different phases, or what Sharon (2001:245) referred to as a case of "fuzzy" dating. What is needed is a method or a set of methods that will objectively evaluate which dates are mostly likely outliers given their respective phase assignments and allow us either to exclude them from or down-weight them in subsequent analyses. OxCal v. 4.1.1 offers several functions that when used in combination do just that.

All of the calibrations and analytical manipulations are performed in OxCal v4.1.1 (Bronk Ramsey 2001, 2009). The latest version, released in 2009, offers what is called outlier analysis, an approach that asks how likely is it for any individual measure to be wrong and then provides a choice of models to determine how the measure should be revised, in addition to allowing phase groupings to model posterior probability distributions using the sequence and phase commands (Bronk Ramsey 2009:3). In previous versions of OxCal, the outlier analysis was not an operational option; the sequence and phase commands, however, would return a set of agreement indices that reflected the agreement of each date in the group as well as the overall agreement of the modeled sequence. Using the outlier analysis and the sequence model in tandem provides both a probability assessment for outliers and an agreement measure for each date.

The OxCal sequence model and outlier model assign an agreement index (A) and an outlier posterior and prior probability (O), respectively, during analysis. The outlier model chosen for this analysis is the one Bronk Ramsey (2009:6–7) advises is the best choice for most radiocarbon-dating applications, particularly those where the offsets should be made on the time scale rather than the radiocarbon scale. The outlier model employed in the analysis is identified as the general model (Bronk Ramsey 2009:7):

```
Outlier_Model(“General”,T(5),U(0,4),“t”);
```

The model “defines [both] how the outliers are distributed” and how the outliers should be scaled (Bronk Ramsey 2009:3–4). The general model “draws from a long-tailed [student-t] distribution . . . [with 5 degrees of freedom so that it] will not be too affected by the odd extreme outlier” (Bronk Ramsey 2009:7). The scale of the offset is unknown so a uniform distribution with a range of 0 to 4, or between 1 and 10,000 years, is specified for scaling outliers (Bronk Ramsey 2009:5). The prior probability of a date being an outlier is set at 10%, or a 1 in 10 chance that the date should be rejected. This is part one of the analysis. In part two, the analysis of sequences and phases, OxCal v.4.1.1 implements a Markov Chain Monte Carlo (MCMC) sampling approach that assumes "events groups between two boundaries [are] uniformly distributed over a limited range of time [and] . . . the boundaries themselves are uniformly distributed over a limited range of time" (Bronk Ramsey 2001:357). If the sequence model returns an agreement score of 60 or higher, the model is considered acceptable (Bronk Ramsey 1995:428, 2009:3; see also the program manual and references therein at http://c14.arch.ox.ac.uk/embed.php?File=oxcal.html).

In the first run, the dataset included all 31 dates grouped by phases into a defined sequence that specified the order among the phases but did not impart an order to the dates within a phase (Figure 55). As anticipated, several dates were considered likely outliers [see Appendix 14 for the CQL code (Bronk Ramsey 1998) and numerical results of the first analysis]. Among the most probable outliers were Beta-230757 (a recently obtained date from Shorter) and DIC-3269 and DIC-3268 (both from the refuse-filled pit beneath the stone mound at 9QU58). Dates with high posterior probabilities of being an outlier are not included in the posterior, or modeled, distributions, hence the high agreement score, as in Beta-230757 (A:74 O:71/10). Dates with posterior outlier probabilities only moderately exceeding their prior probabilities are down-weighted but not excluded. In this run, the model agreement across the sequence is a low 50. Thus, some dates included, even though they are down-weighted, should probably be rejected.

Two dates (UGA-6B and UGA-9B) have moderately low agreement (A:35 and A:41, respectively) and moderately high outlier probability (O:20/10 and O:17/10, respectively). In the second run, these two dates were set to have a 50%, or 1 in 2, chance of being outliers. The results, shown in Figure 56, return a model agreement of 64, which now crosses the acceptable threshold for a good model but not by much (see also Appendix 15). In an effort to get stronger agreement, two additional dates (M-1044 and M-1046) were set to 50%. This resulted in a model agreement of 76, as shown in Figure 57, and is the model that will be used to assign revised absolute dates to phases (see also Appendix 16). Rejecting the moderate outliers, rather than allowing the model to down-weight them, is arguably defensible in this case given the heterogeneous nature of the sample collection strategies and the lab procedures across the whole radiocarbon dataset. Many dates were obtained early (ca. 1960s or 1970s) in a lab's history. Neither the University of Michigan not the University of Georgia radiocarbon dating labs appear to have published their sample pretreatment methodology, which gives the (false?) impression that sample pretreatment was not routine at that time. Some dates submitted to a variety of labs were run in the 1970s, 1980s, and a few as recently as last year (on samples collected in ca. 1960). Although interlaboratory variation should be accounted for in reported standard deviations, excavator sampling strategies and post-depositional movement of samples are not. In the present case, the samples within this 1000-year sequence come from a variety of contexts (mound strata, feature fill, middens, etc.), many of which were collected when radiocarbon dating was a bourgeoning field. Recent scrutiny of radiocarbon results obtained in the 1980s from Dicarb Radioisotope Co. (DIC), a company no longer in operation, indicates the radiocarbon assays in the study "tended to be younger than assays produced by other laboratories on crosscheck samples, with differences ranging between 350 and 1440 yr" (Reuther and Gerlach 2005:359). The three DIC assays included here do not seem younger than expected given the associated context. If anything, the two from 9QU58 seem somewhat older than one would expect. Nevertheless, the DIC dates probably should be excluded in future analyses, based on the compelling study cited above, and efforts to resubmit samples from 9QU58 and 9SW71 are warranted. In sum, the potential for all sorts of error is both great and unknowable, making objective but non-statistical evaluation of individual dates virtually impossible.

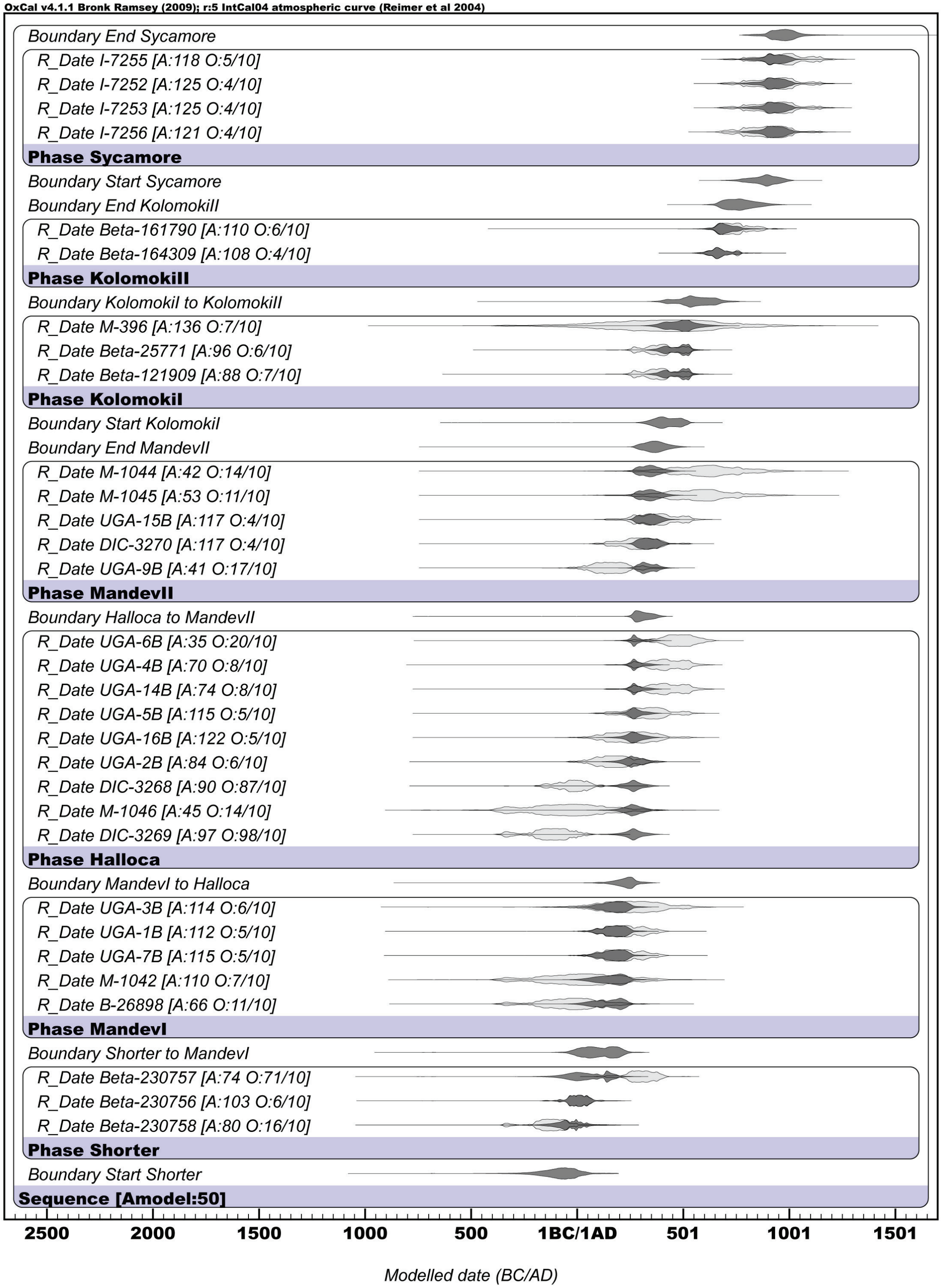


*Figure 55. Outlier analysis with 50% sequence model agreement.*

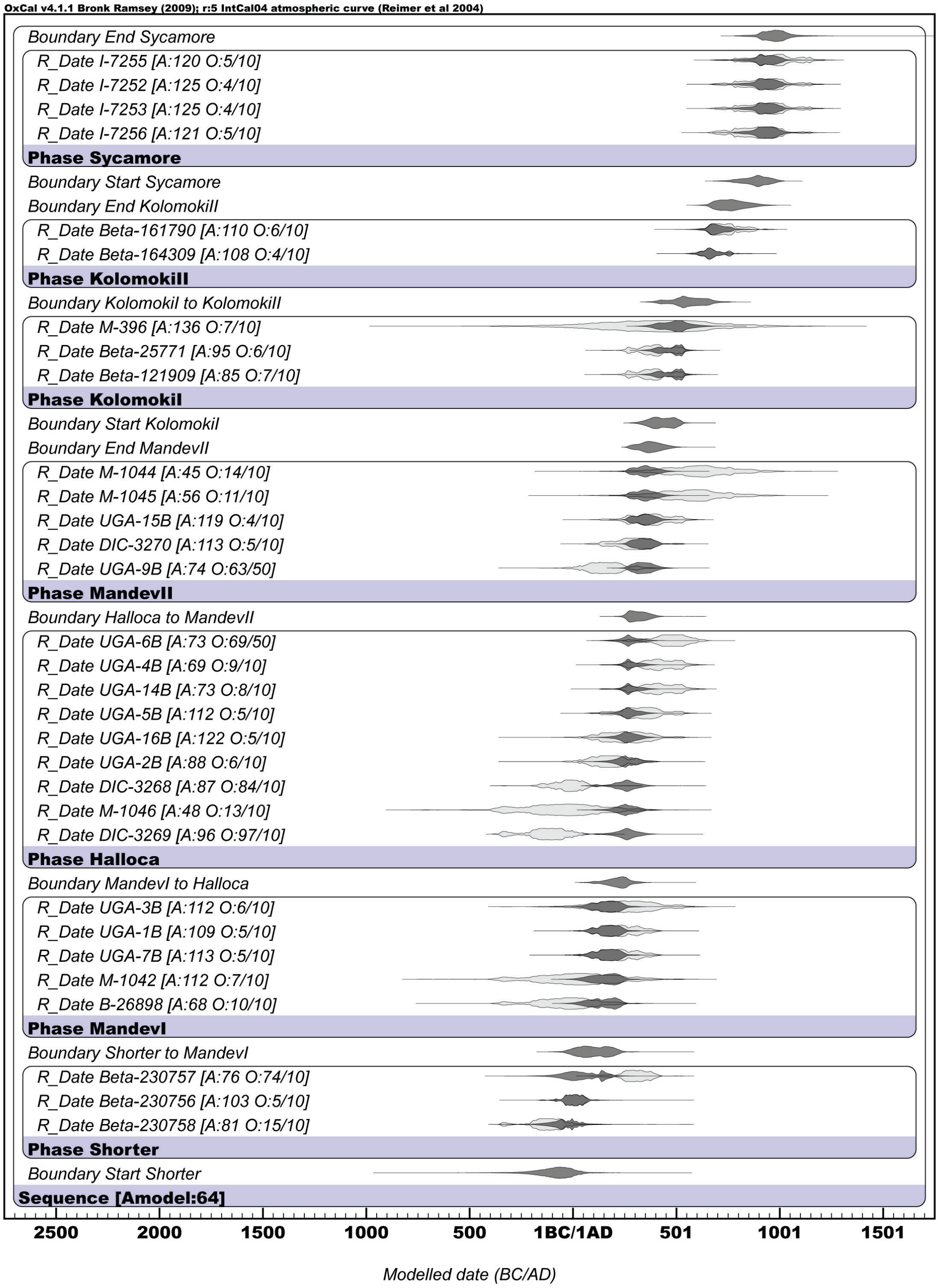


*Figure 56. Outlier analysis with 64% sequence model agreement.*

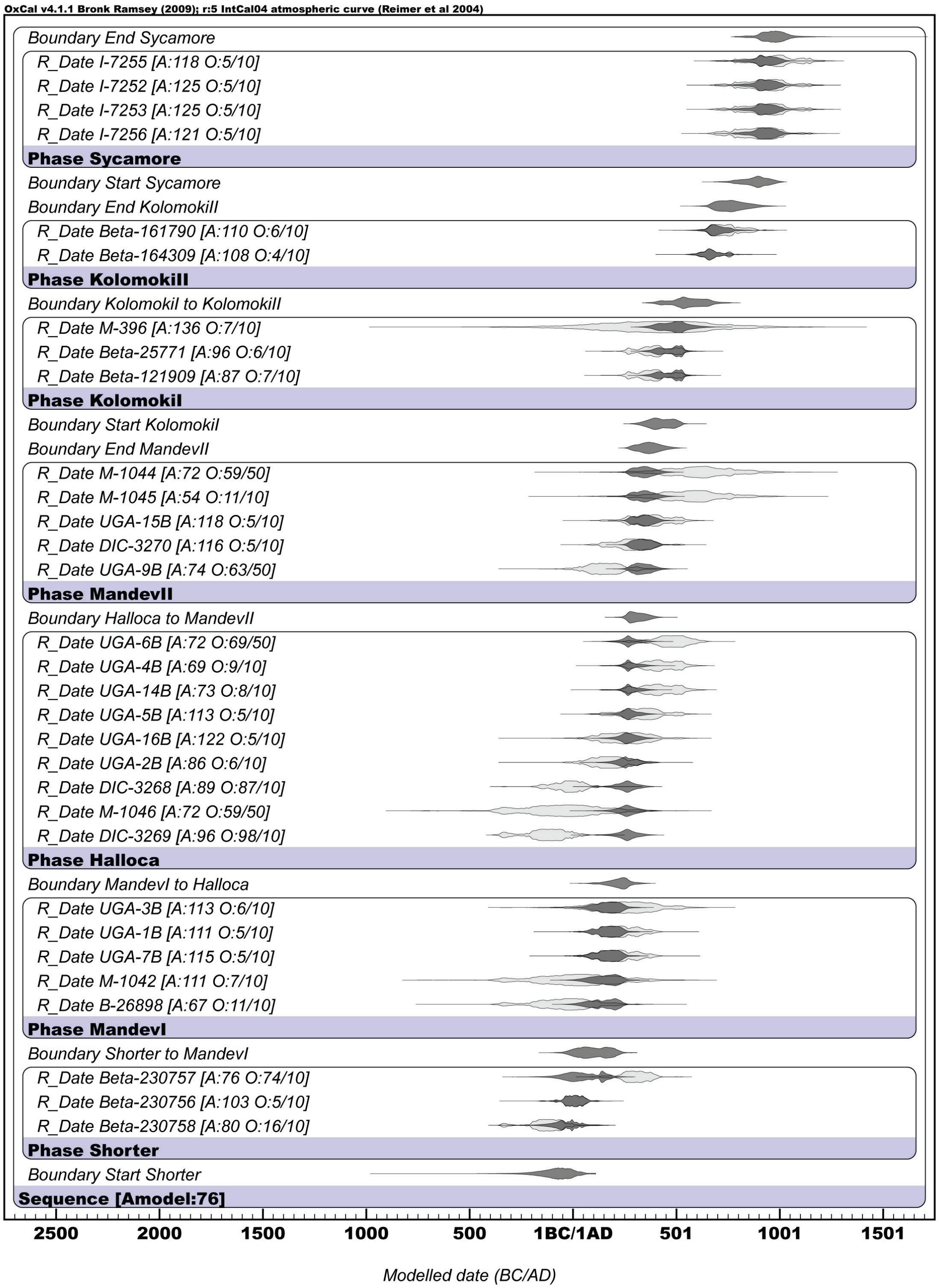


*Figure 57. Outlier analysis with 76% sequence model agreement. In this final run, two additional dates (M-1044 and M-1046) were weighted with a 50% chance of being outliers.*

The next step is to see how the newly modeled phase boundaries compare to the original phase boundaries. The comparisons are made using the modeled mean phase ending or starting boundary rounded to the nearest 10 years (Table 5). The modeled standard deviations and both the original and modeled (mean) durations are included for reference. The Swift Creek and Late Weeden Island phase estimated end dates represent the mean modeled start of the next phase, given that no radiocarbon dates are available for assemblages assigned to these phases. The Hare's Landing phase boundaries cannot be estimated at this time because the next phase also lacks radiocarbon dates and, hence, has no modeled start date. As illustrated in Table 5, the modeled phase end dates are within 20 to 60 years of the previously defined phase end dates for the last five phases (Kolomoki I to Sycamore). However, for the first five phases (Shorter through Swift Creek) the estimated end dates are off by between 70 and 120 years. This result is not terribly surprising because, until recently, no radiocarbon dates for the Shorter phase were available. In at least one case, the Swift Creek phase, the posterior estimated boundaries seem to be on par with more recent interpretations that date the mound at Swift Creek type site near Macon, Georgia, between A.D. 350 and A.D. 400 (Price 2003:9) and seriate the stratified mound assemblages squarely within the Swift Creek phase as defined for the lower Chattahoochee-Apalachicola-Gulf Coast (Smith and Neiman 2007:56). The modeled mean durations are very close to the original estimates. Overall, the results are encouraging, and the correspondence in results between each of the three models suggests we are on the right track.

Table 5. Modeled and Original Phase End Dates.

| N | | Estimated End Dates (A.D.) | | | | Duration | |
|---|---|---|---|---|---|---|---|
| Dates | Phase | A:50 | A:64 | A:76 | Original | Modeled | Original |
| 4 | Sycamore | 970±70 | 980±70 | 970±70 | 950 | 90±80 | 100 |
| 0 | Late Weeden Island | 880±60 | 880±60 | 880±60 | 850 | 110±70 | 50 |
| 0 | Hare's Landing | ? | ? | ? | 800 | | 50 |
| 2 | Kolomoki II | 770±70 | 770±70 | 770±70 | 750 | 210±110 | 250 |
| 3 | Kolomoki I | 560±80 | 560±80 | 560±80 | 500 | 130±90 | 150 |
| 0 | Swift Creek | 420±60 | 430±60 | 430±60 | 350 | 60±50 | 50 |
| 5 | Mandeville II | 370±50 | 380±50 | 370±50 | 300 | 60±50 | 100 |
| 9 | Halloca Creek | 310±50 | 320±50 | 310±40 | 200 | 90±70 | 100 |
| 5 | Mandeville I | 220±70 | 220±60 | 220±50 | 100 | 120±90 | 100 |
| 3 | Shorter | 100±90 | 100±70 | 100±70 | 1 | ? | ? |

The refined absolute dates for each of the phases can now be compared to the reconstructed and smoothed PDSI values (**Table 6**). Grid Point 230 will be used in the comparison (Figure 58). Recall based on the diversity and distance results that two phases, Swift Creek and Late Weeden Island, were thought to mark a shift toward increased residential mobility brought on by population crashes and culminating in positive correlations in diversity and distance residuals during the subsequent phases (Kolomoki I and Sycamore). If climate is a major factor affecting subsistence and population density, then significant climate anomalies should occur during the Swift Creek and Late Weeden Island phases. The Swift Creek phase coincides quite well with the earliest inferred drier period at the close of the Middle Woodland period. The Late Weeden Island phase, though difficult to date with certainty, must also fall within the third or last major drought within the Late Woodland period, given the dates for the bracketing phases.

The only climate anomaly that is significant in both magnitude and duration but whose impact does not seem to be captured by the ceramic analyses performed here is the one covering the period from A.D. 667 to A.D. 722. Given the current radiocarbon and ceramic datasets, this prolonged period of below-average rainfall occurs squarely within the Kolomoki II phase. Because Kolomoki II phase assemblages also showed a positive correlation in distance and diversity residuals, some degree of residential mobility can still be inferred. Perhaps, then, residential mobility continued to buffer groups against climatic fluctuations and drought such that the impact of a change in rainfall is undetected in the current data. If this were the case, then residential stability should be present only after annual summer rainfall returned to a more normal range. In other words, archaeologically detectible signatures of residential stability within the study area should post-date ca. A.D. 722.

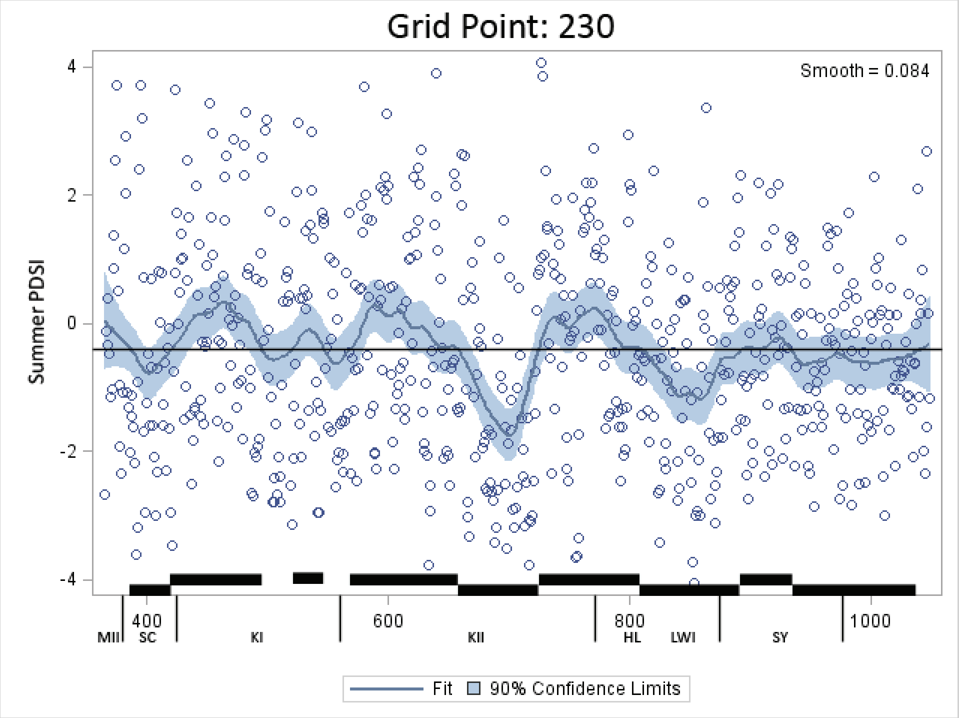


*Figure 58. Grid point 230 with phases.*

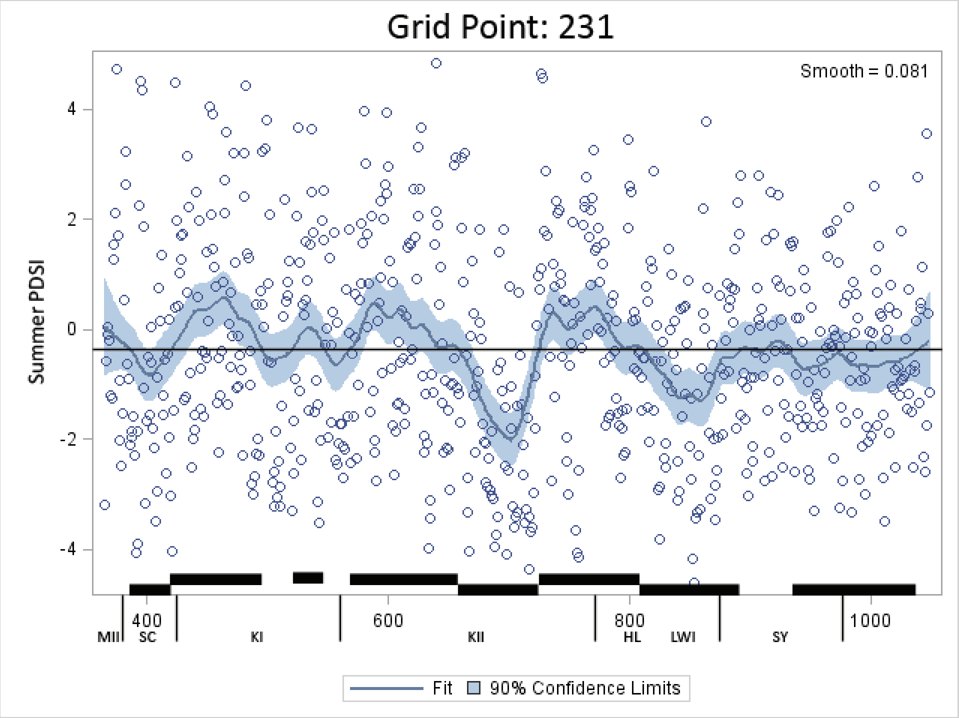


*Figure 59. Grid point 231 with phases.*

Table 6. Summer PDSI Trends at Grid Points 230, 231.

| Grid Point: 230 | | | | | Grid Point: 231 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Range | Span | Mean PDSI | Departure from Average | T-Test Significance | Range | Span | Mean PDSI | Departure from Average | T-Test Significance |
| 934-1039 | 106 | -0.568 | Dry | 0.0006 | 933-1037 | 105 | -0.606 | Dry | 0.0000 |
| 892-933 | 42 | -0.176 | Wet | 0.0367 | 911-932 | 22 | -0.295 | | 0.1737 |
| | | | | | 904-910 | 7 | -0.220 | | 0.4789 |
| | | | | | 891-903 | 13 | -0.363 | | 0.4047 |
| 811-891 | 81 | -0.836 | Dry | 0.0000 | 813-890 | 78 | -0.900 | Dry | 0.0000 |
| 725-810 | 86 | -0.069 | Wet | 0.0000 | 725-812 | 88 | 0.023 | Wet | 0.0000 |
| 659-724 | 66 | -1.182 | Dry | 0.0000 | 660-724 | 65 | -1.348 | Dry | 0.0000 |
| 568-658 | 91 | -0.072 | Wet | 0.0000 | 568-659 | 92 | 0.121 | Wet | 0.0000 |
| 548-567 | 20 | -0.553 | | 0.0871 | 550-567 | 19 | -0.548 | | 0.1092 |
| 521-547 | 27 | -0.220 | Wet | 0.0086 | 520-548 | 29 | -0.175 | Wet | 0.0044 |
| 496-520 | 25 | -0.516 | | 0.1374 | 497-519 | 23 | -0.512 | | 0.1525 |
| 421-495 | 75 | 0.034 | Wet | 0.0000 | 420-496 | 77 | 0.178 | Wet | 0.0000 |
| 388-420 | 33 | -0.620 | Dry | 0.0041 | 388-419 | 32 | -0.656 | Dry | 0.0038 |
| 365-387 | 23 | -0.181 | Wet | 0.0040 | 365-387 | 23 | -0.169 | Wet | 0.0195 |

# CHAPTER 7. SUMMARY AND CONCLUSIONS

A host of archaeological and ethnographical studies point to the dynamic nature of human social relationships. Understanding the dynamic history of these relationships in the Chattahoochee-Apalachicola-Gulf Coast region was the ultimate goal here. Initially, research was aimed at documenting the waxing and waning of interregional interaction on the regional scale, but the results have allowed inferences to be made that seem to have less to do with interregional connections than was expected. With the use of theoretical models and a chronologically fine-grained dataset, the historical picture that emerges is one involving fluctuating and fluid populations, marked by a decline ca. A.D. 388 in population densities that, coincidentally or not, corresponds to a regional reduction in rainfall as inferred from tree-ring data.

The impact of drought on the hunter-gatherer subsistence regime is debatable. But the specific response or outcome appears to be an increase in residential mobility, either in terms of distance or frequency, which may have culminated in a more formalized but periodic aggregated-dispersed residential strategy. A decline in population can be inferred from settlement data for two modern surveys within the study area and place the timing at the start of the fifth century, in line with a regional decrease in rainfall. Populations appear to rebound by the middle of the eighth century (Hare’s Landing phase), and residential mobility again becomes restricted as it likely was during the earlier Halloca Creek phase. Another prolonged drought beginning ca. A.D. 811 may have started the cycle again.

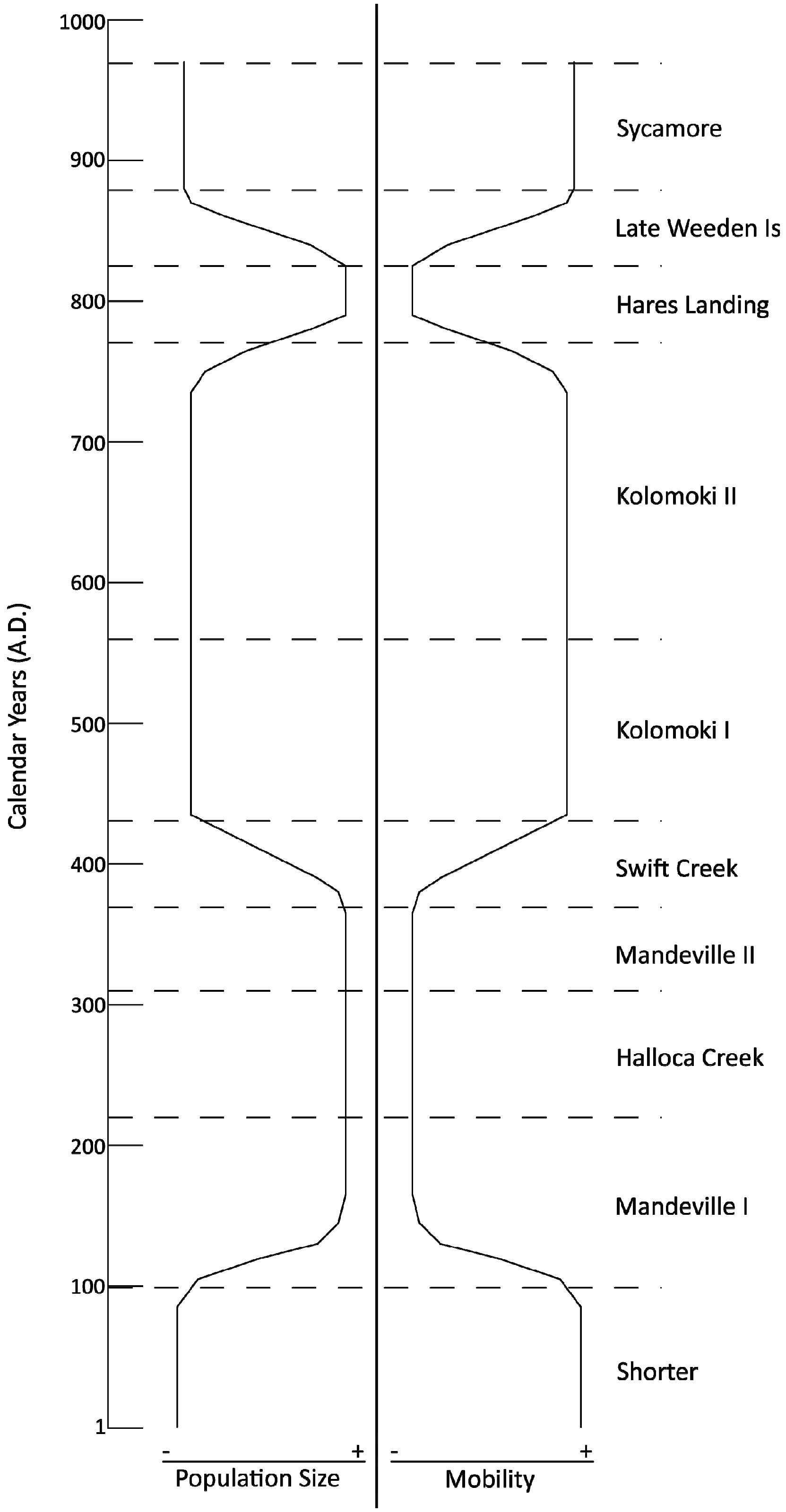


*Figure 60. Heuristic model of Woodland-period temporal change.*

A heuristic model of the temporal trend in population size and mobility is presented in Figure 60. The model suggests several lines of inquiry that would serve to test and refine it. Co-residential group size, perhaps inferred from site-component size, may positively scale with population size and negatively scale with mobility, although, recent work suggests it may not (Grove 2009). Subsistence intensification should characterize the periods of restricted mobility and greater residential stability, and an increase in diet breadth should be seen during higher mobility phases. Future work should focus on charting measures of diet breadth through time using the chronology presented here and targeting faunal collections that are or can be placed within the chronology.

One implication of this model that was briefly mentioned in Section 3.2 concerns the areal extent and intersite paddle connections of Swift Creek Complicated Stamped (SCCS). In Section 3.2, I discuss the wide distribution of pottery classifiable as SCCS and the numerous paddle or design matches found among sites often separated by great distances. The seriation presented in Chapter 4 demonstrates that the pottery type also has a lengthy temporal distribution, reaching a maximum in the Kolomoki I phase, dated to A.D. 430-560 based on the radiocarbon analysis described in Section 6.3. Although we know the temporal and spatial extent of SCCS, we are only beginning to understand how the spatial distribution fluctuated through time. Does the temporal maximum in the Chattahoochee-Apalachicola-Gulf Coast sequence correspond to the spatial maximum, or is the time-space relationship more complicated? The model above suggests that members of mobile groups were the makers of this pottery. Does mobility, rather than the ambiguous concept of interaction, account for the spatial patterning in the distribution of and intersite design connections in SCCS? In light of the current study, the answer would appear to be yes.

One region that may offer additional clues is the Ocmulgee-Big Bend to the east. Recent research suggests that Swift Creek pottery in that river valley appears later than it does within the Chattahoochee-Apalachicola Valley, with the timing of its initial dominance in lower Ocmulgee assemblages radiocarbon dated at ca. A.D. 400 (Stephenson and Smith 2008; Stephenson and Snow 2004). Design connections between the two valleys are strong, though unquantifiable at this time, and these connections, coupled with the new sequence and settlement model for the Chattahoochee-Apalachicola, suggest that Swift Creek people were in fact *highly* mobile and likely traveled in residential units between the two regions during the Kolomoki I and II phases. If we had a sufficient sample of designs from all Swift Creek sites in the Deep South to quantify and if we could control for sampling error and time, I suspect that aggregation sites would be readily apparent, as these sites should share more design connections with their contemporary dispersed counterparts than the dispersed sites share with each other.

So many of the sites discussed in this study have seen minimal testing. Fieldwork is expensive, time consuming, labor intensive, and hard to justify in this day and time outside the context of mitigation. And yet several sites, those fortuitously not built on or inundated, would seem to offer answers to some of the lingering questions this study has raised but is not positioned to resolve. No doubt extant collections from these sites would be a place to start, but many collections are inadequate in size. Kolomoki, obviously, is not among these. It has been thoroughly and systematically explored by two generations of archaeologists (Pluckhahn 2003; Sears 1956), and work at the site is ongoing (Thomas Pluckhahn, personal communication, 2009). Two other sites that should be revisited are Mound Field (8WA8) and Bird Hammock (8WA30), though I would not place Bird Hammock in the minimally tested category either (see site summary). I would single out Fox's Pond (8BY73) as a site in need of additional testing were it not apparently severely impacted by residential development. Mound Field and Bird Hammock are important not only because of their position in the Hare's Landing phase but also because earlier Woodland-period occupations are represented at those locations and site layouts include horseshoe-shaped ring middens. If Hare's Landing phase people did indeed become residentially more sedentary than their predecessors, one would expect to find clues to the nature of this new expression of residential stability at these two sites. Bird Hammock, in particular, seriated well internally, and the results, though not presented here, suggest the ring midden is a Hare's Landing–phase site feature; that is, earlier settlement at the site, including Swift Creek– and Kolomoki I–phase occupation, was smaller (?) and not spatially structured in the same way as the final site occupation.

Some of the details of the settlement and population model presented here may never find support through additional inquiry. Nevertheless, this study demonstrates that historical narratives can only be as detailed as the chronologies that frame them and the theoretical models that drive them. Longer-lived chronological units no doubt would have averaged out some of the trends in diversity and distance, but it is those very trends that beckon for explanation and send one in search of new data. Without the use of mathematical models, one would be left with ad hoc explanations and no clear paths for evaluating them. Any historical narrative of the Chattahoochee-Apalachicola-Gulf Coast that includes causal mechanisms must account for the large sites and the small sites, the mound sites and the nonmound sites, the coastal sites and the interior sites, the sites with considerable extralocal goods and the sites without those goods. Although I do not claim to have developed an inclusive narrative, as many questions remain, I suggest that variation in residential settlement strategies, which were fluid in response to regional climate trends and region-wide changes in population density, seems to account for more than one pattern in the archaeological record in this area. This is a start toward a regional history of the first millennium A.D. for the lower Chattahoochee-Apalachicola-Gulf Coast.

# APPENDICES

## 1. Ceramic Assemblage Inventories

| Assemblage | CA Phase | Deptford-Related Check Stamped | Fabric Impressed | Simple Stamped | Cord Marked | Santa Rosa Punctated | Curvilinear Complicated Stamped | Rectilinear Complicated Stamped | Santa-Rosa Related Stamped | Crystal River Negative Painted | Curvilinear Check Stamped | Ruskin Dentate | Red Filmed | Incised | Weeden Island-Related Punctated | Tucker Ridge Pinched | Net Marked | Cob Marked | Wakulla Check Stamped | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8LI8 | Sycamore | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 5 | 0 | 0 | 22 | 15 | 1 | 0 | 0 | 3643 | 3701 |
| 8FR4-10-1 | Sycamore | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 9 | 2 | 1 | 0 | 0 | 97 | 115 |
| 8GD13-Above Shell | Sycamore | 7 | 0 | 6 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 6 | 0 | 0 | 3 | 602 | 638 |
| 8FR4-10-3 | Sycamore | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 98 | 101 |
| 8GD13-Shell | Sycamore | 7 | 0 | 1 | 5 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 4 | 0 | 0 | 4 | 750 | 794 |
| 8GD13-Shell Contemp | Sycamore | 5 | 0 | 4 | 0 | 0 | 14 | 1 | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 0 | 0 | 10 | 479 | 521 |
| 8FR4-10-4 | Sycamore | 0 | 1 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 200 | 215 |
| 8FR4-10-5 | Sycamore | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 110 | 119 |
| 9SE102 | Sycamore | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 135 | 148 |
| 8JA233 | Sycamore | 0 | 0 | 0 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 5 | 2 | 2 | 199 | 222 |
| 8FR4-9-1 | Sycamore | 10 | 0 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 151 | 171 |
| 8GD13-Below Shell | Sycamore | 10 | 0 | 9 | 2 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 1 | 0 | 4 | 195 | 235 |
| 8WA13 | Sycamore | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 1 | 0 | 0 | 0 | 80 | 93 |
| 8FR4-9-2 | Sycamore | 0 | 1 | 3 | 2 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | 0 | 77 | 97 |
| 8BY137-TUs | Sycamore | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 93 | 116 |
| 8BY24 | Sycamore | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 2 | 30 | 20 | 7 | 0 | 0 | 275 | 341 |
| 8FR4-10-6 | Late Weeden Island | 1 | 0 | 2 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 2 | 21 | 6 | 0 | 0 | 0 | 50 | 89 |
| 8JA19 | Late Weeden Island | 0 | 0 | 0 | 1 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 5 | 24 | 22 | 0 | 0 | 0 | 92 | 168 |
| 8JA5 | Late Weeden Island | 0 | 0 | 1 | 0 | 0 | 26 | 0 | 0 | 0 | 1 | 0 | 0 | 21 | 22 | 0 | 1 | 0 | 48 | 120 |
| 8BY9 | Hares Landing | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 9 | 16 | 37 | 19 | 1 | 0 | 27 | 136 |
| 9SE33-Mid E | Hares Landing | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 11 | 30 | 73 | 3 | 1 | 0 | 1 | 136 |
| 8WA8-PI-2 | Hares Landing | 2 | 0 | 0 | 0 | 0 | 35 | 0 | 0 | 0 | 0 | 0 | 1 | 59 | 23 | 0 | 0 | 0 | 0 | 120 |
| 8WA30_100L60 | Hares Landing | 0 | 0 | 0 | 0 | 0 | 202 | 0 | 0 | 0 | 0 | 0 | 81 | 83 | 122 | 13 | 0 | 0 | 0 | 501 |
| 8BY73-0-20 cm | Hares Landing | 0 | 0 | 0 | 2 | 0 | 76 | 1 | 0 | 0 | 0 | 1 | 89 | 12 | 20 | 12 | 3 | 0 | 0 | 216 |
| 8WA30_155L220 | Hares Landing | 0 | 0 | 0 | 0 | 0 | 73 | 0 | 0 | 0 | 0 | 0 | 37 | 29 | 27 | 1 | 0 | 0 | 0 | 167 |
| 8FR2-PIII-2 | Hares Landing | 1 | 0 | 0 | 6 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 1 | 38 | 11 | 0 | 2 | 0 | 0 | 98 |
| 8FR2-PIII-3 | Hares Landing | 2 | 0 | 0 | 0 | 0 | 60 | 2 | 0 | 0 | 0 | 0 | 1 | 33 | 25 | 1 | 0 | 0 | 0 | 124 |
| 9ER1-TU9 | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 87 | 0 | 0 | 0 | 0 | 0 | 48 | 3 | 3 | 0 | 0 | 0 | 0 | 141 |
| 9ER1-TU18 | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 160 | 0 | 0 | 0 | 0 | 0 | 23 | 16 | 23 | 1 | 3 | 0 | 0 | 226 |
| 8BY73-20-40 cm | Kolomoki II | 0 | 0 | 1 | 1 | 0 | 184 | 2 | 0 | 0 | 0 | 0 | 28 | 12 | 13 | 1 | 9 | 0 | 0 | 251 |
| 9SE33-Mid J | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 5 | 2 | 1 | 0 | 0 | 82 |

| Assemblage | CA Phase | Deptford-Related Check Stamped | Fabric Impressed | Simple Stamped | Cord Marked | Santa Rosa Punctated | Curvilinear Complicated Stamped | Rectilinear Complicated Stamped | Santa-Rosa Related Stamped | Crystal River Negative Painted | Curvilinear Check Stamped | Ruskin Dentate | Red Filmed | Incised | Weeden Island-Related Punctated | Tucker Ridge Pinched | Net Marked | Cob Marked | Wakulla Check Stamped | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9ER1-Md. A | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 97 | 0 | 0 | 0 | 0 | 0 | 21 | 2 | 1 | 0 | 0 | 0 | 0 | 121 |
| 9ER1-TU7 | Kolomoki II | 0 | 0 | 0 | 2 | 0 | 83 | 0 | 0 | 0 | 0 | 1 | 6 | 10 | 4 | 1 | 0 | 0 | 1 | 108 |
| 9ER1-U2-SSB | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 455 | 0 | 0 | 0 | 0 | 0 | 30 | 26 | 18 | 0 | 1 | 0 | 1 | 531 |
| 9ER1-TU14 | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 139 | 0 | 0 | 0 | 0 | 1 | 15 | 3 | 4 | 0 | 0 | 0 | 0 | 162 |
| 8WA30_-160L45 | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 501 | 0 | 0 | 0 | 0 | 0 | 38 | 32 | 7 | 2 | 0 | 0 | 0 | 580 |
| 8WA30_-160L110 | Kolomoki II | 0 | 0 | 0 | 0 | 0 | 285 | 0 | 0 | 0 | 0 | 0 | 10 | 14 | 11 | 0 | 0 | 0 | 0 | 320 |
| 9ER1-Md. H | Kolomoki II | 0 | 0 | 0 | 2 | 0 | 371 | 0 | 1 | 0 | 0 | 2 | 32 | 15 | 1 | 1 | 0 | 0 | 0 | 425 |
| 9ER1-U4-7-12 | Kolomoki I | 0 | 0 | 0 | 7 | 0 | 1810 | 0 | 0 | 0 | 0 | 0 | 68 | 23 | 27 | 3 | 3 | 0 | 5 | 1946 |
| 9ER1-Md. C | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 755 | 0 | 0 | 0 | 0 | 0 | 36 | 4 | 2 | 0 | 0 | 0 | 0 | 797 |
| 9ER1-TU17 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 214 | 0 | 0 | 0 | 0 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 223 |
| 9ER1-U4-4-6 | Kolomoki I | 0 | 0 | 0 | 4 | 0 | 522 | 0 | 0 | 0 | 0 | 0 | 21 | 3 | 4 | 0 | 0 | 0 | 0 | 554 |
| 9ER103 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 112 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 116 |
| 8BY73-40-80 cm | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 160 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 165 |
| 9ER1-TU15 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 143 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 148 |
| 9ER1-TU10 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 266 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 273 |
| 9SE33-Mid. G | Kolomoki I | 0 | 0 | 2 | 2 | 0 | 397 | 0 | 0 | 0 | 0 | 0 | 10 | 4 | 3 | 0 | 1 | 0 | 0 | 419 |
| 9ER1-U4-2-3 | Kolomoki I | 0 | 0 | 0 | 1 | 0 | 774 | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 1 | 0 | 0 | 0 | 0 | 784 |
| 9SE14-C | Kolomoki I | 0 | 0 | 0 | 5 | 0 | 655 | 0 | 0 | 0 | 0 | 0 | 5 | 6 | 2 | 0 | 1 | 2 | 6 | 682 |
| 8WA8-PI-6 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 131 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 138 |
| 9ER1-TU6 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 297 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 298 |
| 8JA63-0-6 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 237 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237 |
| 8JA63-6-12 | Kolomoki I | 0 | 0 | 0 | 1 | 0 | 313 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 317 |
| 8JA63-12-18 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97 |
| 9CE42 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 225 | 4 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 0 | 0 | 0 | 0 | 237 |
| 8GU38 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 81 |
| 8WA8-PI-7 | Kolomoki I | 0 | 0 | 0 | 0 | 0 | 143 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 144 |
| 8WA30_-510R20 | Kolomoki I | 3 | 0 | 0 | 0 | 0 | 349 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 353 |
| 8FR2-PIII-5 | Kolomoki I | 3 | 0 | 0 | 0 | 0 | 158 | 3 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 169 |
| 8BY10 | Swift Creek | 0 | 0 | 0 | 0 | 0 | 101 | 3 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 108 |
| 8WA30_-505R20 | Swift Creek | 4 | 0 | 5 | 2 | 0 | 431 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 448 |
| 8WA30_-505L100 | Swift Creek | 5 | 0 | 2 | 0 | 0 | 231 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 241 |
| 8FR2-PIII-6 | Swift Creek | 3 | 0 | 0 | 0 | 0 | 94 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 8WA30_-505L105 | Swift Creek | 15 | 0 | 0 | 0 | 0 | 410 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 429 |
| 8WA30_-505R15 | Swift Creek | 14 | 0 | 0 | 2 | 0 | 447 | 27 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 491 |
| 8WA30_-445L100 | Swift Creek | 2 | 0 | 4 | 0 | 0 | 103 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 112 |
| 8FR2-I-1 | Swift Creek | 4 | 0 | 1 | 2 | 0 | 116 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 |
| 8FR2-II-1 | Swift Creek | 12 | 0 | 0 | 1 | 0 | 208 | 12 | 0 | 0 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 238 |
| 8FR2-II-2 | Swift Creek | 9 | 0 | 0 | 0 | 0 | 118 | 9 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 137 |
| 9CE16 | Mandeville II | 7 | 0 | 3 | 6 | 0 | 74 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 96 |

| Assemblage | CA Phase | Deptford-Related Check Stamped | Fabric Impressed | Simple Stamped | Cord Marked | Santa Rosa Punctated | Curvilinear Complicated Stamped | Rectilinear Complicated Stamped | Santa-Rosa Related Stamped | Crystal River Negative Painted | Curvilinear Check Stamped | Ruskin Dentate | Red Filmed | Incised | Weeden Island-Related Punctated | Tucker Ridge Pinched | Net Marked | Cob Marked | Wakulla Check Stamped | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9CY1-840W1200 | Mandeville II | 2 | 0 | 7 | 2 | 0 | 119 | 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 141 |
| 8LE148 WB.Str 2 Pits | Mandeville II | 5 | 0 | 19 | 1 | 0 | 175 | 6 | 0 | 19 | 0 | 0 | 7 | 2 | 0 | 0 | 0 | 0 | 1 | 235 |
| 9CY1-900W1200 | Mandeville II | 0 | 0 | 14 | 1 | 0 | 77 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 95 |
| 9CY1-1300W1000 | Mandeville II | 1 | 0 | 11 | 3 | 0 | 61 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 82 |
| 9CY1-IV-0-6 | Mandeville II | 53 | 0 | 49 | 18 | 0 | 383 | 100 | 5 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 614 |
| 9CY1-IV-6-24 | Mandeville II | 43 | 0 | 55 | 18 | 1 | 437 | 116 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 675 |
| 9CY1-III-0-12 | Mandeville II | 33 | 0 | 21 | 10 | 0 | 138 | 47 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 250 |
| 9SW71 | Mandeville II | 51 | 2 | 50 | 0 | 2 | 148 | 17 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 1 | 0 | 0 | 278 |
| 9CY1-1100W1000 | Mandeville II | 7 | 0 | 62 | 11 | 0 | 187 | 28 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 296 |
| 9CY1-440W590 | Mandeville II | 177 | 0 | 306 | 165 | 3 | 1140 | 172 | 2 | 0 | 0 | 0 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 1976 |
| 9CY1-III-12-27 | Mandeville II | 28 | 0 | 16 | 7 | 0 | 52 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 118 |
| 9CY1-900W900 | Halloca Creek | 2 | 0 | 38 | 2 | 1 | 52 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| 9CE4-0-6 | Halloca Creek | 13 | 1 | 80 | 18 | 0 | 100 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 214 |
| 9CE4-6-12 | Halloca Creek | 31 | 8 | 119 | 15 | 0 | 122 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 301 |
| 9CY1-II | Halloca Creek | 29 | 0 | 41 | 11 | 3 | 46 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 132 |
| 9CE4-12-18 | Halloca Creek | 20 | 3 | 53 | 7 | 0 | 30 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 |
| 9QU58 | Halloca Creek | 72 | 0 | 112 | 11 | 6 | 67 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 272 |
| 9CY1-I-0-6 | Halloca Creek | 54 | 0 | 39 | 22 | 2 | 28 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146 |
| 9CY1-I-6-12 | Halloca Creek | 36 | 0 | 34 | 4 | 0 | 19 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96 |
| 9CY1-I-12- | Mandeville I | 68 | 0 | 20 | 8 | 2 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 |
| 8FR4-9-3 | Mandeville I | 67 | 0 | 7 | 12 | 0 | 6 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 98 |
| 8GU56-TUA/B | Mandeville I | 272 | 0 | 58 | 5 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 351 |
| 8GU56-TUC/D | Mandeville I | 56 | 0 | 17 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 74 |
| 9CY1-1200W590 | Mandeville I | 72 | 0 | 6 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 92 |
| 1BR15-X1-Tertiary | Mandeville I | 373 | 8 | 46 | 5 | 0 | 33 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 466 |
| 8GU60-TUBL1-3 | Shorter | 394 | 0 | 0 | 0 | 2 | 9 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 408 |
| 8GU60-TUBL4-8 | Shorter | 235 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 244 |
| 1BR15-X1-Primary | Shorter | 117 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 |
| 1BR15-X1-Pre Md | Shorter | 551 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 580 |

## 2. CA Results for All Assemblages

The CORRESP Procedure

**Inertia and Chi-Square Decomposition**

| Singular Value | Principal Inertia | Chi-Square | Percent | Cumulative Percent | 7 14 21 28 35<br>----+----+----+----+----+--- |
|---|---|---|---|---|---|
| 0.96171 | 0.92488 | 29457.3 | 36.29 | 36.29 | ************************** |
| 0.83838 | 0.70289 | 22387.0 | 27.58 | 63.87 | ******************** |
| 0.57117 | 0.32624 | 10390.8 | 12.80 | 76.67 | ********* |
| 0.46559 | 0.21677 | 6904.3 | 8.51 | 85.18 | ****** |
| 0.29970 | 0.08982 | 2860.8 | 3.52 | 88.70 | *** |
| 0.26287 | 0.06910 | 2200.8 | 2.71 | 91.41 | ** |
| 0.25008 | 0.06254 | 1991.9 | 2.45 | 93.86 | ** |
| 0.20660 | 0.04268 | 1359.5 | 1.67 | 95.54 | * |
| 0.15520 | 0.02409 | 767.2 | 0.95 | 96.48 | * |
| 0.15019 | 0.02256 | 718.4 | 0.89 | 97.37 | * |
| 0.13258 | 0.01758 | 559.8 | 0.69 | 98.06 | |
| 0.11569 | 0.01338 | 426.3 | 0.53 | 98.58 | |
| 0.10142 | 0.01029 | 327.6 | 0.40 | 98.99 | |
| 0.09992 | 0.00998 | 318.0 | 0.39 | 99.38 | |
| 0.08602 | 0.00740 | 235.6 | 0.29 | 99.67 | |
| 0.07356 | 0.00541 | 172.3 | 0.21 | 99.88 | |
| 0.05474 | 0.00300 | 95.4 | 0.12 | 100.00 | |
| Total | 2.54860 | 81173.0 | 100.00 | | |

**Degrees of Freedom = 1666**

**Column Coordinates**

| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Deptford-Related Check Stamped** | 0.6318 | 2.8576 | 0.4797 | -0.7955 | -0.0634 | 0.1593 | -0.0550 | -0.0133 | 0.300 | -0.1865 |
| **Fabric Impressed** | 0.5448 | 2.9540 | 0.5272 | -0.7402 | 0.3629 | -1.6581 | 1.0257 | 0.5462 | -16.359 | 10.3161 |
| **Simple Stamped** | 0.5795 | 0.8213 | -1.2060 | 3.6016 | 0.7820 | -1.7316 | 0.8724 | 0.2483 | -0.853 | -0.0008 |
| **Cord Marked** | 0.5176 | 0.4838 | -0.9880 | 2.8483 | 0.0223 | 0.1970 | -1.0223 | -0.8109 | 4.407 | -0.0750 |
| **Santa Rosa Punctated** | 0.6428 | 1.3678 | -1.0282 | 3.8215 | 1.4041 | -3.9592 | 1.1873 | 0.1828 | 6.595 | -4.7615 |
| **Curvilinear Complicated Stamped** | 0.5859 | -0.5416 | -0.2464 | -0.3919 | -0.1199 | -0.1485 | 0.0315 | 0.1173 | 0.005 | -0.0035 |
| **Rectilinear Complicated Stamped** | 0.6208 | 0.0147 | -1.2606 | 2.1471 | -1.1339 | 5.2591 | -2.6755 | -0.7748 | -1.309 | 0.2499 |
| **Santa-Rosa Related Stamped** | 0.6389 | 0.4258 | -0.7808 | 0.6731 | -1.2346 | 6.4868 | -3.1138 | -1.2924 | 0.447 | -1.1789 |
| **Crystal River Negative Painted** | 0.6208 | -0.3871 | -0.9876 | 0.8992 | 1.0130 | 16.8343 | 32.0237 | 1.4079 | 2.220 | -0.0912 |
| **Curvilinear Check Stamped** | -0.8557 | -0.2041 | -0.1590 | -0.4743 | -1.1551 | 0.2633 | -0.3355 | 0.3617 | -1.352 | -2.1441 |
| **Ruskin Dentate** | 0.5707 | -0.7989 | 0.6554 | -1.1346 | 3.7202 | -0.7527 | -0.3583 | -2.0782 | 2.496 | 4.6637 |
| **Red Filmed** | 0.4467 | -0.7782 | 2.4147 | 0.0566 | 5.4385 | 0.8410 | -0.4433 | -2.4679 | -0.462 | -0.6641 |
| **Incised** | -0.1530 | -0.5623 | 3.3132 | 1.1958 | -2.8414 | -0.7355 | 0.6991 | -3.5144 | 0.897 | 2.6488 |
| **Weeden Island-Related Punctated** | -0.0465 | -0.6594 | 4.5534 | 1.7263 | -1.5185 | 0.2463 | -0.1645 | 2.9136 | -1.427 | -3.5795 |
| **Tucker Ridge Pinched** | -0.1965 | -0.6529 | 4.6631 | 1.7261 | 4.5338 | 2.4693 | -2.0461 | 12.8842 | 5.827 | 12.2210 |
| **Net Marked** | 0.2740 | -0.6914 | 2.4221 | 0.3856 | 2.8360 | 0.2021 | -0.7011 | -0.7595 | 2.735 | 4.3706 |
| **Cob Marked** | -1.5670 | 0.0448 | -0.4020 | -0.1732 | 0.2751 | -0.2522 | -0.0175 | 0.9535 | 1.124 | -0.1375 |
| **Wakulla Check Stamped** | -1.7920 | 0.0588 | -0.2228 | -0.0881 | 0.0694 | 0.0138 | -0.0087 | 0.0102 | -0.020 | -0.0416 |

**Row Coordinates**

| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **8LI8** | -1.7639 | 0.0492 | -0.1812 | -0.0743 | 0.0444 | 0.0107 | -0.0059 | 0.0054 | -0.0203 | -0.0393 |
| **8FR4-10-1** | -1.4996 | 0.0081 | 0.2377 | 0.1220 | 0.0078 | -0.0427 | 0.0393 | -0.1590 | -0.0899 | 0.2886 |
| **8GD13-Above Shell** | -1.6851 | 0.0764 | -0.1250 | -0.0262 | 0.0139 | -0.0128 | 0.0089 | -0.0106 | -0.0176 | -0.0341 |
| **8FR4-10-3** | -1.7228 | 0.0521 | -0.2067 | -0.0531 | 0.1277 | 0.0031 | -0.0039 | -0.0109 | -0.0323 | -0.0469 |
| **8GD13-Shell** | -1.6864 | 0.0657 | -0.1419 | -0.0452 | 0.0118 | -0.0004 | -0.0031 | -0.0318 | 0.0237 | -0.0168 |
| **8GD13-Shell Contemp** | -1.6521 | 0.0651 | -0.1707 | -0.0503 | 0.0305 | -0.0053 | 0.0010 | 0.0019 | 0.0020 | -0.0255 |
| **8FR4-10-4** | -1.6489 | 0.0739 | -0.1512 | 0.0610 | -0.0052 | -0.0260 | -0.0042 | -0.1063 | 0.0454 | 0.0811 |
| **8FR4-10-5** | -1.6456 | 0.0200 | -0.0384 | -0.0032 | 0.0417 | -0.0198 | 0.0215 | -0.1766 | 0.0043 | 0.0617 |
| **9SE102** | -1.5924 | 0.0051 | -0.1684 | -0.0897 | 0.0249 | -0.0017 | -0.0020 | 0.0140 | -0.0214 | -0.0445 |
| **8JA233** | -1.6114 | 0.0140 | 0.0452 | 0.0623 | 0.1131 | 0.0610 | -0.0689 | 0.2767 | 0.2180 | 0.2580 |
| **8FR4-9-1** | -1.5364 | 0.2122 | -0.1089 | -0.0374 | 0.0044 | -0.0205 | 0.0141 | -0.0285 | -0.0155 | -0.0347 |
| **8GD13-Below Shell** | -1.4459 | 0.1690 | -0.0884 | 0.0949 | 0.0489 | -0.0456 | 0.0095 | 0.1172 | 0.0224 | -0.0471 |
| **8WA13** | -1.5474 | -0.0312 | 0.2368 | 0.0678 | -0.2050 | -0.0571 | 0.0615 | -0.3630 | 0.0590 | 0.2034 |
| **8FR4-9-2** | -1.3680 | 0.0466 | 0.0726 | 0.2783 | -0.1768 | 0.0661 | -0.0344 | -0.1441 | -0.1490 | 0.1326 |
| **8BY137-TUs** | -1.4269 | -0.0710 | 0.4211 | 0.1392 | -0.2878 | -0.0333 | 0.0359 | -0.0334 | -0.0569 | -0.1057 |

|  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
| **8BY24** | -1.4508 | -0.0698 | 0.4837 | 0.1632 | -0.1606 | 0.0135 | 0.0009 | 0.1224 | 0.0962 | 0.2365 |
| **8FR4-10-6** | -0.9697 | -0.1536 | 0.9767 | 0.3915 | -0.6042 | -0.1791 | 0.1605 | -0.6679 | 0.0785 | 0.3430 |
| **8JA19** | -0.9092 | -0.2321 | 0.9783 | 0.3113 | -0.4219 | -0.0603 | 0.0588 | -0.1764 | -0.0564 | -0.1338 |
| **8JA5** | -0.6252 | -0.3137 | 1.2809 | 0.4349 | -0.7533 | -0.1208 | 0.0942 | -0.0526 | -0.1070 | -0.1915 |
| **8BY9** | -0.2660 | -0.4892 | 2.3645 | 0.7628 | 0.2567 | 0.3559 | -0.2783 | 2.0356 | 0.5181 | 1.0244 |
| **9SE33-Mid E** | 0.0352 | -0.6277 | 3.4585 | 1.1863 | -0.8956 | 0.0755 | -0.0163 | 0.8825 | -0.4561 | -1.0898 |
| **8WA8-PI-2** | 0.1010 | -0.5197 | 2.4580 | 0.7917 | -1.6788 | -0.3481 | 0.3168 | -1.1560 | 0.1703 | 0.6066 |
| **8WA30_100L60** | 0.2667 | -0.6149 | 2.0698 | 0.5144 | 0.1081 | 0.0783 | -0.0363 | 0.1099 | -0.1203 | -0.2245 |
| **8BY73-0-20 cm** | 0.3806 | -0.6486 | 1.7947 | 0.2440 | 2.2036 | 0.4389 | -0.2949 | -0.2166 | 0.1370 | 0.3026 |
| **8WA30_155L220** | 0.3198 | -0.6173 | 1.7667 | 0.3383 | 0.4407 | 0.0483 | -0.0019 | -0.5576 | -0.1402 | -0.1942 |
| **8FR2-PIII-2** | 0.2169 | -0.4709 | 1.7162 | 0.6762 | -1.2059 | -0.2903 | 0.1832 | -1.0795 | 0.5137 | 0.6998 |
| **8FR2-PIII-3** | 0.2556 | -0.5099 | 1.7250 | 0.5128 | -1.0593 | -0.1039 | 0.1040 | -0.2198 | -0.0194 | 0.0758 |
| **9ER1-TU9** | 0.5094 | -0.6251 | 0.8374 | -0.1604 | 1.6846 | 0.1842 | -0.1201 | -0.7806 | -0.1656 | -0.2480 |
| **9ER1-TU18** | 0.4475 | -0.5816 | 0.8221 | 0.0014 | 0.1706 | -0.0330 | -0.0084 | -0.0735 | -0.0631 | -0.1347 |
| **8BY73-20-40 cm** | 0.4880 | -0.5670 | 0.5696 | -0.0709 | 0.4182 | 0.0154 | -0.0566 | -0.1908 | 0.0461 | 0.0717 |
| **9SE33-Mid J** | 0.4873 | -0.5714 | 0.5235 | -0.1107 | 0.2515 | -0.0054 | -0.0503 | 0.2664 | 0.0914 | 0.1787 |
| **9ER1-Md. A** | 0.5443 | -0.5840 | 0.3140 | -0.2703 | 0.7882 | 0.0168 | -0.0415 | -0.3683 | -0.0732 | -0.1038 |
| **9ER1-TU7** | 0.4557 | -0.5399 | 0.4491 | -0.0659 | -0.0319 | -0.1068 | 0.0170 | -0.1793 | 0.1668 | 0.2277 |
| **9ER1-U2-SSB** | 0.5154 | -0.5591 | 0.2460 | -0.2150 | 0.0194 | -0.1070 | 0.0293 | -0.1137 | -0.0212 | -0.0240 |
| **9ER1-TU14** | 0.5436 | -0.5684 | 0.1900 | -0.2732 | 0.3335 | -0.0618 | -0.0073 | -0.1339 | -0.0418 | -0.0750 |
| **8WA30_-160L45** | 0.5257 | -0.5601 | 0.1992 | -0.2420 | 0.0933 | -0.1023 | 0.0277 | -0.1747 | 0.0263 | 0.0986 |
| **8WA30_-160L110** | 0.5275 | -0.5540 | 0.1575 | -0.2356 | -0.1134 | -0.1297 | 0.0392 | -0.0263 | -0.0198 | -0.0310 |
| **9ER1-Md. H** | 0.5458 | -0.5548 | 0.1020 | -0.2778 | 0.2263 | -0.0733 | -0.0002 | -0.1870 | 0.0450 | 0.0796 |
| **9ER1-U4-7-12** | 0.5555 | -0.5469 | -0.0356 | -0.3111 | 0.0355 | -0.1092 | 0.0119 | 0.0375 | 0.0082 | -0.0196 |
| **9ER1-Md. C** | 0.5743 | -0.5527 | -0.0963 | -0.3583 | 0.1140 | -0.1058 | 0.0130 | -0.0107 | -0.0153 | -0.0290 |
| **9ER1-TU17** | 0.5698 | -0.5468 | -0.1783 | -0.3907 | 0.0124 | -0.1480 | 0.0210 | 0.0263 | 0.0472 | 0.0831 |
| **9ER1-U4-4-6** | 0.5716 | -0.5442 | -0.0969 | -0.3276 | 0.0670 | -0.1089 | 0.0081 | 0.0131 | 0.0135 | -0.0405 |
| **9ER103** | 0.5604 | -0.5423 | -0.1236 | -0.3371 | -0.2138 | -0.1688 | 0.0546 | -0.0080 | 0.0357 | 0.0880 |
| **8BY73-40-80 cm** | 0.5781 | -0.5475 | -0.1603 | -0.3714 | -0.0017 | -0.1281 | 0.0241 | 0.0326 | -0.0010 | -0.0034 |
| **9ER1-TU15** | 0.5643 | -0.5428 | -0.1617 | -0.3649 | -0.0886 | -0.1403 | 0.0317 | 0.0349 | 0.0015 | 0.0090 |
| **9ER1-TU10** | 0.5824 | -0.5477 | -0.1781 | -0.3804 | 0.0226 | -0.1232 | 0.0194 | 0.0510 | -0.0071 | -0.0204 |
| **9SE33-Mid. G** | 0.5699 | -0.5373 | -0.1163 | -0.3145 | -0.0112 | -0.1328 | 0.0224 | 0.0350 | 0.0155 | -0.0094 |
| **9ER1-U4-2-3** | 0.5821 | -0.5423 | -0.2117 | -0.3775 | -0.0859 | -0.1415 | 0.0280 | 0.0906 | 0.0074 | -0.0064 |
| **9SE14-C** | 0.5484 | -0.5296 | -0.1832 | -0.3402 | -0.0990 | -0.1411 | 0.0241 | 0.0680 | 0.0445 | 0.0097 |
| **8WA8-PI-6** | 0.5620 | -0.5364 | -0.1051 | -0.2860 | -0.2045 | -0.0701 | -0.0023 | 0.1125 | -0.0323 | -0.0391 |
| **9ER1-TU6** | 0.5838 | -0.5420 | -0.2303 | -0.3848 | -0.1246 | -0.1472 | 0.0309 | 0.1266 | 0.0001 | -0.0155 |
| **8JA63-0-6** | 0.5859 | -0.5416 | -0.2464 | -0.3919 | -0.1199 | -0.1485 | 0.0315 | 0.1173 | 0.0049 | -0.0035 |
| **8JA63-6-12** | 0.5806 | -0.5393 | -0.2179 | -0.3702 | -0.1191 | -0.1480 | 0.0309 | 0.0833 | 0.0230 | 0.0110 |
| **8JA63-12-18** | 0.5859 | -0.5416 | -0.2464 | -0.3919 | -0.1199 | -0.1485 | 0.0315 | 0.1173 | 0.0049 | -0.0035 |
| **9CE42** | 0.5710 | -0.5373 | -0.1338 | -0.3009 | -0.1018 | -0.0406 | -0.0206 | 0.1014 | -0.0436 | -0.0567 |
| **8GU38** | 0.5859 | -0.5416 | -0.2464 | -0.3919 | -0.1199 | -0.1485 | 0.0315 | 0.1173 | 0.0049 | -0.0035 |
| **8WA8-PI-7** | 0.5862 | -0.5378 | -0.2534 | -0.3742 | -0.1270 | -0.1110 | 0.0127 | 0.1111 | -0.0042 | -0.0017 |
| **8WA30_-510R20** | 0.5864 | -0.5112 | -0.2431 | -0.3881 | -0.1223 | -0.1306 | 0.0231 | 0.1136 | 0.0037 | -0.0043 |
| **8FR2-PIII-5** | 0.5661 | -0.4726 | -0.1388 | -0.3038 | -0.2096 | -0.0586 | -0.0034 | 0.0297 | -0.0005 | 0.0394 |
| **8BY10** | 0.5732 | -0.5073 | -0.2590 | -0.2982 | -0.1269 | 0.1375 | -0.1097 | 0.0447 | -0.0403 | -0.0441 |
| **8WA30_-505R20** | 0.5864 | -0.4840 | -0.2675 | -0.3024 | -0.1223 | -0.0895 | -0.0008 | 0.1015 | 0.0000 | -0.0020 |
| **8WA30_-505L100** | 0.5873 | -0.4529 | -0.2519 | -0.3355 | -0.1239 | -0.0880 | 0.0030 | 0.1045 | -0.0124 | -0.0041 |
| **8FR2-PIII-6** | 0.5866 | -0.4309 | -0.2183 | -0.3487 | -0.0829 | -0.0213 | -0.0299 | 0.0697 | -0.0172 | -0.0105 |
| **8WA30_-505L105** | 0.5874 | -0.4194 | -0.2219 | -0.3872 | -0.1121 | -0.0977 | 0.0085 | 0.1004 | 0.0050 | -0.0096 |
| **8WA30_-505R15** | 0.5886 | -0.4104 | -0.2790 | -0.2496 | -0.1622 | 0.1610 | -0.1250 | 0.0554 | -0.0419 | 0.0036 |
| **8WA30_-445L100** | 0.5875 | -0.4173 | -0.2948 | -0.1884 | -0.1139 | -0.0547 | -0.0125 | 0.0957 | -0.0556 | 0.0001 |
| **8FR2-I-1** | 0.5881 | -0.3808 | -0.2974 | -0.1870 | -0.1637 | 0.1452 | -0.1266 | 0.0519 | 0.0044 | 0.0035 |
| **8FR2-II-1** | 0.5692 | -0.3361 | -0.2080 | -0.2468 | -0.1995 | 0.1454 | -0.1157 | 0.0721 | -0.0476 | -0.0371 |
| **8FR2-II-2** | 0.5858 | -0.2819 | -0.2393 | -0.2400 | -0.2027 | 0.2226 | -0.1471 | 0.0236 | -0.0555 | 0.0205 |
| **9CE16** | 0.5628 | -0.1703 | -0.1902 | 0.0350 | -0.1955 | -0.0033 | -0.0781 | -0.0875 | 0.2616 | 0.0696 |
| **9CY1-840W1200** | 0.5868 | -0.3734 | -0.3473 | 0.0299 | -0.1048 | 0.1727 | -0.1382 | 0.0271 | -0.0675 | 0.0063 |
| **8LE148 WB.Str 2 Pits** | 0.5692 | -0.3327 | -0.2878 | 0.1336 | 0.1637 | 1.2678 | 2.6021 | 0.0943 | 0.0997 | -0.0053 |
| **9CY1-900W1200** | 0.5854 | -0.3124 | -0.4276 | 0.3109 | -0.0175 | -0.2074 | 0.0589 | 0.0986 | -0.1167 | 0.0042 |
| **9CY1-1300W1000** | 0.5762 | -0.2461 | -0.4118 | 0.4316 | -0.0881 | -0.0219 | -0.0522 | 0.0006 | -0.0148 | 0.0398 |
| **9CY1-IV-0-6** | 0.5930 | -0.0113 | -0.4422 | 0.4177 | -0.1804 | 0.7844 | -0.2522 | -0.0739 | -0.1109 | 0.0069 |
| **9CY1-IV-6-24** | 0.5923 | -0.0871 | -0.4686 | 0.4435 | -0.1929 | 0.7380 | -0.3083 | -0.0643 | -0.1390 | 0.0157 |
| **9CY1-III-0-12** | 0.5955 | 0.1710 | -0.4536 | 0.5015 | -0.2261 | 0.8161 | -0.4729 | -0.0994 | -0.0973 | 0.0127 |
| **9SW71** | 0.5843 | 0.3958 | -0.2615 | 0.4618 | 0.0663 | -0.0752 | 0.0146 | -0.0137 | -0.2332 | 0.0538 |
| **9CY1-1100W1000** | 0.5839 | -0.0851 | -0.5417 | 0.8010 | -0.0295 | 0.0495 | -0.0874 | 0.0105 | -0.1255 | 0.0230 |
| **9CY1-440W590** | 0.5848 | 0.1109 | -0.4657 | 0.6937 | -0.0320 | 0.1375 | -0.1720 | -0.0466 | 0.1616 | -0.0104 |
| **9CY1-III-12-27** | 0.5963 | 0.5813 | -0.3771 | 0.5688 | -0.1047 | 0.4178 | -0.2816 | -0.0644 | 0.0528 | -0.0186 |
| **9CY1-900W900** | 0.5886 | 0.1029 | -0.7236 | 1.4238 | 0.0709 | 0.0192 | -0.0573 | 0.0222 | -0.3254 | -0.0159 |
| **9CE4-0-6** | 0.5807 | 0.2822 | -0.6292 | 1.3711 | 0.2254 | -0.6491 | 0.2313 | 0.0739 | -0.0165 | 0.0310 |
| **9CE4-6-12** | 0.5843 | 0.5024 | -0.5876 | 1.3482 | 0.2422 | -0.6578 | 0.2750 | 0.1030 | -0.5457 | 0.2545 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **9CY1-II** | 0.5830 | 0.7554 | -0.4173 | 1.1411 | 0.2406 | -0.6274 | 0.2136 | 0.0063 | 0.3230 | -0.1418 |
| **9CE4-12-18** | 0.5863 | 0.8410 | -0.6049 | 1.6107 | 0.3092 | -0.7489 | 0.3187 | 0.0941 | -0.5210 | 0.2352 |
| **9QU58** | 0.5944 | 1.0112 | -0.5114 | 1.4070 | 0.2909 | -0.7095 | 0.2979 | 0.0875 | 0.0338 | -0.1549 |
| **9CY1-I-0-6** | 0.5919 | 1.2642 | -0.3635 | 1.0890 | 0.1773 | -0.4206 | 0.0626 | -0.0411 | 0.6295 | -0.1447 |
| **9CY1-I-6-12** | 0.5991 | 1.2759 | -0.3765 | 1.0855 | 0.1949 | -0.4104 | 0.1684 | 0.0482 | -0.0459 | -0.0662 |
| **9CY1-I-12-** | 0.6088 | 1.8196 | -0.0667 | 0.4068 | 0.0891 | -0.1900 | 0.0263 | -0.0161 | 0.4282 | -0.1945 |
| **8FR4-9-3** | 0.5816 | 2.0037 | 0.3034 | 0.1312 | -0.0102 | 0.0726 | -0.1371 | 0.0024 | 0.6079 | -0.2873 |
| **8GU56-TUA/B** | 0.6195 | 2.3324 | 0.1472 | 0.0014 | 0.0749 | -0.1666 | 0.0884 | 0.0245 | 0.1546 | -0.1459 |
| **8GU56-TUC/D** | 0.6192 | 2.3439 | 0.0827 | 0.2201 | 0.1301 | -0.2792 | 0.1592 | 0.0486 | 0.0312 | -0.1413 |
| **9CY1-1200W590** | 0.6009 | 2.2740 | 0.2883 | -0.2015 | -0.0668 | -0.0011 | -0.0356 | -0.1158 | 0.4865 | -0.0935 |
| **1BR15-X1-Tertiary** | 0.6207 | 2.3860 | 0.2432 | -0.2865 | 0.0220 | -0.0690 | 0.0452 | 0.0212 | -0.0800 | 0.0272 |
| **8GU60-TUBL1-3** | 0.6290 | 2.7550 | 0.4571 | -0.7518 | -0.0700 | 0.1612 | -0.0602 | -0.0243 | 0.3267 | -0.2028 |
| **8GU60-TUBL4-8** | 0.6297 | 2.7912 | 0.4246 | -0.6511 | -0.0339 | 0.0899 | -0.0202 | -0.0024 | 0.1941 | -0.1374 |
| **1BR15-X1-Primary** | 0.6304 | 2.8592 | 0.4805 | -0.7945 | -0.0562 | 0.1288 | -0.0369 | -0.0039 | 0.0202 | -0.0100 |
| **1BR15-X1-Pre Md** | 0.6275 | 2.8624 | 0.4821 | -0.7927 | -0.0421 | 0.0685 | -0.0010 | 0.0147 | -0.5328 | 0.3386 |

## 3. CA Results for Early and Middle Assemblages

The CORRESP Procedure

**Inertia and Chi-Square Decomposition**

| Singular Value | Principal Inertia | Chi-Square | Percent | Cumulative Percent | 11 22 33 44 55 ----+----+----+----+----+--- |
|---|---|---|---|---|---|
| 0.84353 | 0.71154 | 15901.6 | 54.54 | 54.54 | ************************ |
| 0.49077 | 0.24085 | 5382.6 | 18.46 | 73.00 | ******** |
| 0.30661 | 0.09401 | 2100.9 | 7.21 | 80.21 | *** |
| 0.25646 | 0.06577 | 1469.9 | 5.04 | 85.25 | ** |
| 0.24822 | 0.06162 | 1377.0 | 4.72 | 89.97 | ** |
| 0.16681 | 0.02783 | 621.8 | 2.13 | 92.10 | * |
| 0.15684 | 0.02460 | 549.7 | 1.89 | 93.99 | * |
| 0.13403 | 0.01796 | 401.4 | 1.38 | 95.37 | * |
| 0.11816 | 0.01396 | 312.0 | 1.07 | 96.44 | |
| 0.10187 | 0.01038 | 231.9 | 0.80 | 97.23 | |
| 0.09368 | 0.00878 | 196.1 | 0.67 | 97.90 | |
| 0.08638 | 0.00746 | 166.8 | 0.57 | 98.48 | |
| 0.07826 | 0.00613 | 136.9 | 0.47 | 98.95 | |
| 0.07528 | 0.00567 | 126.7 | 0.43 | 99.38 | |
| 0.06469 | 0.00419 | 93.5 | 0.32 | 99.70 | |
| 0.05880 | 0.00346 | 77.3 | 0.26 | 99.97 | |
| 0.02114 | 0.00045 | 10.0 | 0.03 | 100.00 | |
| Total | 1.30464 | 29156.1 | 100.00 | | |

**Degrees of Freedom = 1207**

**Column Coordinates**

| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Deptford-Related Check Stamped** | 2.4155 | -0.7595 | -0.1496 | 0.0742 | 0.079 | 0.0391 | -0.2968 | -0.1824 | -0.006 | 0.012 |
| **Fabric Impressed** | 2.5997 | -0.8018 | 0.4535 | -0.9814 | -1.668 | -2.6949 | 16.0818 | 9.9453 | -0.072 | -0.233 |
| **Simple Stamped** | 0.6804 | 3.1168 | 1.4455 | -0.7156 | -1.096 | -0.1625 | 0.6551 | -1.0242 | 0.207 | -0.075 |
| **Cord Marked** | 0.4174 | 2.5956 | 0.4177 | -0.0602 | 1.132 | 0.8952 | -3.4557 | 5.6372 | -1.010 | 0.236 |
| **Santa Rosa Punctated** | 1.1240 | 3.0921 | 2.5730 | -1.9799 | -1.870 | 0.6632 | -6.3473 | -7.6352 | 0.574 | 0.734 |
| **Curvilinear Complicated Stamped** | -0.4829 | -0.1996 | -0.2375 | -0.1738 | -0.157 | 0.0055 | -0.0030 | -0.0165 | -0.059 | 0.008 |
| **Rectilinear Complicated Stamped** | -0.0139 | 2.1295 | -2.1071 | 2.6620 | 3.749 | -0.2587 | 1.1089 | -0.8265 | 0.495 | -0.015 |
| **Santa-Rosa Related Stamped** | 0.3283 | 0.8611 | -2.6491 | 3.3546 | 4.457 | -1.1617 | -0.8768 | -4.1273 | 2.567 | -1.005 |
| **Crystal River Negative Painted** | -0.3599 | 1.0400 | -1.5618 | 24.3205 | -17.836 | 2.5764 | -1.2681 | 1.8486 | -0.667 | -0.076 |
| **Curvilinear Check Stamped** | -0.5508 | -0.6148 | -2.7562 | -0.6057 | 0.516 | 0.6884 | 1.0634 | -5.2652 | -1.387 | -10.546 |
| **Ruskin Dentate** | -0.6954 | -1.1939 | 1.3361 | -0.6627 | -0.485 | -2.2047 | -2.0196 | 3.7718 | 34.336 | 35.116 |
| **Red Filmed** | -0.6614 | -1.2641 | 4.2769 | 1.8239 | 1.488 | -4.6021 | -0.6670 | 0.0826 | -0.654 | 0.202 |
| **Incised** | -0.6006 | -1.1787 | 3.4799 | 0.9362 | 1.212 | 3.4612 | 0.3766 | 0.3124 | 5.134 | -3.568 |
| **Weeden Island-Related Punctated** | -0.6174 | -1.4309 | 4.6738 | 1.2542 | 2.331 | 6.3293 | 1.2059 | -0.0131 | -0.875 | -1.689 |
| **Tucker Ridge Pinched** | -0.7079 | -1.5035 | 5.1371 | 1.3545 | 2.416 | 7.3995 | 1.8626 | -0.1347 | 4.207 | 2.366 |
| **Net Marked** | -0.6542 | -1.4699 | 7.1070 | 2.5691 | 4.112 | 11.5263 | 5.1019 | -4.5389 | -16.438 | 19.885 |
| **Cob Marked** | -0.6767 | -0.8693 | -1.5106 | -2.0868 | -2.225 | 2.6885 | -1.2574 | 2.9796 | 0.331 | 8.565 |
| **Wakulla Check Stamped** | -0.6691 | -0.9249 | 0.1495 | 0.8103 | -2.597 | 2.6082 | -0.9604 | 2.5756 | 6.188 | 6.870 |

**Row Coordinates**

| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **9ER1-TU9** | -0.5491 | -0.6090 | 1.4829 | 0.5603 | 0.4854 | -1.3550 | -0.1952 | 0.0243 | -0.1686 | -0.0384 |
| **9ER1-TU18** | -0.5264 | -0.5252 | 1.1062 | 0.2966 | 0.4289 | 0.6104 | 0.1553 | -0.0434 | -0.0338 | -0.1241 |
| **8BY73-20-40 cm** | -0.5105 | -0.4368 | 0.9774 | 0.3014 | 0.4170 | 0.4275 | 0.1919 | -0.1401 | -0.4883 | 0.4930 |
| **9SE33-Mid J** | -0.5161 | -0.4357 | 0.7490 | 0.1708 | 0.2803 | 0.5012 | 0.1438 | -0.0551 | -0.0583 | 0.0875 |
| **9ER1-Md. A** | -0.5170 | -0.4107 | 0.6481 | 0.2031 | 0.1720 | -0.6848 | -0.1020 | 0.0061 | -0.0835 | -0.0318 |
| **9ER1-TU7** | -0.4978 | -0.3713 | 0.6195 | 0.1137 | 0.1757 | 0.3923 | -0.0342 | 0.1823 | 0.7565 | 0.0392 |
| **9ER1-U2-SSB** | -0.5040 | -0.3532 | 0.3807 | 0.0489 | 0.0911 | 0.1553 | 0.0268 | 0.0017 | 0.1146 | -0.1636 |
| **9ER1-TU14** | -0.5063 | -0.3529 | 0.3804 | 0.0640 | 0.0804 | -0.2147 | -0.0401 | 0.0222 | 0.1739 | 0.1342 |
| **8WA30_-160L45** | -0.5035 | -0.3427 | 0.3412 | 0.0409 | 0.0655 | -0.0039 | -0.0046 | 0.0078 | 0.1930 | -0.1893 |
| **8WA30_-160L110** | -0.4983 | -0.3181 | 0.2351 | -0.0137 | 0.0402 | 0.2300 | 0.0344 | 0.0011 | 0.1212 | -0.2011 |
| **9ER1-Md. H** | -0.4962 | -0.3093 | 0.2627 | 0.0293 | 0.0428 | -0.1962 | -0.0602 | 0.0370 | 0.2508 | 0.0615 |
| **9ER1-U4-7-12** | -0.4903 | -0.2613 | 0.0553 | -0.0615 | -0.0396 | 0.0121 | -0.0091 | 0.0107 | -0.0362 | 0.0013 |
| **9ER1-Md. C** | -0.4919 | -0.2557 | -0.0026 | -0.0744 | -0.0692 | -0.1694 | -0.0281 | -0.0104 | -0.0623 | -0.0058 |
| **9ER1-TU17** | -0.4905 | -0.2394 | -0.1301 | -0.1463 | -0.1452 | -0.0690 | -0.0507 | 0.0659 | 0.6008 | 0.6547 |
| **9ER1-U4-4-6** | -0.4848 | -0.2340 | -0.0060 | -0.0809 | -0.0596 | -0.0984 | -0.0423 | 0.0299 | -0.0666 | -0.0150 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **9ER103** | -0.4870 | -0.2334 | -0.1093 | -0.1355 | -0.1094 | 0.1246 | 0.0101 | -0.0052 | 0.1196 | -0.1157 |
| **8BY73-40-80 cm** | -0.4880 | -0.2314 | -0.1055 | -0.1186 | -0.1085 | -0.0853 | -0.0168 | -0.0121 | -0.0424 | -0.0094 |
| **9ER1-TU15** | -0.4874 | -0.2300 | -0.1432 | -0.1347 | -0.1114 | -0.0055 | 0.0003 | -0.0462 | -0.0063 | -0.1094 |
| **9ER1-TU10** | -0.4875 | -0.2269 | -0.1217 | -0.1225 | -0.1145 | -0.1127 | -0.0200 | -0.0140 | -0.0747 | 0.0126 |
| **9SE33-Mid. G** | -0.4798 | -0.2171 | -0.0304 | -0.1008 | -0.0746 | 0.0047 | -0.0077 | 0.0004 | -0.0722 | 0.0141 |
| **9ER1-U4-2-3** | -0.4836 | -0.2083 | -0.1863 | -0.1537 | -0.1357 | -0.0118 | -0.0100 | -0.0077 | -0.0530 | -0.0019 |
| **9SE14-C** | -0.4815 | -0.2094 | -0.1420 | -0.1373 | -0.1371 | 0.0748 | -0.0309 | 0.0535 | 0.0046 | 0.0889 |
| **8WA8-PI-6** | -0.4808 | -0.2068 | -0.1039 | -0.0855 | -0.0261 | 0.1892 | 0.0449 | -0.0234 | 0.0061 | -0.0814 |
| **9ER1-TU6** | -0.4834 | -0.2038 | -0.2210 | -0.1690 | -0.1483 | 0.0267 | 0.0010 | -0.0165 | -0.0622 | 0.0019 |
| **8JA63-0-6** | -0.4829 | -0.1996 | -0.2375 | -0.1738 | -0.1566 | 0.0055 | -0.0030 | -0.0165 | -0.0595 | 0.0076 |
| **8JA63-6-12** | -0.4814 | -0.2003 | -0.1977 | -0.1601 | -0.1387 | 0.0155 | -0.0136 | 0.0037 | -0.0316 | -0.0136 |
| **8JA63-12-18** | -0.4829 | -0.1996 | -0.2375 | -0.1738 | -0.1566 | 0.0055 | -0.0030 | -0.0165 | -0.0595 | 0.0076 |
| **9CE42** | -0.4800 | -0.1987 | -0.1133 | -0.0718 | -0.0221 | 0.0640 | 0.0293 | -0.0275 | -0.0495 | -0.0340 |
| **8GU38** | -0.4829 | -0.1996 | -0.2375 | -0.1738 | -0.1566 | 0.0055 | -0.0030 | -0.0165 | -0.0595 | 0.0076 |
| **8WA8-PI-7** | -0.4797 | -0.1835 | -0.2504 | -0.1541 | -0.1295 | 0.0036 | 0.0047 | -0.0221 | -0.0556 | 0.0074 |
| **8WA30_-510R20** | -0.4570 | -0.1978 | -0.2420 | -0.1636 | -0.1436 | 0.0050 | -0.0024 | -0.0202 | -0.0574 | 0.0076 |
| **8FR2-PIII-5** | -0.4267 | -0.1987 | -0.1520 | -0.0843 | -0.0360 | 0.1206 | 0.0276 | -0.0260 | 0.0694 | -0.0874 |
| **8BY10** | -0.4572 | -0.1290 | -0.3156 | -0.0151 | 0.0588 | -0.0598 | 0.0154 | -0.1628 | -0.0132 | -0.1077 |
| **8WA30_-505R20** | -0.4338 | -0.1239 | -0.2400 | -0.1391 | -0.1070 | 0.0043 | 0.0012 | -0.0149 | -0.0528 | 0.0074 |
| **8WA30_-505L100** | -0.4073 | -0.1547 | -0.2449 | -0.1378 | -0.1109 | 0.0015 | 0.0102 | -0.0384 | -0.0492 | 0.0067 |
| **8FR2-PIII-6** | -0.3884 | -0.1805 | -0.2271 | -0.0896 | -0.0550 | -0.0449 | 0.0038 | -0.0367 | -0.0527 | 0.0092 |
| **8WA30_-505L105** | -0.3787 | -0.2054 | -0.2369 | -0.1406 | -0.1173 | -0.0060 | -0.0071 | -0.0277 | -0.0551 | 0.0081 |
| **8WA30_-505R15** | -0.3712 | -0.0783 | -0.3259 | -0.0062 | 0.0735 | -0.0139 | 0.0343 | -0.0426 | -0.0325 | 0.0078 |
| **8WA30_-445L100** | -0.3771 | -0.0288 | -0.2259 | -0.1127 | -0.0814 | -0.0070 | 0.0450 | -0.0772 | -0.0341 | 0.0041 |
| **8FR2-I-1** | -0.3457 | -0.0229 | -0.3124 | -0.0158 | 0.0735 | 0.0047 | -0.0002 | 0.0140 | -0.0405 | 0.0094 |
| **8FR2-II-1** | -0.3116 | -0.1166 | -0.2888 | -0.0048 | 0.0899 | 0.0710 | 0.0444 | -0.0847 | -0.0290 | -0.1103 |
| **8FR2-II-2** | -0.2626 | -0.0905 | -0.3274 | 0.0369 | 0.1254 | 0.0155 | 0.0535 | -0.0782 | 0.0184 | -0.0197 |
| **9CE16** | -0.1680 | 0.0801 | -0.0798 | -0.0422 | 0.0766 | 0.1580 | -0.1731 | 0.2782 | 0.0730 | -0.0928 |
| **9CY1-840W1200** | -0.3393 | 0.1544 | -0.2439 | 0.0198 | 0.1070 | -0.0412 | 0.0507 | -0.0454 | -0.0238 | 0.0065 |
| **8LE148 WB.Str 2 Pits** | -0.3086 | 0.1851 | -0.0838 | 1.9141 | -1.5015 | 0.1007 | -0.0653 | 0.0694 | -0.0226 | -0.0008 |
| **9CY1-900W1200** | -0.2872 | 0.3921 | -0.0416 | -0.1629 | -0.1582 | -0.0183 | 0.0927 | -0.1311 | -0.0126 | -0.0029 |
| **9CY1-1300W1000** | -0.2314 | 0.4708 | -0.0553 | -0.0528 | 0.0222 | 0.0419 | 0.0278 | 0.0077 | 0.0394 | -0.0401 |
| **9CY1-IV-0-6** | -0.0308 | 0.4875 | -0.3849 | 0.4278 | 0.4218 | -0.0414 | 0.0875 | -0.1013 | 0.0444 | -0.0034 |
| **9CY1-IV-6-24** | -0.0955 | 0.5167 | -0.3885 | 0.3693 | 0.4442 | -0.0346 | 0.1145 | -0.1092 | 0.0369 | 0.0032 |
| **9CY1-III-0-12** | 0.1248 | 0.5590 | -0.4194 | 0.3652 | 0.5998 | -0.0230 | 0.0809 | -0.0656 | 0.0467 | 0.0020 |
| **9SW71** | 0.3160 | 0.4255 | 0.1237 | -0.0205 | -0.0130 | -0.0370 | 0.2124 | -0.2722 | 0.0253 | 0.0314 |
| **9CY1-1100W1000** | -0.0933 | 0.8027 | -0.0228 | -0.0052 | 0.0741 | -0.0092 | 0.1060 | -0.0969 | 0.0324 | -0.0154 |
| **9CY1-440W590** | 0.0752 | 0.7002 | -0.0513 | 0.0315 | 0.1773 | 0.0202 | -0.1316 | 0.1993 | -0.0353 | 0.0077 |
| **9CY1-III-12-27** | 0.4756 | 0.5791 | -0.1872 | 0.1788 | 0.3448 | 0.0099 | -0.0470 | 0.0399 | 0.0036 | 0.0081 |
| **9CY1-900W900** | 0.0666 | 1.3342 | 0.1280 | 0.0159 | 0.0635 | -0.0658 | 0.2502 | -0.4446 | 0.0977 | -0.0133 |
| **9CE4-0-6** | 0.2226 | 1.2602 | 0.4379 | -0.3290 | -0.3558 | 0.0045 | 0.0203 | 0.1112 | -0.0313 | -0.0052 |
| **9CE4-6-12** | 0.4117 | 1.2236 | 0.4507 | -0.3217 | -0.4020 | -0.0902 | 0.5045 | 0.0984 | 0.0149 | -0.0201 |
| **9CY1-II** | 0.6245 | 0.9997 | 0.4854 | -0.2956 | -0.3054 | 0.0410 | -0.2972 | -0.0647 | 0.0053 | -0.0072 |
| **9CE4-12-18** | 0.7007 | 1.4264 | 0.5788 | -0.3452 | -0.4418 | -0.0870 | 0.4780 | 0.0801 | 0.0243 | -0.0225 |
| **9QU58** | 0.8421 | 1.2376 | 0.5398 | -0.3248 | -0.4094 | -0.0082 | -0.0730 | -0.4267 | 0.0483 | -0.0003 |
| **9CY1-I-0-6** | 1.0608 | 0.9614 | 0.3690 | -0.2150 | -0.1230 | 0.1143 | -0.5354 | 0.3950 | -0.0990 | 0.0314 |
| **9CY1-I-6-12** | 1.0682 | 0.9542 | 0.3604 | -0.1794 | -0.2253 | -0.0126 | 0.0108 | -0.2254 | 0.0329 | -0.0111 |
| **9CY1-I-12-** | 1.5320 | 0.3383 | 0.1691 | -0.0956 | -0.0530 | 0.0648 | -0.3934 | -0.0431 | -0.0267 | 0.0241 |
| **8FR4-9-3** | 1.6895 | -0.0406 | 0.2505 | 0.0785 | 0.2533 | 0.3338 | -0.5257 | 0.4833 | -0.1537 | -0.0346 |
| **8GU56-TUA/B** | 1.9682 | -0.0457 | 0.1181 | -0.0696 | -0.1110 | 0.0164 | -0.1711 | -0.2310 | 0.0128 | 0.0009 |
| **8GU56-TUC/D** | 1.9777 | 0.1385 | 0.2157 | -0.1106 | -0.1942 | -0.0077 | -0.0741 | -0.3735 | 0.0426 | -0.0078 |
| **9CY1-1200W590** | 1.9175 | -0.2605 | 0.0646 | 0.0165 | 0.0803 | 0.1539 | -0.4069 | 0.1638 | 0.0510 | -0.0569 |
| **1BR15-X1-Tertiary** | 2.0155 | -0.2958 | 0.0139 | -0.0354 | -0.0645 | -0.0216 | 0.0683 | -0.0188 | 0.0007 | 0.0015 |
| **8GU60-TUBL1-3** | 2.3276 | -0.7214 | -0.1415 | 0.0768 | 0.0885 | 0.0439 | -0.3211 | -0.2334 | 0.0212 | 0.0021 |
| **8GU60-TUBL4-8** | 2.3594 | -0.6326 | -0.0948 | 0.0439 | 0.0333 | 0.0212 | -0.1984 | -0.1685 | 0.0011 | 0.0085 |
| **1BR15-X1-Primary** | 2.4186 | -0.7602 | -0.1394 | 0.0564 | 0.0496 | -0.0069 | -0.0215 | -0.0122 | -0.0067 | 0.0083 |
| **1BR15-X1-Pre Md** | 2.4247 | -0.7616 | -0.1194 | 0.0214 | -0.0084 | -0.0976 | 0.5222 | 0.3240 | -0.0089 | 0.0001 |

## 4. CA Results for Late Assemblages

The CORRESP Procedure

| Inertia and Chi-Square Decomposition | | | | | |
|---|---|---|---|---|---|
| Singular Value | Principal Inertia | Chi-Square | Percent | Cumulative Percent | 13 26 39 52 65<br>----+----+----+----+----+--- |
| 0.86536 | 0.74885 | 7115.6 | 66.95 | 66.95 | ************************** |
| 0.38581 | 0.14885 | 1414.4 | 13.31 | 80.26 | ***** |
| 0.26143 | 0.06834 | 649.4 | 6.11 | 86.37 | ** |
| 0.19526 | 0.03813 | 362.3 | 3.41 | 89.78 | * |
| 0.17980 | 0.03233 | 307.2 | 2.89 | 92.67 | * |
| 0.15497 | 0.02402 | 228.2 | 2.15 | 94.82 | * |
| 0.14657 | 0.02148 | 204.1 | 1.92 | 96.74 | * |
| 0.12667 | 0.01605 | 152.5 | 1.43 | 98.17 | * |
| 0.08860 | 0.00785 | 74.6 | 0.70 | 98.88 | |
| 0.08240 | 0.00679 | 64.5 | 0.61 | 99.48 | |
| 0.05615 | 0.00315 | 30.0 | 0.28 | 99.77 | |
| 0.04119 | 0.00170 | 16.1 | 0.15 | 99.92 | |
| 0.02384 | 0.00057 | 5.4 | 0.05 | 99.97 | |
| 0.01885 | 0.00036 | 3.4 | 0.03 | 100.00 | |
| Total | 1.11845 | 10627.5 | 100.00 | | |
| Degrees of Freedom = 364 | | | | | |

| Column Coordinates | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
| **Deptford-Related Check Stamped** | -0.1812 | -0.9658 | 2.2844 | 7.6324 | -6.4967 | -1.6274 | -4.5287 | -0.2123 | -5.571 | 3.274 |
| **Fabric Impressed** | -0.3651 | -0.4382 | 2.0833 | 7.8892 | 5.7550 | 12.7185 | 19.0931 | -8.7044 | -3.773 | -25.163 |
| **Simple Stamped** | -0.3717 | -0.4405 | 1.6193 | 8.2678 | -4.6053 | 2.4650 | 1.3185 | -2.0292 | 0.465 | -6.568 |
| **Cord Marked** | 0.3927 | -0.7231 | 4.0531 | 6.1431 | 8.7967 | 4.1398 | 0.8575 | 10.7231 | -2.049 | -3.004 |
| **Curvilinear Complicated Stamped** | 2.0845 | 0.0374 | 1.5340 | -0.5841 | -0.4228 | -1.9845 | 0.8556 | 0.8513 | -0.218 | -0.383 |
| **Rectilinear Complicated Stamped** | 0.9361 | -0.3244 | 4.3225 | 7.5582 | 0.9565 | 3.7400 | 27.2850 | -9.8725 | 0.674 | 18.554 |
| **Curvilinear Check Stamped** | -0.3665 | -0.3588 | -0.0408 | -0.8297 | -1.7513 | -0.7470 | -1.1153 | 0.2804 | -11.448 | 5.313 |
| **Ruskin Dentate** | 2.9402 | 12.3900 | 2.2665 | 4.9318 | 6.0294 | 9.7757 | -5.5259 | -6.6506 | -0.916 | 24.913 |
| **Red Filmed** | 2.5806 | 4.6549 | 0.2179 | -0.1372 | -0.3537 | 2.3727 | -1.0145 | -0.8702 | 0.234 | -0.047 |
| **Incised** | 1.4928 | -2.3137 | 1.1493 | -0.0448 | 1.2121 | 0.9782 | -1.4230 | -2.0017 | 0.611 | 0.181 |
| **Weeden Island-Related Punctated** | 1.8933 | -1.4435 | -2.9786 | -0.0769 | -1.2096 | 1.2284 | 0.6037 | 1.2450 | -0.210 | 0.142 |
| **Tucker Ridge Pinched** | 1.8010 | 1.9254 | -5.8689 | 4.8718 | 5.1752 | -6.4273 | -0.5407 | -3.3950 | -0.013 | -1.073 |
| **Net Marked** | 1.8098 | 1.3791 | -0.3364 | 5.3527 | 9.5610 | 3.1276 | -4.1191 | 8.2121 | -1.479 | 13.422 |
| **Cob Marked** | -0.5188 | 0.1051 | 0.8562 | 5.3871 | -3.8210 | -1.7836 | -1.2605 | 4.0292 | 17.118 | 2.374 |
| **Wakulla Check Stamped** | -0.5089 | 0.0797 | -0.0317 | -0.1199 | 0.0229 | -0.0124 | 0.0159 | -0.0001 | -0.016 | 0.006 |

| Row Coordinates | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dim1 | Dim2 | Dim3 | Dim4 | Dim5 | Dim6 | Dim7 | Dim8 | Dim9 | Dim10 |
| **8LI8** | -0.4759 | 0.0591 | -0.0318 | -0.1208 | 0.0221 | -0.0122 | 0.0114 | -0.0041 | -0.0296 | 0.0125 |
| **8FR4-10-1** | -0.2061 | -0.0122 | 0.0124 | 0.1452 | 0.0988 | 0.2469 | 0.0703 | -0.2983 | 0.0117 | -0.3223 |
| **8GD13-Above Shell** | -0.4338 | 0.0114 | 0.0141 | 0.0686 | -0.1060 | -0.0004 | -0.0395 | -0.0169 | 0.0146 | -0.0076 |
| **8FR4-10-3** | -0.4512 | 0.1195 | 0.0027 | -0.0417 | -0.0311 | 0.0162 | 0.0269 | -0.0204 | -0.0110 | -0.0639 |
| **8GD13-Shell** | -0.4226 | 0.0175 | 0.0452 | 0.0217 | 0.0031 | -0.0087 | -0.0337 | 0.0675 | 0.0156 | 0.0178 |
| **8GD13-Shell Contemp** | -0.4001 | 0.0309 | 0.0730 | 0.1278 | -0.1502 | -0.0725 | 0.0184 | 0.0453 | 0.2654 | 0.0597 |
| **8FR4-10-4** | -0.4259 | -0.0167 | 0.1405 | 0.1722 | 0.2845 | 0.2133 | 0.1001 | 0.1839 | -0.0685 | -0.2517 |
| **8FR4-10-5** | -0.3499 | 0.0513 | 0.0492 | -0.0505 | 0.0239 | 0.0735 | -0.0439 | -0.1088 | 0.0166 | -0.0464 |
| **9SE102** | -0.2864 | 0.0501 | 0.0728 | -0.1536 | -0.0106 | -0.1439 | 0.0725 | 0.0580 | -0.0283 | -0.0212 |
| **8JA233** | -0.3171 | 0.0478 | -0.1020 | 0.2022 | 0.3435 | -0.0473 | -0.0380 | 0.2209 | 0.0944 | 0.0714 |
| **8FR4-9-1** | -0.4070 | -0.0445 | 0.1545 | 0.4725 | -0.4415 | -0.0661 | -0.2456 | -0.0644 | -0.3920 | 0.1117 |
| **8GD13-Below Shell** | -0.3269 | -0.0373 | 0.1492 | 0.6872 | -0.4300 | -0.0323 | -0.1193 | 0.0933 | 0.0354 | -0.1042 |
| **8WA13** | -0.2067 | -0.1453 | 0.0832 | -0.1166 | 0.1286 | 0.1119 | -0.1346 | -0.2022 | 0.0496 | 0.0212 |
| **8FR4-9-2** | -0.1883 | -0.1668 | 0.2743 | 0.5850 | 0.1748 | 0.4561 | 1.0601 | -0.3046 | -0.0321 | 0.0615 |
| **8BY137-TUs** | -0.0554 | -0.2260 | -0.1012 | -0.1308 | 0.0003 | 0.0757 | -0.0140 | -0.0221 | 0.0087 | 0.0130 |
| **8BY24** | -0.0731 | -0.1563 | -0.1868 | -0.0180 | 0.1496 | -0.0107 | -0.0765 | -0.1605 | 0.0249 | -0.0014 |
| **8FR4-10-6** | 0.4055 | -0.5117 | 0.2402 | 0.1394 | -0.0004 | 0.2410 | -0.2629 | -0.3890 | 0.0568 | -0.0866 |
| **8JA19** | 0.5595 | -0.3363 | 0.0066 | -0.1331 | 0.0087 | 0.1055 | -0.0184 | 0.0366 | 0.0145 | -0.0266 |
| **8JA5** | 0.8654 | -0.6247 | -0.0149 | -0.0899 | -0.0654 | 0.0018 | 0.0208 | 0.1162 | -0.0892 | 0.0782 |
| **8BY9** | 1.4392 | -0.0545 | -1.1848 | 0.5449 | 0.5040 | -0.6651 | -0.0031 | -0.1993 | -0.0291 | -0.0695 |
| **9SE33-Mid E** | 1.8641 | -0.8508 | -1.2681 | 0.0106 | -0.2788 | 0.7001 | -0.0071 | 0.2482 | 0.0023 | 0.1394 |
| **8WA8-PI-2** | 1.7233 | -1.3807 | 0.4815 | -0.0811 | 0.1295 | 0.1302 | -0.4183 | -0.5080 | 0.1055 | 0.0585 |
| **8WA30_100L60** | 2.0128 | 0.0828 | -0.0335 | -0.1574 | -0.1871 | -0.1221 | 0.0782 | 0.0860 | -0.0004 | -0.1255 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **8BY73-0-20 cm** | 2.2018 | 1.8442 | 0.1549 | 0.1880 | 0.1949 | 0.2348 | -0.1187 | -0.1067 | -0.0072 | 0.1691 |
| **8WA30_155L220** | 2.0591 | 0.4240 | 0.4017 | -0.2768 | -0.2173 | -0.0118 | -0.0035 | 0.0127 | 0.0286 | -0.1301 |
| **8FR2-PIII-2** | 1.7064 | -1.0228 | 0.9886 | 0.3034 | 0.8297 | 0.0523 | -0.2316 | 0.5154 | -0.0836 | 0.0564 |
| **8FR2-PIII-3** | 1.8351 | -0.8564 | 0.5086 | -0.0269 | -0.1764 | -0.4509 | 0.5115 | -0.0668 | -0.0625 | 0.2343 |

## 5. Beta-230756 Report Form (1BR15)

# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.8:lab. mult=1)

**Laboratory number:** **Beta-230756**

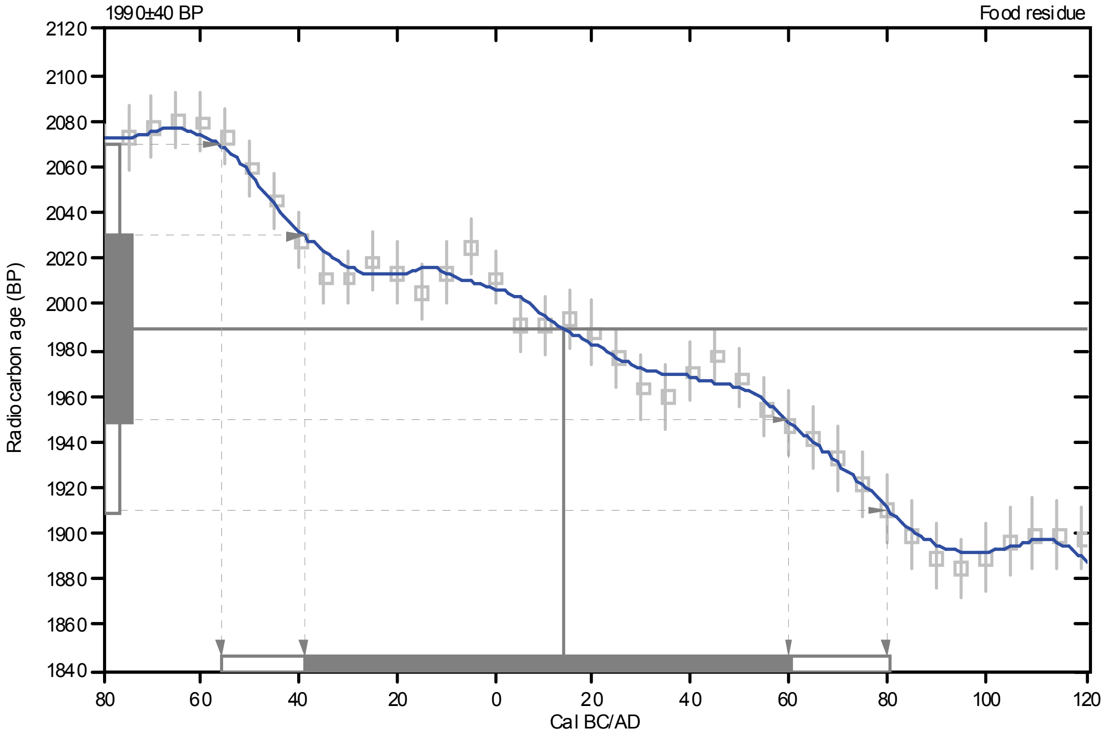
**Conventional radiocarbon age:** **1990±40 BP**

**2 Sigma calibrated result: (95% probability)** **Cal BC 60 to Cal AD 80 (Cal BP 2010 to 1870)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 10 (Cal BP 1940)

1 Sigma calibrated result: (68% probability) Cal BC 40 to Cal AD 60 (Cal BP 1990 to 1890)



References:

***Database used***

*INTCAL04*

***Calibration Database***

***INTCAL04 Radiocarbon Age Calibration***

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

***Mathematics***

***A Simplified Approach to Calibrating C14 Dates***

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

**Beta Analytic Radiocarbon Dating Laboratory**

*4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com*

## 6. Beta-230757 Report Form (1BR15)

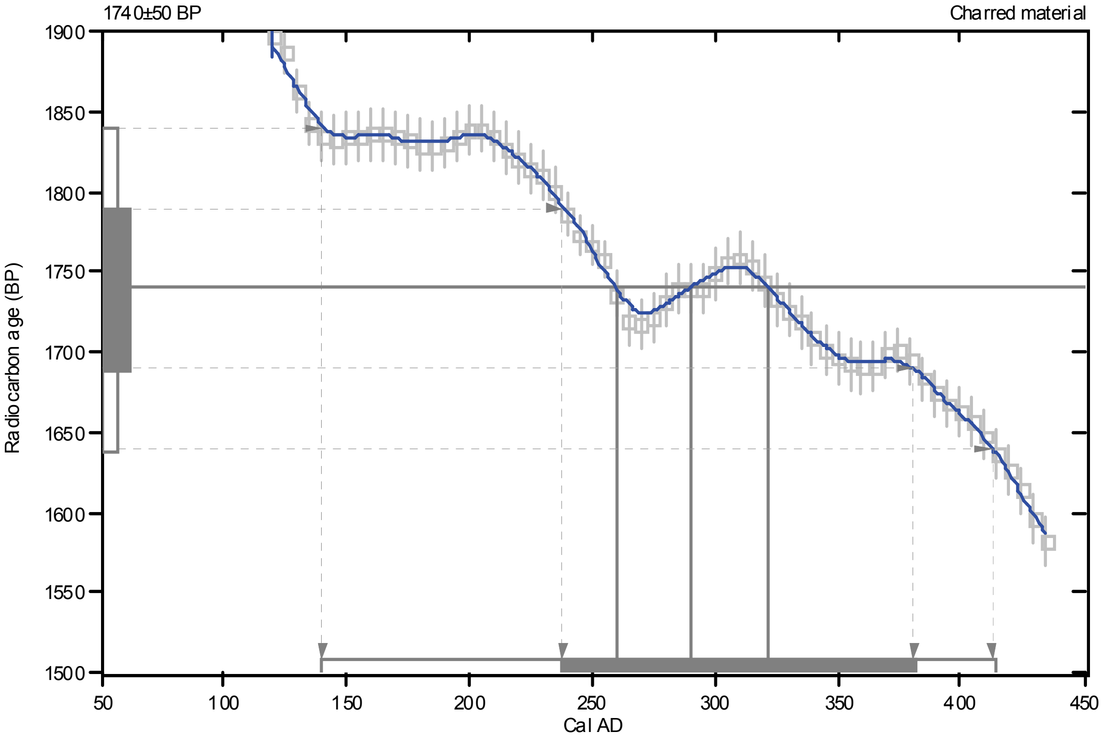
# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.7:lab. mult=1)

| | |
|---|---|
| **Laboratory number:** | **Beta-230757** |
| **Conventional radiocarbon age:** | **1740±50 BP** |
| **2 Sigma calibrated result:**<br>**(95% probability)** | **Cal AD 140 to 410 (Cal BP 1810 to 1540)** |

Intercept data

| | |
|---|---|
| Intercepts of radiocarbon age with calibration curve: | Cal AD 260 (Cal BP 1690) and<br>Cal AD 290 (Cal BP 1660) and<br>Cal AD 320 (Cal BP 1630) |
| 1 Sigma calibrated result:<br>(68% probability) | Cal AD 240 to 380 (Cal BP 1710 to 1570) |



References:

*Database used*

*INTCAL04*

***Calibration Database***

***INTCAL04 Radiocarbon Age Calibration***

*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*

***Mathematics***

***A Simplified Approach to Calibrating C14 Dates***

*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

## Beta Analytic Radiocarbon Dating Laboratory

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## 7. Beta-230758 Report Form (1BR15)

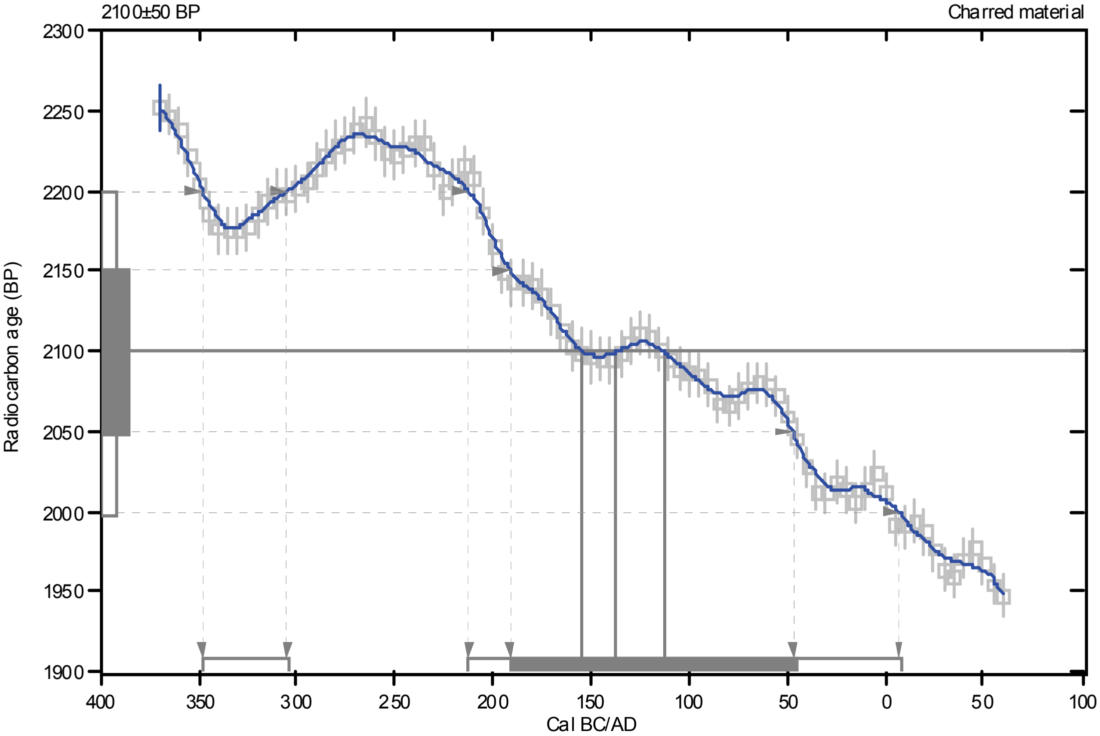
# CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.2:lab. mult=1)

| | |
|---|---|
| **Laboratory number:** | **Beta-230758** |
| **Conventional radiocarbon age:** | **2100±50 BP** |
| **2 Sigma calibrated results:**<br>**(95% probability)** | **Cal BC 350 to 300 (Cal BP 2300 to 2260) and**<br>**Cal BC 210 to Cal AD 10 (Cal BP 2160 to 1940)** |

Intercept data

| | |
|---|---|
| Intercepts of radiocarbon age with calibration curve: | Cal BC 150 (Cal BP 2100) and<br>Cal BC 140 (Cal BP 2090) and<br>Cal BC 110 (Cal BP 2060) |
| 1 Sigma calibrated result:<br>(68% probability) | Cal BC 190 to 50 (Cal BP 2140 to 2000) |



References:

***Database used***
*INTCAL04*
***Calibration Database***
***INTCAL04 Radiocarbon Age Calibration***
*IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).*
***Mathematics***
***A Simplified Approach to Calibrating C14 Dates***
*Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322*

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## 8. Diversity Scores, Bootstrapped Means, and Confidence Limits for Assemblages

| Assemblage | Label | Simpson's D | Boot Mean | P_25 | P_97.5 |
|---|---|---|---|---|---|
| 1BR15-X1-Pre Md | 01 | 1.10497 | 1.10598 | 1.02739 | 1.23891 |
| 1BR15-X1-Primary | 02 | 1.03418 | 1.03481 | 1.00000 | 1.11391 |
| 8GU60-TUBL4-8 | 03 | 1.07680 | 1.08022 | 1.00000 | 1.17763 |
| 8GU60-TUBL1-3 | 04 | 1.07171 | 1.07164 | 1.00000 | 1.18068 |
| 1BR15-X1-Tertiary | 05 | 1.52471 | 1.53569 | 1.25080 | 1.89547 |
| 9CY1-1200W590 | 06 | 1.59819 | 1.59954 | 1.31985 | 1.99272 |
| 8GU56-TUC/D | 07 | 1.59837 | 1.59569 | 1.33888 | 1.86894 |
| 8GU56-TUA/B | 08 | 1.58705 | 1.59470 | 1.32047 | 1.95014 |
| 8FR4-9-3 | 09 | 2.02787 | 2.03999 | 1.59650 | 2.64158 |
| 9CY1-I-12- | 10 | 2.48544 | 2.47426 | 1.90205 | 3.18002 |
| 9CY1-I-6-12 | 11 | 3.24736 | 3.16472 | 2.74074 | 3.64824 |
| 9CY1-I-0-6 | 12 | 3.73310 | 3.61141 | 3.04561 | 4.12971 |
| 9QU58 | 13 | 3.30433 | 3.21415 | 2.65825 | 3.72771 |
| 9CE4-12-18 | 14 | 3.17070 | 3.11415 | 2.46890 | 3.78438 |
| 9CY1-II | 15 | 3.65283 | 3.53379 | 3.00714 | 4.10187 |
| 9CE4-6-12 | 16 | 2.98708 | 2.94016 | 2.46889 | 3.52382 |
| 9CE4-0-6 | 17 | 2.71014 | 2.67193 | 2.25443 | 3.20797 |
| 9CY1-900W900 | 18 | 2.76130 | 2.71343 | 2.27503 | 3.16167 |
| 9CY1-III-12-27 | 19 | 3.46541 | 3.38263 | 2.66085 | 4.10803 |
| 9CY1-440W590 | 20 | 2.63563 | 2.61567 | 1.98838 | 3.35539 |
| 9CY1-1100W1000 | 21 | 2.20318 | 2.20533 | 1.74506 | 2.76008 |
| 9SW71 | 22 | 2.82802 | 2.78889 | 2.18341 | 3.49013 |
| 9CY1-III-0-12 | 23 | 2.73117 | 2.74160 | 2.12495 | 3.47022 |
| 9CY1-IV-6-24 | 24 | 2.17344 | 2.18247 | 1.71823 | 2.78117 |
| 9CY1-IV-0-6 | 25 | 2.32332 | 2.32262 | 1.78546 | 2.99726 |
| 9CY1-1300W1000 | 26 | 1.73388 | 1.75010 | 1.39837 | 2.24335 |
| 9CY1-900W1200 | 27 | 1.47107 | 1.46957 | 1.24285 | 1.74506 |
| 8LE148 WB.Str 2 Pits | 28 | 1.75524 | 1.76074 | 1.37037 | 2.27032 |
| 9CY1-840W1200 | 29 | 1.38843 | 1.39463 | 1.17966 | 1.69483 |
| 9CE16 | 30 | 1.64925 | 1.64908 | 1.32848 | 2.10054 |
| 8FR2-II-2 | 31 | 1.33236 | 1.34082 | 1.14705 | 1.61154 |
| 8FR2-II-1 | 32 | 1.30031 | 1.30353 | 1.11573 | 1.56681 |
| 8FR2-I-1 | 33 | 1.24945 | 1.25893 | 1.08565 | 1.48602 |
| 8WA30_-445L100 | 34 | 1.17917 | 1.17818 | 1.05551 | 1.36219 |
| 8WA30_-505R15 | 35 | 1.20097 | 1.20640 | 1.05592 | 1.39765 |
| 8WA30_-505L105 | 36 | 1.09330 | 1.09445 | 1.00000 | 1.21258 |
| 8FR2-PIII-6 | 37 | 1.12994 | 1.13605 | 1.02739 | 1.28605 |
| 8WA30_-505L100 | 38 | 1.08768 | 1.08978 | 1.00000 | 1.21419 |
| 8WA30_-505R20 | 39 | 1.07997 | 1.08162 | 1.00000 | 1.18170 |
| 8BY10 | 40 | 1.14174 | 1.14317 | 1.02739 | 1.28847 |
| 8FR2-PIII-5 | 41 | 1.14249 | 1.14918 | 1.02739 | 1.32334 |
| 8WA30_-510R20 | 42 | 1.02297 | 1.02341 | 1.00000 | 1.08522 |
| 8WA8-PI-7 | 43 | 1.01399 | 1.01526 | 1.00000 | 1.05551 |
| 8GU38 | 44 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |
| 9CE42 | 45 | 1.10859 | 1.10981 | 1.01370 | 1.24994 |
| 8JA63-12-18 | 46 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |
| 8JA63-6-12 | 47 | 1.02566 | 1.02565 | 1.00000 | 1.08522 |
| 8JA63-0-6 | 48 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |
| 9ER1-TU6 | 49 | 1.00673 | 1.00721 | 1.00000 | 1.05551 |
| 8WA8-PI-6 | 50 | 1.10863 | 1.11171 | 1.00000 | 1.24852 |
| 9SE14-C | 51 | 1.08381 | 1.08591 | 1.00000 | 1.21581 |
| 9ER1-U4-2-3 | 52 | 1.02593 | 1.02691 | 1.00000 | 1.08565 |
| 9SE33-Mid. G | 53 | 1.11296 | 1.11484 | 1.02739 | 1.25137 |
| 9ER1-TU10 | 54 | 1.05260 | 1.05309 | 1.00000 | 1.14417 |
| 9ER1-TU15 | 55 | 1.07068 | 1.06934 | 1.00000 | 1.17966 |
| 8BY73-40-80 cm | 56 | 1.06277 | 1.06179 | 1.00000 | 1.14705 |
| 9ER103 | 57 | 1.07134 | 1.07338 | 1.00000 | 1.17511 |
| 9ER1-U4-4-6 | 58 | 1.12437 | 1.12778 | 1.02739 | 1.25194 |

| | | | | | |
|---|---|---|---|---|---|
| 9ER1-TU17 | 59 | 1.08524 | 1.08451 | 1.00000 | 1.21258 |
| 9ER1-Md. C | 60 | 1.11179 | 1.11390 | 1.02739 | 1.24285 |
| 9ER1-U4-7-12 | 61 | 1.15382 | 1.15581 | 1.05551 | 1.32334 |
| 9ER1-Md. H | 62 | 1.30039 | 1.30778 | 1.11618 | 1.56368 |
| 8WA30_-160L110 | 63 | 1.25426 | 1.25657 | 1.08522 | 1.48120 |
| 8WA30_-160L45 | 64 | 1.32691 | 1.32860 | 1.11618 | 1.57992 |
| 9ER1-TU14 | 65 | 1.34090 | 1.34117 | 1.14609 | 1.61059 |
| 9ER1-U2-SSB | 66 | 1.34957 | 1.34961 | 1.14705 | 1.61678 |
| 9ER1-TU7 | 67 | 1.65494 | 1.65248 | 1.29120 | 2.09675 |
| 9ER1-Md. A | 68 | 1.48564 | 1.48981 | 1.24285 | 1.76875 |
| 9SE33-Mid J | 69 | 1.56372 | 1.56714 | 1.28696 | 1.94599 |
| 8BY73-20-40 cm | 70 | 1.79792 | 1.81038 | 1.40989 | 2.26937 |
| 9ER1-TU18 | 71 | 1.89704 | 1.90771 | 1.52027 | 2.42838 |
| 9ER1-TU9 | 72 | 2.01001 | 1.99006 | 1.68492 | 2.29698 |
| 8FR2-PIII-3 | 73 | 2.88805 | 2.82944 | 2.28548 | 3.36779 |
| 8FR2-PIII-2 | 74 | 3.07033 | 3.01815 | 2.47114 | 3.59790 |
| 8WA30_155L220 | 75 | 3.37272 | 3.30028 | 2.70020 | 3.84011 |
| 8BY73-0-20 cm | 76 | 3.24000 | 3.18906 | 2.61010 | 3.84551 |
| 8WA30_100L60 | 77 | 3.62158 | 3.53864 | 2.90043 | 4.14221 |
| 8WA8-PI-2 | 78 | 2.74809 | 2.70002 | 2.22964 | 3.14532 |
| 9SE33-Mid E | 79 | 2.78135 | 2.74613 | 2.13990 | 3.43539 |
| 8BY9 | 80 | 5.24560 | 4.99675 | 4.18335 | 5.69824 |
| 8JA5 | 81 | 3.68475 | 3.58974 | 2.89429 | 4.13283 |
| 8JA19 | 82 | 2.78728 | 2.76734 | 2.14409 | 3.43108 |
| 8FR4-10-6 | 83 | 2.60988 | 2.59357 | 1.97191 | 3.28692 |
| 8BY24 | 84 | 1.50961 | 1.51317 | 1.25137 | 1.86259 |
| 8BY137-TUs | 85 | 1.52286 | 1.53614 | 1.24909 | 1.89875 |
| 8FR4-9-2 | 86 | 1.56791 | 1.57356 | 1.28908 | 1.96202 |
| 8WA13 | 87 | 1.33000 | 1.33835 | 1.14705 | 1.57492 |
| 8GD13-Below Shell | 88 | 1.44172 | 1.44750 | 1.21581 | 1.76759 |
| 8FR4-9-1 | 89 | 1.27551 | 1.27889 | 1.11527 | 1.50110 |
| 8JA233 | 90 | 1.24185 | 1.24601 | 1.08522 | 1.45949 |
| 9SE102 | 91 | 1.19381 | 1.19541 | 1.05551 | 1.38074 |
| 8FR4-10-5 | 92 | 1.16734 | 1.16630 | 1.05551 | 1.32334 |
| 8FR4-10-4 | 93 | 1.15340 | 1.15099 | 1.02739 | 1.30493 |
| 8GD13-Shell Contemp | 94 | 1.18111 | 1.18627 | 1.05551 | 1.38969 |
| 8GD13-Shell | 95 | 1.12003 | 1.11892 | 1.02739 | 1.25252 |
| 8FR4-10-3 | 96 | 1.06183 | 1.06068 | 1.00000 | 1.14801 |
| 8GD13-Above Shell | 97 | 1.12242 | 1.12186 | 1.02739 | 1.25338 |
| 8FR4-10-1 | 98 | 1.39079 | 1.39645 | 1.17840 | 1.68648 |
| 8LI8 | 99 | 1.03202 | 1.03373 | 1.00000 | 1.11550 |

## 9. Diversity Scores, Bootstrapped Means, and Confidence Limits for Phases

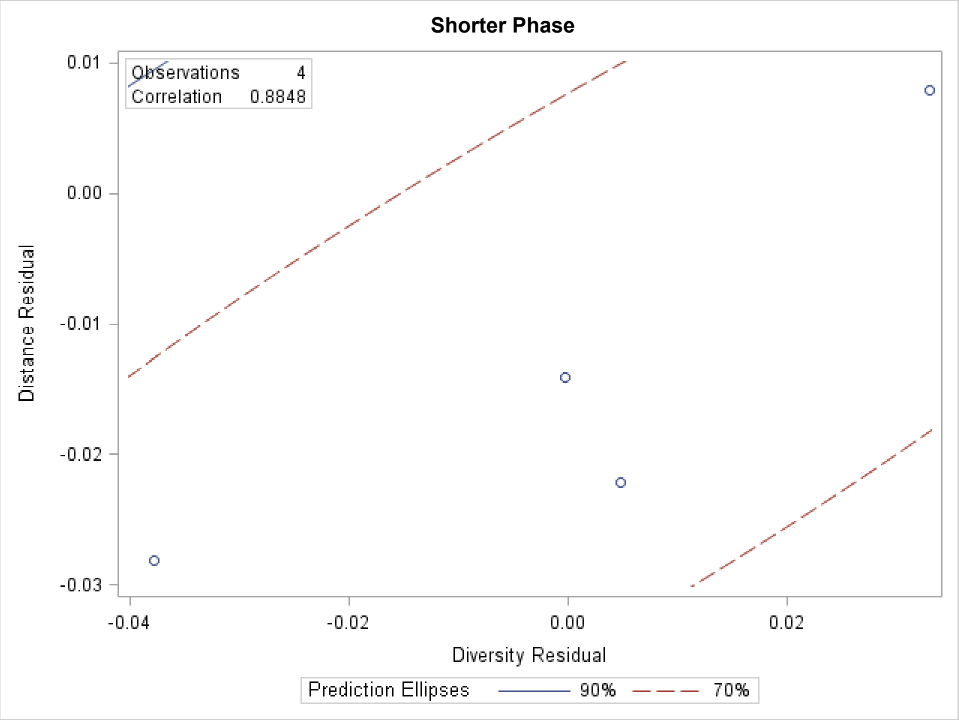
| Phase | LABEL | Simpson's D | Boot Mean | P_25 | P_97.5 |
|---|---|---|---|---|---|
| Shorter | 01 | 1.084243 | 1.08400 | 1.04359 | 1.13269 |
| Mandeville I | 02 | 1.672004 | 1.67363 | 1.52993 | 1.84782 |
| Halloca Creek | 03 | 3.448331 | 3.43094 | 3.17252 | 3.69368 |
| Mandeville II | 04 | 2.401287 | 2.39924 | 2.10005 | 2.70115 |
| Swift Creek | 05 | 1.158558 | 1.15821 | 1.10160 | 1.22526 |
| Kolomoki I | 06 | 1.087757 | 1.08886 | 1.04929 | 1.13853 |
| Kolomoki II | 07 | 1.451512 | 1.45209 | 1.33595 | 1.58807 |
| Hare's Landing | 08 | 4.153117 | 4.12365 | 3.78607 | 4.46947 |
| Late Weeden Island | 09 | 3.07193 | 3.06475 | 2.73662 | 3.40567 |
| Sycamore | 10 | 1.126382 | 1.12856 | 1.07810 | 1.18563 |

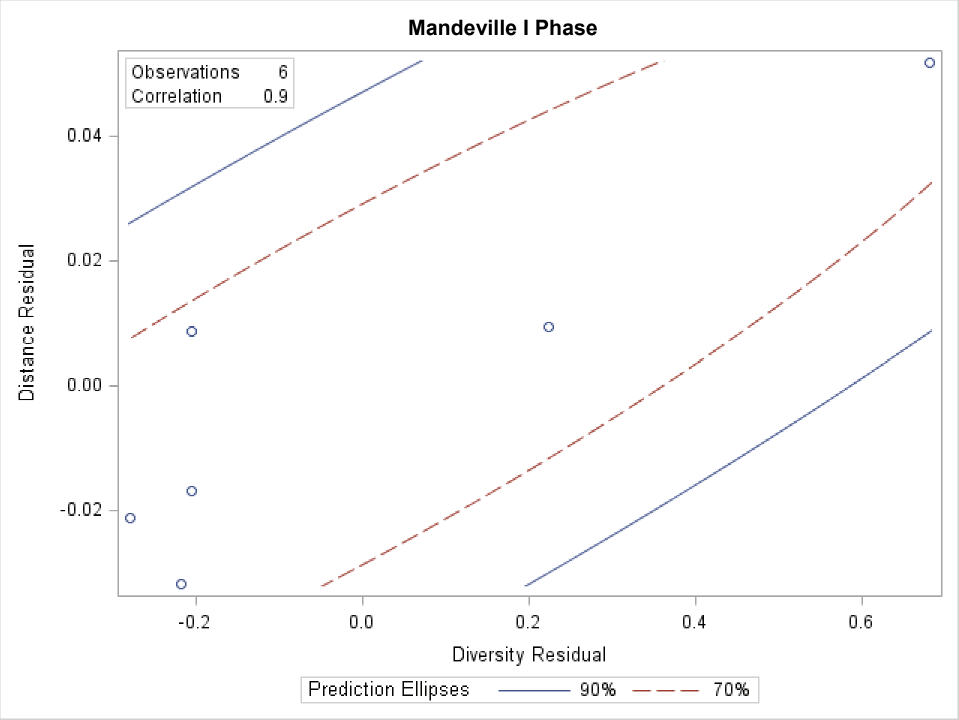
## 10. Diversity and Distance Residuals

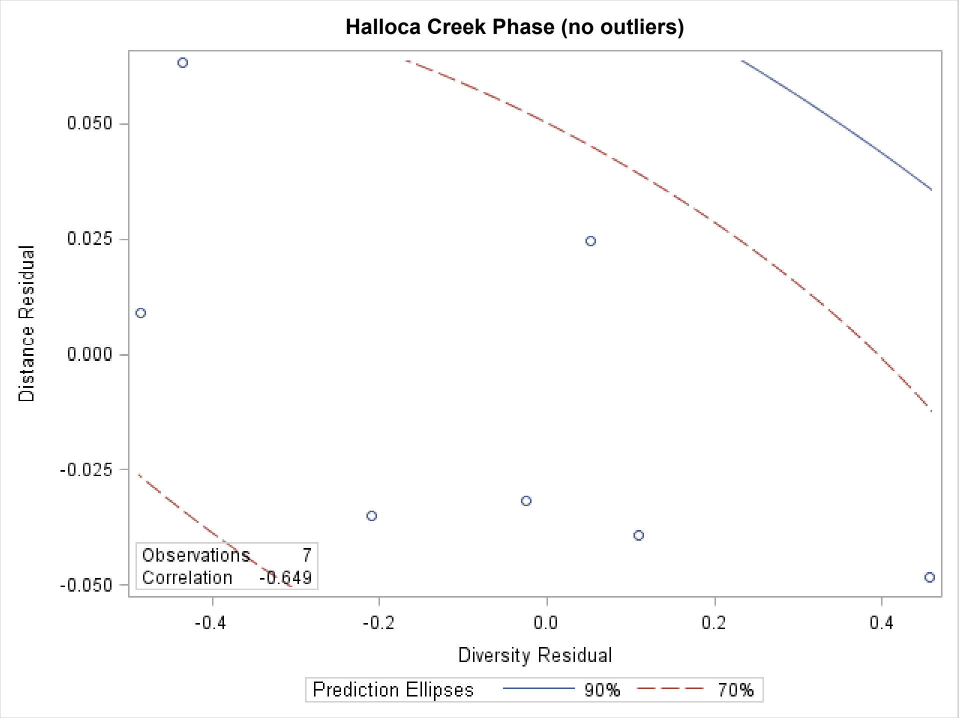
| Assemblage | Phase | PhaseII | Diversity Residual | Distance Residual |
|---|---|---|---|---|
| 1BR15-X1-Pre Md | Shorter | P01 | 0.03306 | 0.00793 |
| 1BR15-X1-Primary | Shorter | P01 | -0.03774 | -0.02811 |
| 8GU60-TUBL4-8 | Shorter | P01 | 0.00488 | -0.02210 |
| 8GU60-TUBL1-3 | Shorter | P01 | -0.00021 | -0.01409 |
| 1BR15-X1-Tertiary | MandevI | P01 | -0.27889 | -0.02112 |
| 9CY1-1200W590 | MandevI | P01 | -0.20542 | -0.01679 |
| 8GU56-TUC/D | MandevI | P01 | -0.20524 | 0.00864 |
| 8GU56-TUA/B | MandevI | P01 | -0.21656 | -0.03185 |
| 8FR4-9-3 | MandevI | P01 | 0.22427 | 0.00938 |
| 9CY1-I-12- | MandevI | P01 | 0.68183 | 0.05173 |
| 9CY1-I-6-12 | Halloca | P02 | 0.05150 | 0.02474 |
| 9CY1-I-0-6 | Halloca | P02 | 0.53725 | 0.05696 |
| 9QU58 | Halloca | P02 | 0.10848 | -0.03933 |
| 9CE4-12-18 | Halloca | P02 | -0.02515 | -0.03157 |
| 9CY1-II | Halloca | P02 | 0.45698 | -0.04827 |
| 9CE4-6-12 | Halloca | P02 | -0.20878 | -0.03484 |
| 9CE4-0-6 | Halloca | P02 | -0.48571 | 0.00895 |
| 9CY1-900W900 | Halloca | P02 | -0.43456 | 0.06337 |
| 9CY1-III-12-27 | MandevII | P02 | 1.26890 | 0.09551 |
| 9CY1-440W590 | MandevII | P02 | 0.43912 | -0.02746 |
| 9CY1-1100W1000 | MandevII | P02 | 0.00668 | -0.02050 |
| 9SW71 | MandevII | P02 | 0.63151 | 0.02449 |
| 9CY1-III-0-12 | MandevII | P02 | 0.53466 | 0.00014 |
| 9CY1-IV-6-24 | MandevII | P02 | -0.02306 | -0.03868 |
| 9CY1-IV-0-6 | MandevII | P02 | 0.12682 | -0.04053 |
| 9CY1-1300W1000 | MandevII | P02 | -0.46262 | -0.03183 |
| 9CY1-900W1200 | MandevII | P02 | -0.72543 | 0.01314 |
| 8LE148 WB.Str 2 Pits | MandevII | P02 | -0.44127 | -0.00485 |
| 9CY1-840W1200 | MandevII | P02 | -0.80807 | 0.03051 |
| 9CE16 | MandevII | P02 | -0.54725 | 0.00005 |
| 8FR2-II-2 | SwiftCreek | P02 | 0.15287 | 0.02776 |
| 8FR2-II-1 | SwiftCreek | P02 | 0.12082 | 0.00928 |
| 8FR2-I-1 | SwiftCreek | P02 | 0.06996 | -0.00270 |
| 8WA30_-445L100 | SwiftCreek | P03 | -0.00032 | -0.00449 |
| 8WA30_-505R15 | SwiftCreek | P03 | 0.02148 | -0.00857 |
| 8WA30_-505L105 | SwiftCreek | P03 | -0.08619 | -0.00225 |
| 8FR2-PIII-6 | SwiftCreek | P03 | -0.04955 | -0.01184 |
| 8WA30_-505L100 | SwiftCreek | P03 | -0.09181 | -0.00475 |
| 8WA30_-505R20 | SwiftCreek | P03 | -0.09952 | 0.00032 |
| 8BY10 | SwiftCreek | P03 | -0.03775 | -0.00276 |
| 8FR2-PIII-5 | KolomokiI | P03 | 0.07656 | 0.01502 |
| 8WA30_-510R20 | KolomokiI | P03 | -0.04295 | -0.00403 |
| 8WA8-PI-7 | KolomokiI | P03 | -0.05194 | -0.00308 |
| 8GU38 | KolomokiI | P03 | -0.06592 | -0.00015 |
| 9CE42 | KolomokiI | P03 | 0.04267 | 0.00095 |
| 8JA63-12-18 | KolomokiI | P03 | -0.06592 | -0.00015 |
| 8JA63-6-12 | KolomokiI | P03 | -0.04026 | -0.00670 |
| 8JA63-0-6 | KolomokiI | P03 | -0.06592 | -0.00015 |
| 9ER1-TU6 | KolomokiI | P03 | -0.05919 | -0.00202 |
| 8WA8-PI-6 | KolomokiI | P03 | 0.04271 | 0.00450 |
| 9SE14-C | KolomokiI | P03 | 0.01789 | -0.00602 |

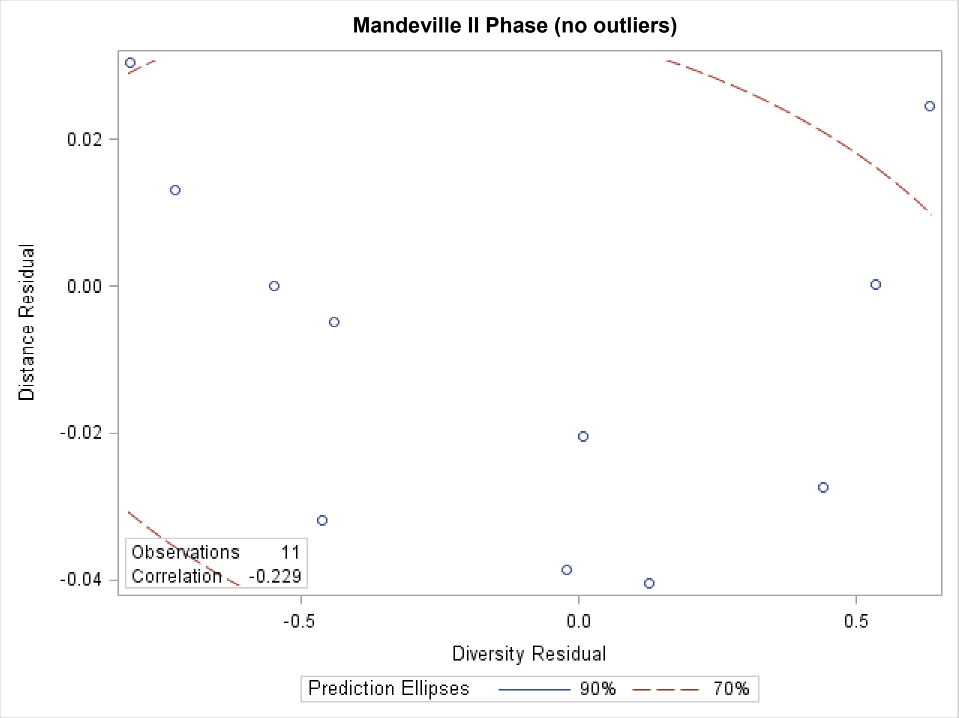
| Assemblage | Phase | PhaseII | Diversity Residual | Distance Residual |
|---|---|---|---|---|
| 9ER1-U4-2-3 | KolomokiI | P03 | -0.03999 | -0.00732 |
| 9SE33-Mid. G | KolomokiI | P03 | 0.04703 | -0.00129 |
| 9ER1-TU10 | KolomokiI | P03 | -0.01333 | -0.00553 |
| 9ER1-TU15 | KolomokiI | P03 | 0.00476 | -0.00776 |
| 8BY73-40-80 cm | KolomokiI | P03 | -0.00315 | -0.00718 |
| 9ER103 | KolomokiI | P03 | 0.00542 | 0.00377 |
| 9ER1-U4-4-6 | KolomokiI | P03 | 0.05845 | 0.00695 |
| 9ER1-TU17 | KolomokiI | P03 | 0.01932 | -0.00287 |
| 9ER1-Md. C | KolomokiI | P03 | 0.04586 | 0.00901 |
| 9ER1-U4-7-12 | KolomokiI | P03 | 0.08790 | 0.01407 |
| 9ER1-Md. H | KolomokiII | P04 | -0.24337 | -0.02605 |
| 8WA30_-160L110 | KolomokiII | P04 | -0.28950 | -0.00516 |
| 8WA30_-160L45 | KolomokiII | P04 | -0.21685 | -0.03170 |
| 9ER1-TU14 | KolomokiII | P04 | -0.20286 | -0.03254 |
| 9ER1-U2-SSB | KolomokiII | P04 | -0.19419 | -0.03431 |
| 9ER1-TU7 | KolomokiII | P04 | 0.11118 | -0.01538 |
| 9ER1-Md. A | KolomokiII | P04 | -0.05811 | -0.00508 |
| 9SE33-Mid J | KolomokiII | P04 | 0.01997 | -0.03321 |
| 8BY73-20-40 cm | KolomokiII | P04 | 0.25417 | -0.01234 |
| 9ER1-TU18 | KolomokiII | P04 | 0.35329 | 0.01487 |
| 9ER1-TU9 | KolomokiII | P04 | 0.46626 | 0.18091 |
| 8FR2-PIII-3 | HaresLdg | P04 | -0.48291 | -0.05237 |
| 8FR2-PIII-2 | HaresLdg | P04 | -0.30063 | -0.02687 |
| 8WA30_155L220 | HaresLdg | P04 | 0.00175 | -0.06643 |
| 8BY73-0-20 cm | HaresLdg | P04 | -0.13097 | 0.08568 |
| 8WA30_100L60 | HaresLdg | P04 | 0.25062 | -0.09038 |
| 8WA8-PI-2 | HaresLdg | P04 | -0.62288 | 0.01755 |
| 9SE33-Mid E | HaresLdg | P04 | -0.58961 | 0.10503 |
| 8BY9 | HaresLdg | P04 | 1.87464 | 0.02779 |
| 8JA5 | LateWI | P04 | 0.65744 | 0.02742 |
| 8JA19 | LateWI | P04 | -0.24002 | -0.03181 |
| 8FR4-10-6 | LateWI | P04 | -0.41742 | 0.00439 |
| 8BY24 | Sycamore | P05 | 0.24010 | 0.02593 |
| 8BY137-TUs | Sycamore | P05 | 0.25335 | 0.03477 |
| 8FR4-9-2 | Sycamore | P05 | 0.29839 | 0.02749 |
| 8WA13 | Sycamore | P05 | 0.06049 | 0.00729 |
| 8GD13-Below Shell | Sycamore | P05 | 0.17221 | 0.01066 |
| 8FR4-9-1 | Sycamore | P05 | 0.00599 | -0.00717 |
| 8JA233 | Sycamore | P05 | -0.02766 | -0.01991 |
| 9SE102 | Sycamore | P05 | -0.07570 | -0.00084 |
| 8FR4-10-5 | Sycamore | P05 | -0.10217 | -0.02069 |
| 8FR4-10-4 | Sycamore | P05 | -0.11611 | -0.01664 |
| 8GD13-Shell Contemp | Sycamore | P05 | -0.08840 | -0.02114 |
| 8GD13-Shell | Sycamore | P05 | -0.14949 | -0.01789 |
| 8FR4-10-3 | Sycamore | P05 | -0.20768 | 0.00311 |
| 8GD13-Above Shell | Sycamore | P05 | -0.14710 | -0.01779 |
| 8FR4-10-1 | Sycamore | P05 | 0.12128 | 0.00024 |
| 8LI8 | Sycamore | P05 | -0.23749 | 0.01258 |

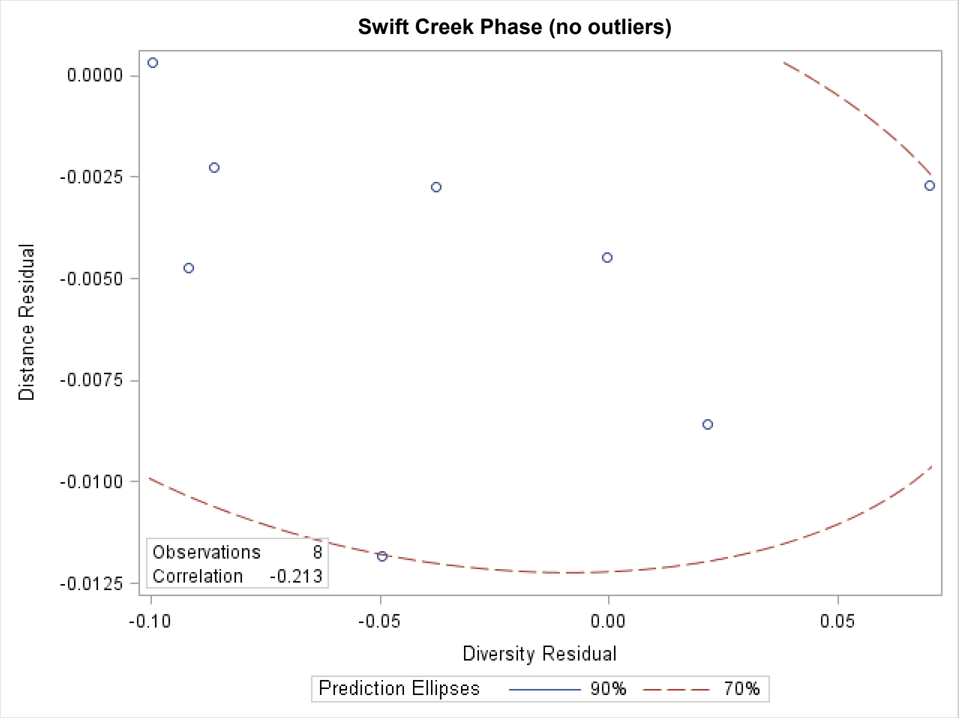
## 11. Diversity and Distance Residual Plots by Phase

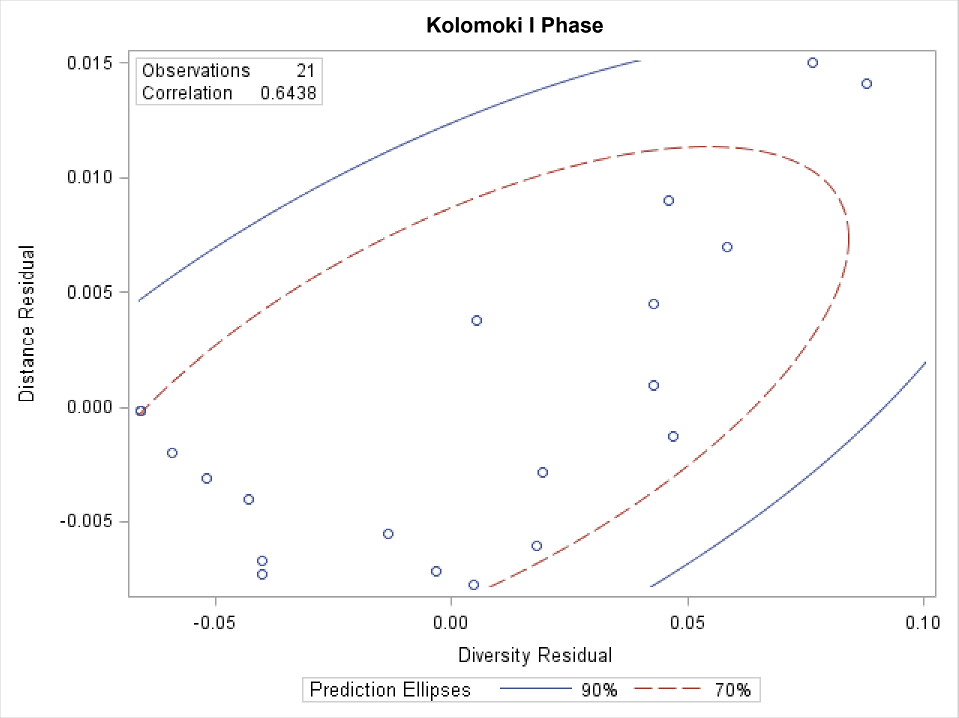


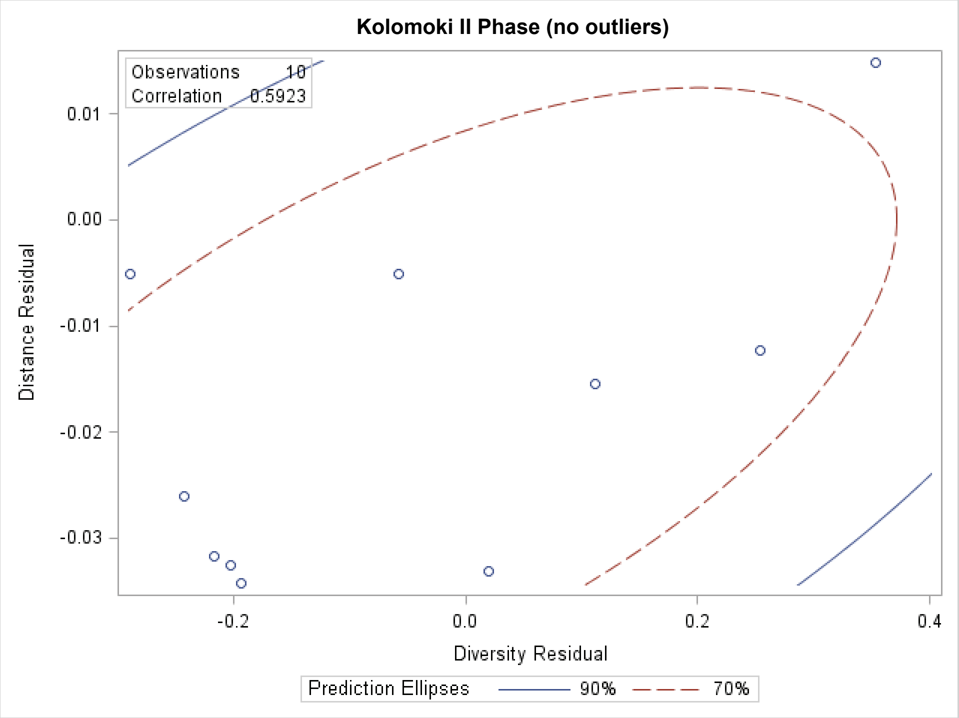


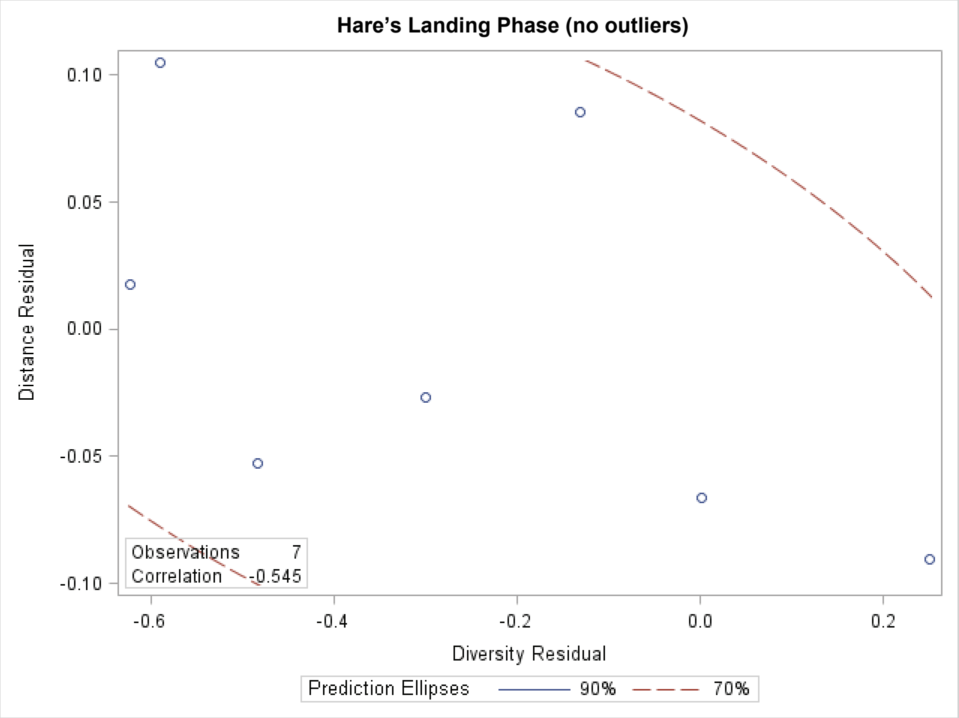

Halloca Creek Phase (no outliers)
Distance Residual
0.050
0.025
0.000
-0.025
-0.050
-0.4
-0.2
0.0
0.2
0.4
Diversity Residual
Observations 7
Correlation -0.649
Prediction Ellipses
90%
70%

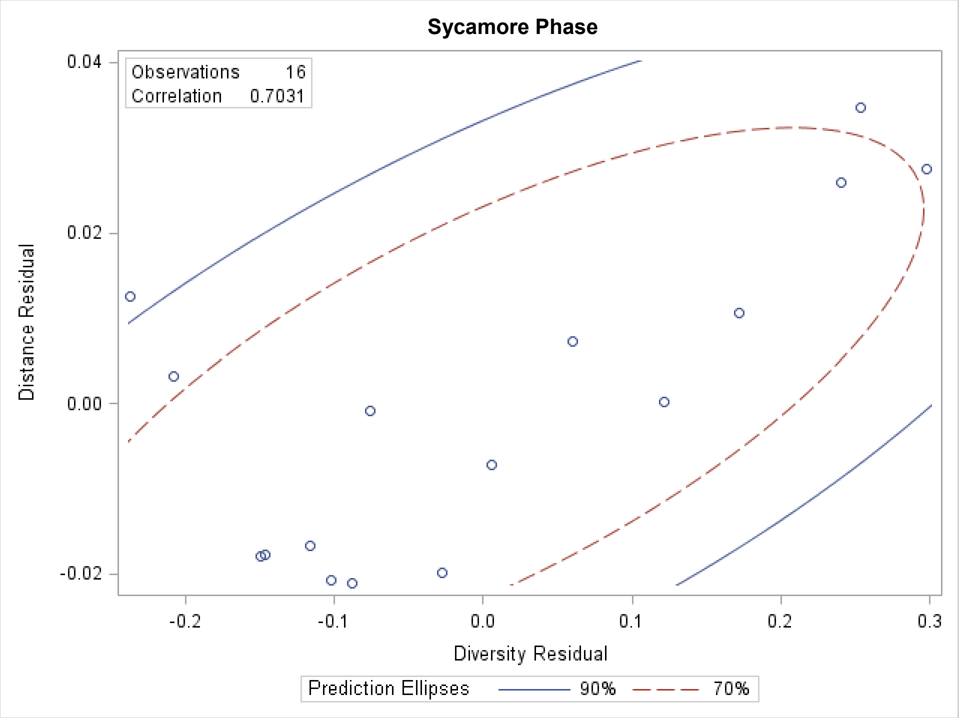

Mandeville II Phase (no outliers)
Distance Residual
0.02
0.00
-0.02
-0.04
-0.5
0.0
0.5
Diversity Residual
Observations 11
Correlation -0.229
Prediction Ellipses
90%
70%


Swift Creek Phase (no outliers)
0.0000
-0.0025
-0.0050
-0.0075
-0.0100
-0.0125
Distance Residual
Observations 8
Correlation -0.213
-0.10
-0.05
0.00
0.05
Diversity Residual
Prediction Ellipses 90% 70%


Kolomoki I Phase
0.015
0.010
0.005
0.000
-0.005
Distance Residual
Observations 21
Correlation 0.6438
-0.05
0.00
0.05
0.10
Diversity Residual
Prediction Ellipses 90% 70%


Kolomoki II Phase (no outliers)
Observations 10
Correlation 0.5923
0.01
0.00
-0.01
-0.02
-0.03
Distance Residual
-0.2
0.0
0.2
0.4
Diversity Residual
Prediction Ellipses 90% 70%


Hare’s Landing Phase (no outliers)
0.10
0.05
0.00
-0.05
-0.10
Distance Residual
Observations 7
Correlation -0.545
-0.6
-0.4
-0.2
0.0
0.2
Diversity Residual
Prediction Ellipses 90% 70%

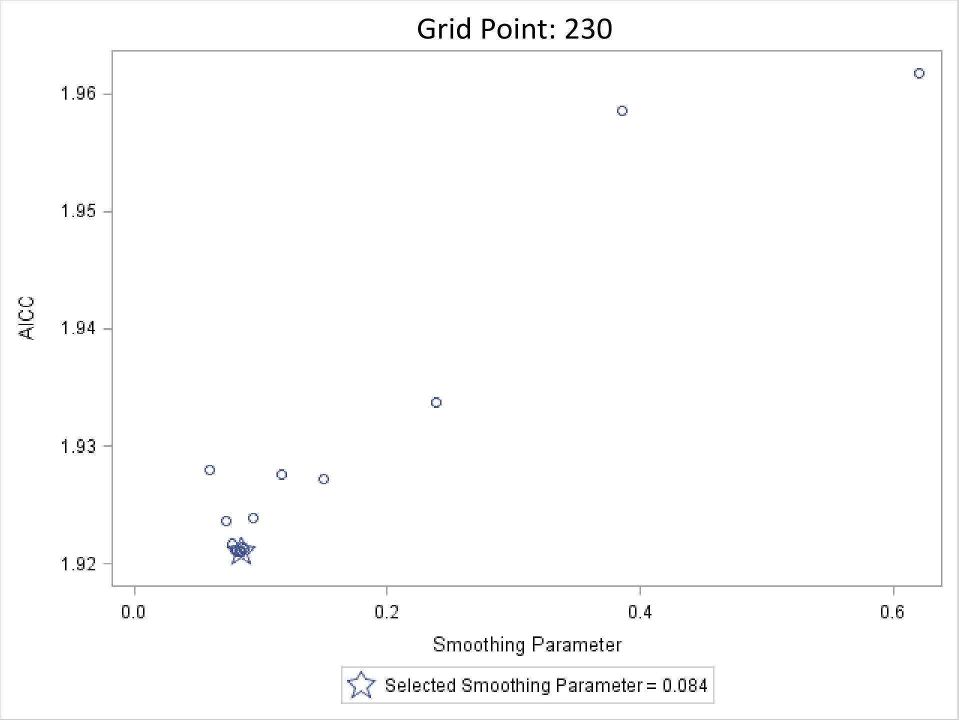

Sycamore Phase
Observations 16
Correlation 0.7031
0.04
0.02
0.00
-0.02
Distance Residual
-0.2
-0.1
0.0
0.1
0.2
0.3
Diversity Residual
Prediction Ellipses
90%
70%

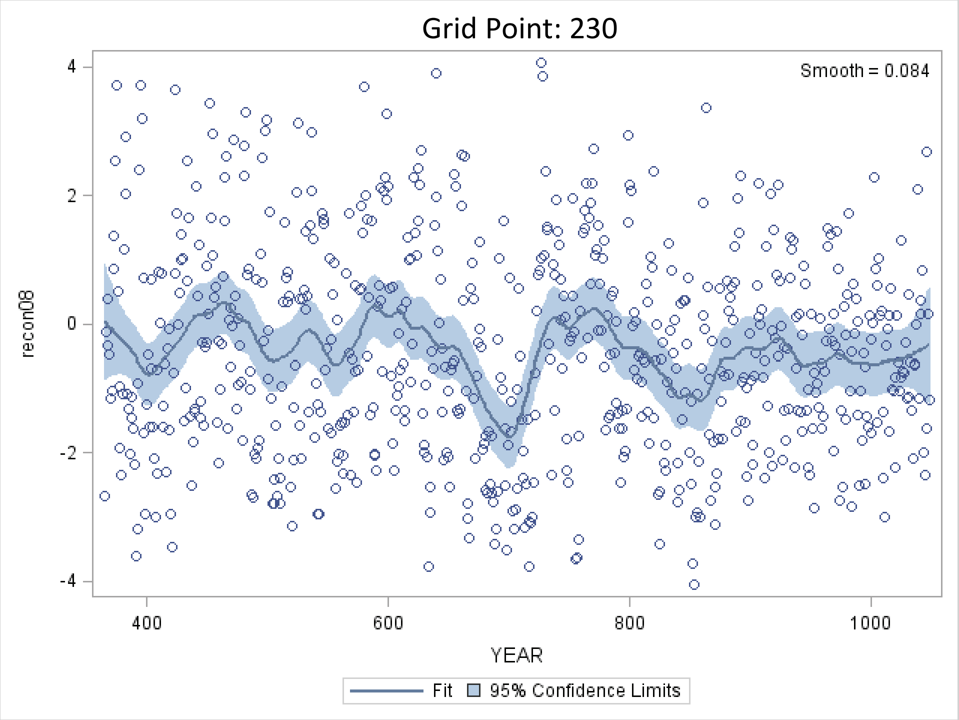
## 12. PDSI Smoothing Analysis Details and Results for Grid Point 230

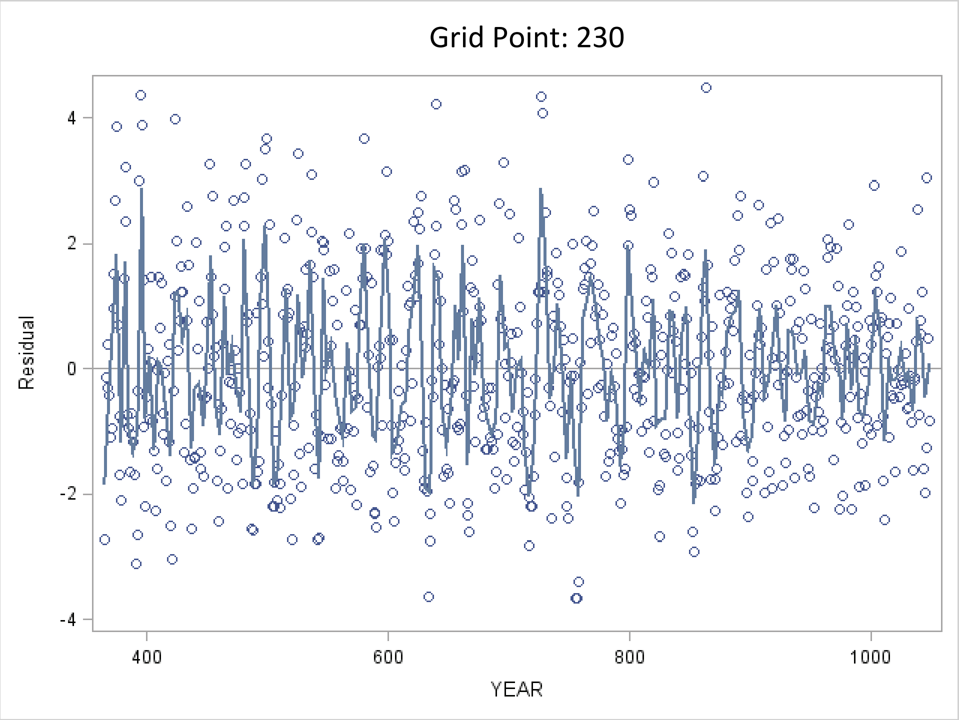
Grid Point: 230

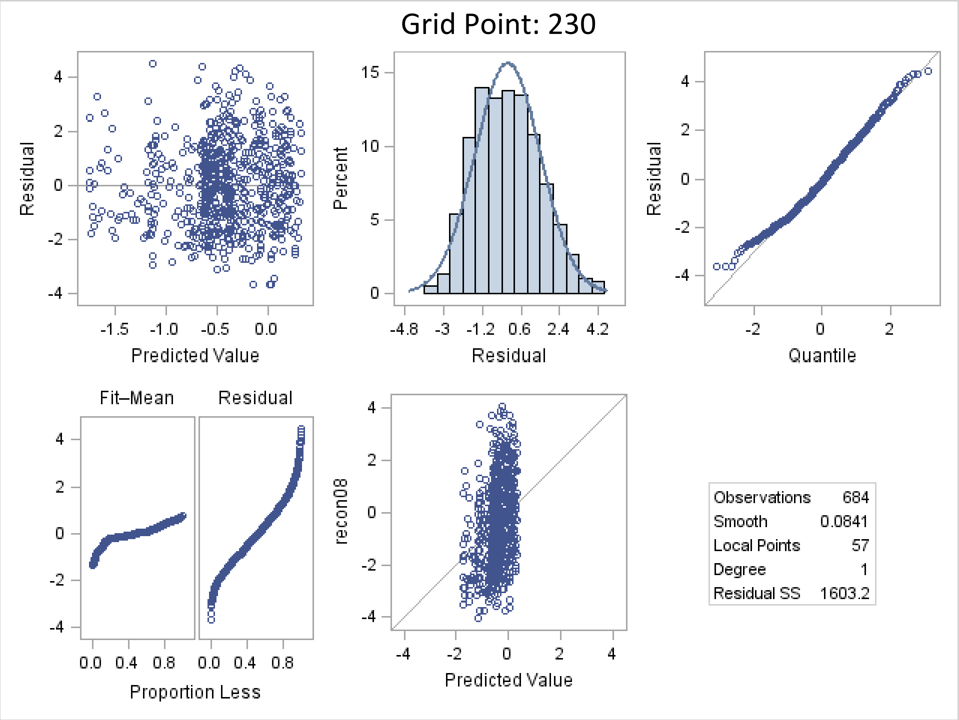
The LOESS Procedure
Selected Smoothing Parameter: 0.084
Dependent Variable: Year

| Fit Summary | |
|---|---|
| **Fit Method** | Direct |
| **Number of Observations** | 684 |
| **Degree of Local Polynomials** | 1 |
| **Smoothing Parameter** | 0.08406 |
| **Points in Local Neighborhood** | 57 |
| **Residual Sum of Squares** | 1603.23488 |
| **Trace[L]** | 21.84937 |
| **GCV** | 0.00366 |
| **AICC** | 1.92105 |
| **AICC1** | 1314.25938 |
| **Delta1** | 658.46355 |
| **Delta2** | 657.97336 |
| **Equivalent Number of Parameters** | 18.16229 |
| **Lookup Degrees of Freedom** | 658.95410 |
| **Residual Standard Error** | 1.56039 |




Grid Point: 230
Smooth = 0.084
recon08
4
2
0
-2
-4
400
600
800
1000
YEAR
Fit
95% Confidence Limits


Grid Point: 230
Residual
4
2
0
-2
-4
400
600
800
1000
YEAR

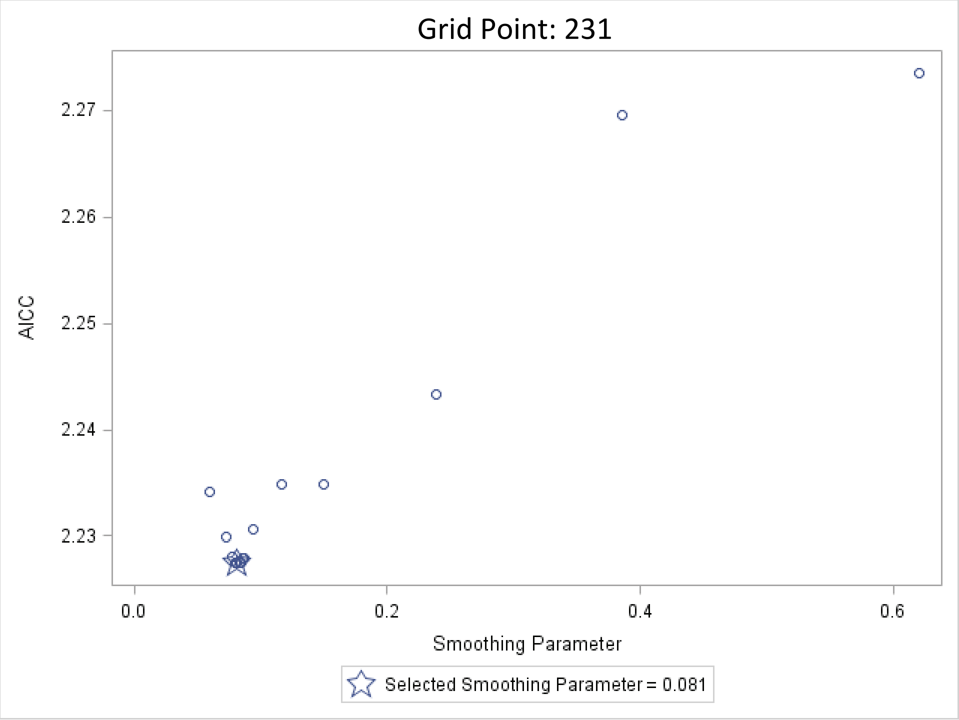

Grid Point: 230
Residual
4
2
0
-2
-4
-1.5
-1.0
-0.5
0.0
Predicted Value
Percent
15
10
5
0
-4.8
-3
-1.2
0.6
2.4
4.2
Residual
Residual
4
2
0
-2
-4
-2
0
2
Quantile
Fit–Mean
Residual
4
2
0
-2
-4
0.0
0.4
0.8
0.0
0.4
0.8
Proportion Less
recon08
4
2
0
-2
-4
-4
-2
0
2
4
Predicted Value
Observations 684
Smooth 0.0841
Local Points 57
Degree 1
Residual SS 1603.2

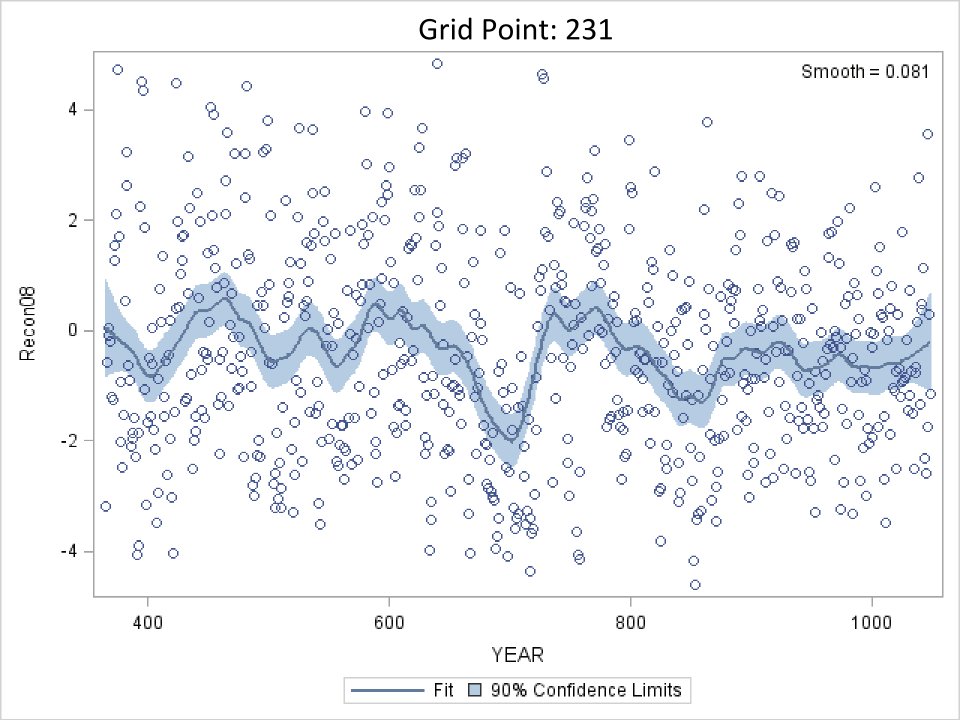
## 13. PDSI Smoothing Analysis Details and Results for Grid Point 231

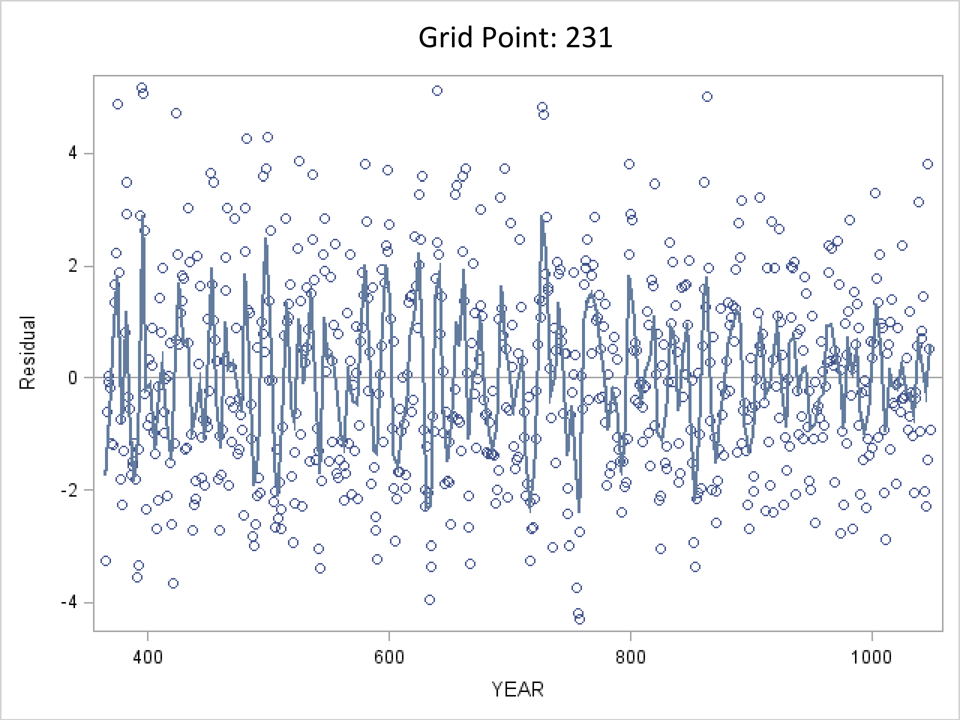
Grid Point: 231

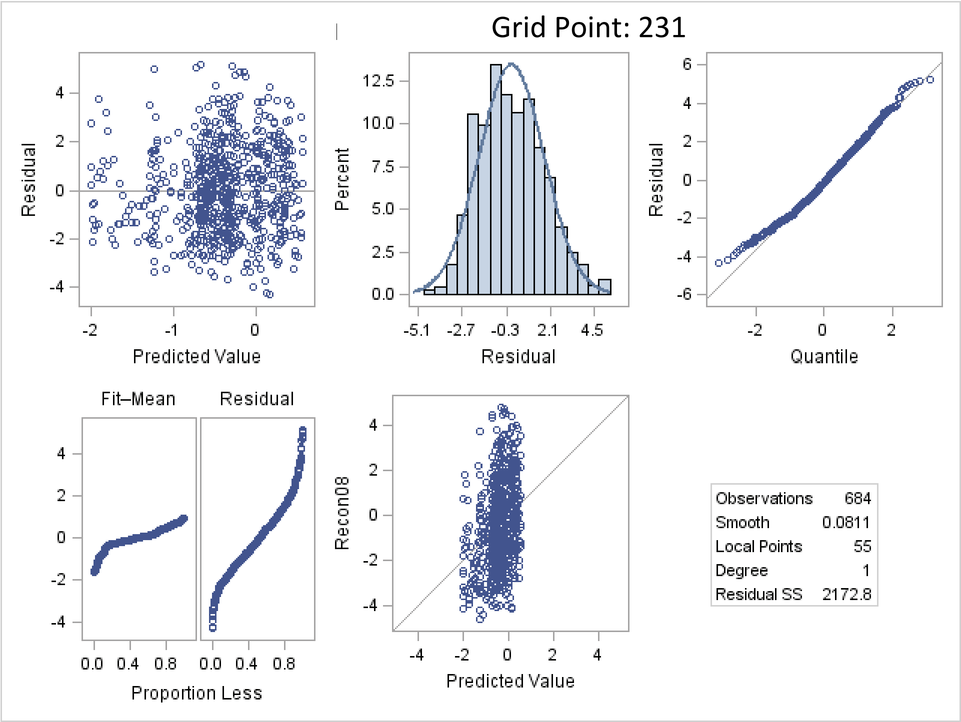
The LOESS Procedure
Selected Smoothing Parameter: 0.081
Dependent Variable: Year

| Fit Summary | |
|---|---|
| **Fit Method** | Direct |
| **Number of Observations** | 684 |
| **Degree of Local Polynomials** | 1 |
| **Smoothing Parameter** | 0.08114 |
| **Points in Local Neighborhood** | 55 |
| **Residual Sum of Squares** | 2172.81762 |
| **Trace[L]** | 22.63067 |
| **GCV** | 0.00497 |
| **AICC** | 2.22750 |
| **AICC1** | 1523.89369 |
| **Delta1** | 657.54149 |
| **Delta2** | 657.03825 |
| **Equivalent Number of Parameters** | 18.80283 |
| **Lookup Degrees of Freedom** | 658.04512 |
| **Residual Standard Error** | 1.81782 |




Grid Point: 231
Smooth = 0.081
Recon08
4
2
0
-2
-4
400
600
800
1000
YEAR
Fit
90% Confidence Limits


Grid Point: 231
Residual
4
2
0
-2
-4
400
600
800
1000
YEAR


Grid Point: 231
Residual
Predicted Value
Percent
Residual
-5.1
-2.7
-0.3
2.1
4.5
Residual
Quantile
Fit–Mean
Residual
Proportion Less
Recon08
Predicted Value
Observations 684
Smooth 0.0811
Local Points 55
Degree 1
Residual SS 2172.8

## 14. OxCal CQL Code and Results for Outlier Analysis with 50% Model Agreement

```
Plot()
 {
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence()
  {
   Boundary("Start Shorter");
   Phase("Shorter")
   {
   R_Date("Beta-230758", 2097, 50)
    {Outlier("General",0.1);};
    R_Date("Beta-230756", 1993, 40)
    {Outlier("General",0.1);};
    R_Date("Beta-230757", 1735, 50)
    {Outlier("General",0.1);};
    Interval("Shorter");
   };
   Boundary("Shorter to Mandevl");
   Phase("Mandevl")
   {
    R_Date("B-26898", 2010, 105)
    {Outlier("General",0.1);};
    R_Date("M-1042", 1960, 153)
    {Outlier("General",0.1);};
    R_Date("UGA-7B", 1810, 77)
    {Outlier("General",0.1);};
    R_Date("UGA-1B", 1800, 73)
    {Outlier("General",0.1);};
    R_Date("UGA-3B", 1775, 124)
    {Outlier("General",0.1);};
    Interval("Mandevl");
   };
   Boundary("Mandevl to Halloca");
   Phase("Halloca")
   {
    R_Date("DIC-3269", 2090, 68)
    {Outlier("General",0.1);};
    R_Date("M-1046", 2020, 153)
    {Outlier("General",0.1);};
    R_Date("DIC-3268", 2010, 59)
    {Outlier("General",0.1);};
    R_Date("UGA-2B", 1840, 77)
    {Outlier("General",0.1);};
    R_Date("UGA-16B", 1772, 91)
    {Outlier("General",0.1);};
    R_Date("UGA-5B", 1705, 77)
    {Outlier("General",0.1);};
    R_Date("UGA-14B", 1642, 77)
    {Outlier("General",0.1);};
    R_Date("UGA-4B", 1640, 73)
    {Outlier("General",0.1);};
```

```
 R_Date("UGA-6B", 1580, 73)
 {Outlier("General",0.1);};
 Interval("Halloca");
};
Boundary("Halloca to MandevII");
Phase("MandevII")
{
 R_Date("UGA-9B", 1860, 73)
 {Outlier("General",0.1);};
 R_Date("DIC-3270", 1740, 68)
 {Outlier("General",0.1);};
 R_Date("UGA-15B", 1667, 77)
 {Outlier("General",0.1);};
 R_Date("M-1045", 1460, 153)
 {Outlier("General",0.1);};
 R_Date("M-1044", 1420, 153)
 {Outlier("General",0.1);};
 Interval("MandevII");
};
Boundary("End MandevII");
Interval("MandevII to KolomokiI");
Boundary("Start KolomokiI");
Phase("KolomokiI")
{
 R_Date("Beta-121909", 1660, 59)
 {Outlier("General",0.1);};
 R_Date("Beta-25771", 1650, 59)
 {Outlier("General",0.1);};
 R_Date("M-396", 1600, 252)
 {Outlier("General",0.1);};
 Interval("KolomokiI");
};
Boundary("KolomokiI to KolomokiII");
Phase("KolomokiII")
{
 R_Date("Beta-164309", 1360, 59)
 {Outlier("General",0.1);};
 R_Date("Beta-161790", 1290, 68)
 {Outlier("General",0.1);};
 Interval("Span KolomokiII");
};
Boundary("End KolomokiII");
Interval( "KolomokiII to Sycamore");
Boundary("Start Sycamore");
Phase("Sycamore")
{
 R_Date("I-7256", 1125, 91)
 {Outlier("General",0.1);};
 R_Date("I-7253", 1090, 91)
 {Outlier("General",0.1);};
 R_Date("I-7252", 1090, 91)
 {Outlier("General",0.1);};
 R_Date("I-7255", 1055, 91)
```

```
   {Outlier("General",0.1);};
   Interval("Sycamore");
  };
  Boundary("End Sycamore");
 };
};
```

**Model Specifications**

| Parameter | Name | Type | mu | sigma | llim | ulim |
|---|---|---|---|---|---|---|
| 0 | intcal04 | Curve | | | -24054.5 | 1970.5 |
| 2 | General | Outlier_Model | -74.9675 | 267.611 | -80000 | 80000 |
| 3 | | Sum | -0.314704 | 1.11549 | -11.55 | 11.65 |
| 4 | | U | 2.43317 | 0.256273 | 0 | 3.96 |
| 6 | Start Shorter | Boundary | -87.9435 | 109.07 | -1069.5 | 2205.5 |
| 8 | Beta-230758 | R_Date | -34.2239 | 86.6568 | -1069.5 | 2205.5 |
| 9 | Beta-230756 | R_Date | 6.42007 | 71.9874 | -1069.5 | 2205.5 |
| 10 | Beta-230757 | R_Date | 45.4967 | 106.373 | -1069.5 | 2205.5 |
| 11 | Shorter | Interval | 188.075 | 127.092 | 0 | 3275 |
| 12 | Shorter to MandevI | Boundary | 100.132 | 92.2625 | -1069.5 | 2205.5 |
| 14 | B-26898 | R_Date | 146.329 | 81.3068 | -1069.5 | 2205.5 |
| 15 | M-1042 | R_Date | 156.642 | 79.6409 | -1069.5 | 2205.5 |
| 16 | UGA-7B | R_Date | 172.047 | 71.9593 | -1069.5 | 2205.5 |
| 17 | UGA-1B | R_Date | 174.007 | 72.3904 | -1069.5 | 2205.5 |
| 18 | UGA-3B | R_Date | 170.032 | 75.3106 | -1069.5 | 2205.5 |
| 19 | MandevI | Interval | 123.629 | 91.4348 | 0 | 3275 |
| 20 | MandevI to Halloca | Boundary | 223.761 | 69.8485 | -1069.5 | 2205.5 |
| 22 | DIC-3269 | R_Date | 261.237 | 64.3501 | -1069.5 | 2205.5 |
| 23 | M-1046 | R_Date | 260.099 | 61.7291 | -1069.5 | 2205.5 |
| 24 | DIC-3268 | R_Date | 258.006 | 65.516 | -1069.5 | 2205.5 |
| 25 | UGA-2B | R_Date | 260.464 | 61.6766 | -1069.5 | 2205.5 |
| 26 | UGA-16B | R_Date | 267.816 | 58.9247 | -1069.5 | 2205.5 |
| 27 | UGA-5B | R_Date | 274.521 | 56.8093 | -1069.5 | 2205.5 |
| 28 | UGA-14B | R_Date | 278.814 | 55.4731 | -1069.5 | 2205.5 |
| 29 | UGA-4B | R_Date | 279.342 | 57.456 | -1069.5 | 2205.5 |
| 30 | UGA-6B | R_Date | 280.601 | 57.1273 | -1069.5 | 2205.5 |
| 31 | Halloca | Interval | 86.9099 | 69.4959 | 0 | 3275 |
| 32 | Halloca to MandevII | Boundary | 310.67 | 54.8177 | -1069.5 | 2205.5 |
| 34 | UGA-9B | R_Date | 332.863 | 44.5085 | -1069.5 | 2205.5 |
| 35 | DIC-3270 | R_Date | 336.572 | 44.7058 | -1069.5 | 2205.5 |
| 36 | UGA-15B | R_Date | 340.741 | 47.7573 | -1069.5 | 2205.5 |
| 37 | M-1045 | R_Date | 343.176 | 50.3213 | -1069.5 | 2205.5 |
| 38 | M-1044 | R_Date | 343.738 | 50.2057 | -1069.5 | 2205.5 |
| 39 | MandevII | Interval | 57.6659 | 58.397 | 0 | 3275 |
| 40 | End MandevII | Boundary | 368.336 | 53.484 | -1069.5 | 2205.5 |
| 41 | MandevII to KolomokiI | Interval | 55.4393 | 46.1623 | 0 | 3275 |
| 42 | Start KolomokiI | Boundary | 423.776 | 57.889 | -1069.5 | 2205.5 |
| 44 | Beta-121909 | R_Date | 467.989 | 57.7925 | -1069.5 | 2205.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 45 | Beta-25771 | R_Date | 469.907 | 56.881 | -1069.5 | 2205.5 |
| 46 | M-396 | R_Date | 489.186 | 69.0951 | -1069.5 | 2205.5 |
| 47 | KolomokiI | Interval | 134.557 | 92.2612 | 0 | 3275 |
| 48 | KolomokiI to KolomokiII | Boundary | 558.333 | 81.836 | -1069.5 | 2205.5 |
| 50 | Beta-164309 | R_Date | 672.044 | 48.7276 | -1069.5 | 2205.5 |
| 51 | Beta-161790 | R_Date | 701.155 | 54.0771 | -1069.5 | 2205.5 |
| 52 | Span KolomokiII | Interval | 210.327 | 114.245 | 0 | 3275 |
| 53 | End KolomokiII | Boundary | 768.66 | 68.9327 | -1069.5 | 2205.5 |
| 54 | KolomokiII to Sycamore | Interval | 113.783 | 73.795 | 0 | 3275 |
| 55 | Start Sycamore | Boundary | 882.444 | 63.2196 | -1069.5 | 2205.5 |
| 57 | I-7256 | R_Date | 924.793 | 56.1168 | -1069.5 | 2205.5 |
| 58 | I-7253 | R_Date | 928.048 | 56.6399 | -1069.5 | 2205.5 |
| 59 | I-7252 | R_Date | 927.979 | 56.6026 | -1069.5 | 2205.5 |
| 60 | I-7255 | R_Date | 931.338 | 57.5282 | -1069.5 | 2205.5 |
| 61 | Sycamore | Interval | 90.5092 | 80.0957 | 0 | 3275 |
| 62 | End Sycamore | Boundary | 972.953 | 69.1296 | -1069.5 | 2205.5 |

## Model Results

| Name | Unmodelled (BC/AD) | | | Modelled (BC/AD) | | | Indices Amodel 50.3 Aoverall 50.4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | from | to | % | from | to | % | Acomb | A | P | C |
| Boundary End Sycamore | | | | 815 | 1108 | 95.4 | | | | 99.3 |
| Interval Sycamore | | | | 0 | 255 | 95.4 | | | | 99.8 |
| R_Date I-7255 | 728 | 1183 | 95.4 | 803 | 1031 | 95.4 | | 118.4 | 95.3 | 99.9 |
| R_Date I-7252 | 695 | 1155 | 95.5 | 803 | 1026 | 95.4 | | 124.8 | 95.8 | 99.9 |
| R_Date I-7253 | 695 | 1155 | 95.5 | 804 | 1026 | 95.4 | | 124.8 | 95.8 | 99.9 |
| R_Date I-7256 | 675 | 1146 | 95.4 | 803 | 1023 | 95.4 | | 120.8 | 95.7 | 99.9 |
| Phase Sycamore | | | | | | | | | | |
| Boundary Start Sycamore | | | | 755 | 999 | 95.4 | | | | 99.8 |
| Interval KolomokiII to Sycamore | | | | 0 | 249 | 95.4 | | | | 99.9 |
| Boundary End KolomokiII | | | | 650 | 912 | 95.4 | | | | 99.9 |
| Interval Span KolomokiII | | | | 0 | 410 | 95.4 | | | | 99.9 |
| R_Date Beta-161790 | 635 | 892 | 95.4 | 600 | 820 | 95.4 | | 109.8 | 94.2 | 99.9 |
| R_Date Beta-164309 | 565 | 779 | 95.4 | 582 | 773 | 95.4 | | 107.8 | 95.9 | 99.9 |
| Phase KolomokiII | | | | | | | | | | |
| Boundary KolomokiI to KolomokiII | | | | 395 | 704 | 95.4 | | | | 99.8 |
| Interval KolomokiI | | | | 0 | 305 | 95.4 | | | | 99.9 |
| R_Date M-396 | -168 | 963 | 95.4 | 356 | 626 | 95.4 | | 136 | 93.3 | 99.9 |
| R_Date Beta-25771 | 255 | 540 | 95.4 | 356 | 559 | 95.4 | | 96.4 | 94.3 | 99.8 |
| R_Date Beta-121909 | 251 | 537 | 95.4 | 354 | 555 | 95.4 | | 87.5 | 93.5 | 99.8 |
| Phase KolomokiI | | | | | | | | | | |
| Boundary Start KolomokiI | | | | 322 | 527 | 95.4 | | | | 99.8 |
| Interval MandevII to KolomokiI | | | | 0 | 150 | 95.4 | | | | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Boundary End MandevII | | | | 272 | 470 | 95.4 | | | 99.7 |
| Interval MandevII | | | | 0 | 157 | 95.4 | | | 99.9 |
| R_Date M-1044 | 259 | 964 | 95.4 | 261 | 438 | 95.4 | 42.3 | 85.9 | 99.7 |
| R_Date M-1045 | 238 | 893 | 95.4 | 261 | 437 | 95.4 | 52.8 | 88.9 | 99.8 |
| R_Date UGA-15B | 144 | 565 | 95.5 | 262 | 423 | 95.4 | 117.4 | 95.7 | 99.7 |
| R_Date DIC-3270 | 90 | 432 | 95.4 | 264 | 414 | 95.4 | 117.3 | 95.9 | 99.7 |
| R_Date UGA-9B | -35 | 340 | 95.4 | 260 | 415 | 95.4 | 41 | 83.1 | 99.8 |
| Phase MandevII | | | | | | | | | |
| Boundary Halloca to MandevII | | | | 248 | 394 | 95.4 | | | 99.7 |
| Interval Halloca | | | | 0 | 217 | 95.4 | | | 99.6 |
| R_Date UGA-6B | 263 | 632 | 95.4 | 207 | 376 | 95.4 | 35.2 | 79.5 | 99.9 |
| R_Date UGA-4B | 240 | 571 | 95.4 | 211 | 375 | 95.4 | 69.9 | 91.9 | 99.9 |
| R_Date UGA-14B | 234 | 584 | 95.4 | 209 | 375 | 95.4 | 74.3 | 92.5 | 99.9 |
| R_Date UGA-5B | 135 | 534 | 95.4 | 195 | 370 | 95.4 | 115.1 | 95.4 | 99.9 |
| R_Date UGA-16B | 29 | 529 | 95.4 | 175 | 365 | 95.4 | 122.4 | 95.4 | 99.9 |
| R_Date UGA-2B | 18 | 382 | 95.4 | 163 | 358 | 95.4 | 83.5 | 93.6 | 99.9 |
| R_Date DIC-3268 | -174 | 123 | 95.4 | 115 | 367 | 95.4 | 89.5 | 12.5 | 99.8 |
| R_Date M-1046 | -396 | 330 | 95.4 | 160 | 363 | 95.4 | 45.4 | 86.2 | 99.8 |
| R_Date DIC-3269 | -357 | 55 | 95.5 | 156 | 370 | 95.4 | 96.7 | 2.3 | 99.9 |
| Phase Halloca | | | | | | | | | |
| Boundary MandevI to Halloca | | | | 99 | 331 | 95.4 | | | 99.8 |
| Interval MandevI | | | | 0 | 283 | 95.4 | | | 99.7 |
| R_Date UGA-3B | -37 | 540 | 95.4 | 34 | 280 | 95.4 | 113.7 | 94.1 | 99.8 |
| R_Date UGA-1B | 68 | 398 | 95.4 | 56 | 278 | 95.4 | 111.5 | 94.9 | 99.8 |
| R_Date UGA-7B | 53 | 400 | 95.4 | 52 | 275 | 95.4 | 115.4 | 95.1 | 99.8 |
| R_Date M-1042 | -361 | 382 | 95.4 | 13 | 266 | 95.4 | 109.6 | 93.2 | 99.8 |
| R_Date B-26898 | -356 | 235 | 95.4 | 6 | 259 | 95.4 | 65.5 | 89.3 | 99.6 |
| Phase MandevI | | | | | | | | | |
| Boundary Shorter to MandevI | | | | -39 | 237 | 95.4 | | | 99.4 |
| Interval Shorter | | | | 0 | 417 | 95.4 | | | 99.1 |
| R_Date Beta-230757 | 140 | 416 | 95.4 | -129 | 216 | 95.4 | 74.1 | 28.9 | 99.3 |
| R_Date Beta-230756 | -98 | 116 | 95.4 | -101 | 125 | 95.4 | 102.5 | 93.8 | 99.7 |
| R_Date Beta-230758 | -352 | 18 | 95.4 | -186 | 140 | 95.4 | 80.4 | 83.6 | 99.5 |
| Phase Shorter | | | | | | | | | |
| Boundary Start Shorter | | | | -317 | 111 | 95.4 | | | 98.6 |
| Sequence | | | | | | | | | |
| U(0,4) | 0.02 | 3.98 | 95.4 | 1.968 | 2.952 | 95.4 | 100 | | 97.4 |
| T(5) | -2.65 | 2.65 | 95.4 | -2.41 | 1.895 | 95.4 | 96.4 | | 98.8 |
| Outlier_Model General | | | | -493 | 410 | 95.4 | | | 99.5 |

## 15. OxCal Results for Outlier Analysis with 64% Model Agreement

### Model Specifications

| Parameter | Name | Type | mu | sigma | llim | ulim |
|---|---|---|---|---|---|---|
| 0 | intcal04 | Curve | | | -24054.5 | 1970.5 |
| 2 | General | Outlier_Model | -61.035 | 243.855 | -80000 | 80000 |
| 3 | | Sum | -0.259426 | 1.1171 | -11.55 | 11.65 |
| 4 | | U | 2.3867 | 0.208518 | 0 | 3.96 |
| 6 | Start Shorter | Boundary | -90.6825 | 100.276 | -1069.5 | 2205.5 |
| 8 | Beta-230758 | R_Date | -34.6078 | 71.6026 | -1069.5 | 2205.5 |
| 9 | Beta-230756 | R_Date | 8.5905 | 49.4778 | -1069.5 | 2205.5 |
| 10 | Beta-230757 | R_Date | 43.6335 | 92.2071 | -1069.5 | 2205.5 |
| 11 | Shorter | Interval | 191.117 | 128.3 | 0 | 3275 |
| 12 | Shorter to MandevI | Boundary | 100.435 | 74.7965 | -1069.5 | 2205.5 |
| 14 | B-26898 | R_Date | 143.791 | 67.1193 | -1069.5 | 2205.5 |
| 15 | M-1042 | R_Date | 153.109 | 65.2151 | -1069.5 | 2205.5 |
| 16 | UGA-7B | R_Date | 167.519 | 56.6234 | -1069.5 | 2205.5 |
| 17 | UGA-1B | R_Date | 169.649 | 55.9765 | -1069.5 | 2205.5 |
| 18 | UGA-3B | R_Date | 165.531 | 60.6339 | -1069.5 | 2205.5 |
| 19 | MandevI | Interval | 115.431 | 85.2687 | 0 | 3275 |
| 20 | MandevI to Halloca | Boundary | 215.865 | 57.0226 | -1069.5 | 2205.5 |
| 22 | DIC-3269 | R_Date | 258.325 | 54.71 | -1069.5 | 2205.5 |
| 23 | M-1046 | R_Date | 257.017 | 52.9419 | -1069.5 | 2205.5 |
| 24 | DIC-3268 | R_Date | 253.988 | 57.9285 | -1069.5 | 2205.5 |
| 25 | UGA-2B | R_Date | 257.842 | 50.5725 | -1069.5 | 2205.5 |
| 26 | UGA-16B | R_Date | 266.851 | 48.6944 | -1069.5 | 2205.5 |
| 27 | UGA-5B | R_Date | 275.406 | 45.2796 | -1069.5 | 2205.5 |
| 28 | UGA-14B | R_Date | 281.025 | 44.1212 | -1069.5 | 2205.5 |
| 29 | UGA-4B | R_Date | 281.892 | 43.7627 | -1069.5 | 2205.5 |
| 30 | UGA-6B | R_Date | 276.19 | 49.1842 | -1069.5 | 2205.5 |
| 31 | Halloca | Interval | 101.12 | 71.6938 | 0 | 3275 |
| 32 | Halloca to MandevII | Boundary | 316.986 | 45.0776 | -1069.5 | 2205.5 |
| 34 | UGA-9B | R_Date | 342.201 | 47.3835 | -1069.5 | 2205.5 |
| 35 | DIC-3270 | R_Date | 342.484 | 44.7521 | -1069.5 | 2205.5 |
| 36 | UGA-15B | R_Date | 347.09 | 47.236 | -1069.5 | 2205.5 |
| 37 | M-1045 | R_Date | 350.118 | 50.258 | -1069.5 | 2205.5 |
| 38 | M-1044 | R_Date | 350.589 | 50.4922 | -1069.5 | 2205.5 |
| 39 | MandevII | Interval | 58.9473 | 49.1579 | 0 | 3275 |
| 40 | End MandevII | Boundary | 375.933 | 54.2549 | -1069.5 | 2205.5 |
| 41 | MandevII to KolomokiI | Interval | 54.2987 | 46.2452 | 0 | 3275 |
| 42 | Start KolomokiI | Boundary | 430.232 | 57.6296 | -1069.5 | 2205.5 |
| 44 | Beta-121909 | R_Date | 472.899 | 56.3643 | -1069.5 | 2205.5 |
| 45 | Beta-25771 | R_Date | 474.581 | 55.5402 | -1069.5 | 2205.5 |
| 46 | M-396 | R_Date | 493.322 | 67.208 | -1069.5 | 2205.5 |
| 47 | KolomokiI | Interval | 129.848 | 90.8273 | 0 | 3275 |
| 48 | KolomokiI to KolomokiII | Boundary | 560.08 | 79.3745 | -1069.5 | 2205.5 |
| 50 | Beta-164309 | R_Date | 672.105 | 48.5264 | -1069.5 | 2205.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 51 | Beta-161790 | R_Date | 701.669 | 52.4829 | -1069.5 | 2205.5 |
| 52 | Span KolomokiII | Interval | 209.208 | 112.567 | 0 | 3275 |
| 53 | End KolomokiII | Boundary | 769.287 | 69.0809 | -1069.5 | 2205.5 |
| 54 | KolomokiII to Sycamore | Interval | 114.821 | 73.7486 | 0 | 3275 |
| 55 | Start Sycamore | Boundary | 884.109 | 63.3781 | -1069.5 | 2205.5 |
| 57 | I-7256 | R_Date | 927.697 | 55.8053 | -1069.5 | 2205.5 |
| 58 | I-7253 | R_Date | 931.076 | 56.4602 | -1069.5 | 2205.5 |
| 59 | I-7252 | R_Date | 931.162 | 56.3835 | -1069.5 | 2205.5 |
| 60 | I-7255 | R_Date | 934.622 | 57.3723 | -1069.5 | 2205.5 |
| 61 | Sycamore | Interval | 94.063 | 82.8083 | 0 | 3275 |
| 62 | End Sycamore | Boundary | 978.172 | 70.0724 | -1069.5 | 2205.5 |

## Model Results

| Name | Unmodelled (BC/AD) | | | Modelled (BC/AD) | | | Indices Amodel 64 Aoverall 64.7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | from | to | % | from | to | % | Acomb | A | P | C |
| Boundary End Sycamore | | | | 818 | 1116 | 95.4 | | | | 96.9 |
| Interval Sycamore | | | | 0 | 263 | 95.4 | | | | 99.4 |
| R_Date I-7255 | 728 | 1183 | 95.4 | 804 | 1035 | 95.4 | | 119.8 | 95 | 99.4 |
| R_Date I-7252 | 695 | 1155 | 95.5 | 805 | 1028 | 95.4 | | 125.4 | 95.6 | 99.4 |
| R_Date I-7253 | 695 | 1155 | 95.5 | 805 | 1029 | 95.4 | | 125.4 | 95.5 | 99.4 |
| R_Date I-7256 | 675 | 1146 | 95.4 | 805 | 1025 | 95.4 | | 120.7 | 95.4 | 99.4 |
| Phase Sycamore | | | | | | | | | | |
| Boundary Start Sycamore | | | | 756 | 1001 | 95.4 | | | | 99.3 |
| Interval KolomokiII to Sycamore | | | | 0 | 251 | 95.4 | | | | 99.8 |
| Boundary End KolomokiII | | | | 651 | 914 | 95.4 | | | | 99.8 |
| Interval Span KolomokiII | | | | 0 | 406 | 95.4 | | | | 99.8 |
| R_Date Beta-161790 | 635 | 892 | 95.4 | 600 | 820 | 95.4 | | 109.6 | 94.1 | 99.9 |
| R_Date Beta-164309 | 565 | 779 | 95.4 | 583 | 773 | 95.4 | | 107.8 | 95.8 | 99.9 |
| Phase KolomokiII | | | | | | | | | | |
| Boundary KolomokiI to KolomokiII | | | | 396 | 705 | 95.4 | | | | 99.5 |
| Interval KolomokiI | | | | 0 | 300 | 95.4 | | | | 99.8 |
| R_Date M-396 | -168 | 963 | 95.4 | 360 | 630 | 95.4 | | 136 | 93 | 99.7 |
| R_Date Beta-25771 | 255 | 540 | 95.4 | 359 | 562 | 95.4 | | 94.6 | 93.7 | 99.8 |
| R_Date Beta-121909 | 251 | 537 | 95.4 | 356 | 561 | 95.4 | | 85.3 | 92.7 | 99.7 |
| Phase KolomokiI | | | | | | | | | | |
| Boundary Start KolomokiI | | | | 321 | 530 | 95.4 | | | | 99.6 |
| Interval MandevII to KolomokiI | | | | 0 | 146 | 95.4 | | | | 99.9 |
| Boundary End MandevII | | | | 270 | 477 | 95.4 | | | | 99.5 |
| Interval MandevII | | | | 0 | 162 | 95.4 | | | | 99.8 |
| R_Date M-1044 | 259 | 964 | 95.4 | 259 | 446 | 95.4 | | 44.9 | 86.2 | 99.6 |
| R_Date M-1045 | 238 | 893 | 95.4 | 259 | 446 | 95.4 | | 56 | 89 | 99.7 |
| R_Date UGA-15B | 144 | 565 | 95.5 | 259 | 431 | 95.4 | | 119.1 | 95.5 | 99.7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| R_Date DIC-3270 | 90 | 432 | 95.4 | 259 | 423 | 95.4 | 113.3 | 95.3 | 99.7 |
| R_Date UGA-9B | -35 | 340 | 95.4 | 254 | 434 | 95.4 | 73.6 | 36.8 | 99.6 |
| Phase MandevII | | | | | | | | | |
| Boundary Halloca to MandevII | | | | 241 | 410 | 95.4 | | | 99.5 |
| Interval Halloca | | | | 0 | 236 | 95.4 | | | 99.6 |
| R_Date UGA-6B | 263 | 632 | 95.4 | 175 | 380 | 95.4 | 72.8 | 31.3 | 99.7 |
| R_Date UGA-4B | 240 | 571 | 95.4 | 195 | 385 | 95.4 | 69.4 | 90.9 | 99.8 |
| R_Date UGA-14B | 234 | 584 | 95.4 | 192 | 383 | 95.4 | 73.3 | 91.6 | 99.8 |
| R_Date UGA-5B | 135 | 534 | 95.4 | 179 | 375 | 95.4 | 111.8 | 95 | 99.8 |
| R_Date UGA-16B | 29 | 529 | 95.4 | 163 | 369 | 95.4 | 121.7 | 95.4 | 99.7 |
| R_Date UGA-2B | 18 | 382 | 95.4 | 149 | 357 | 95.4 | 88.3 | 93.8 | 99.7 |
| R_Date DIC-3268 | -174 | 123 | 95.4 | 106 | 370 | 95.4 | 86.7 | 15.6 | 99.5 |
| R_Date M-1046 | -396 | 330 | 95.4 | 146 | 367 | 95.4 | 47.7 | 86.5 | 99.7 |
| R_Date DIC-3269 | -357 | 55 | 95.5 | 143 | 372 | 95.4 | 95.8 | 2.8 | 99.7 |
| Phase Halloca | | | | | | | | | |
| Boundary MandevI to Halloca | | | | 90 | 324 | 95.4 | | | 99.2 |
| Interval MandevI | | | | 0 | 276 | 95.4 | | | 99.4 |
| R_Date UGA-3B | -37 | 540 | 95.4 | 33 | 271 | 95.4 | 111.6 | 93.9 | 99.3 |
| R_Date UGA-1B | 68 | 398 | 95.4 | 52 | 269 | 95.4 | 108.8 | 94.7 | 99.3 |
| R_Date UGA-7B | 53 | 400 | 95.4 | 51 | 266 | 95.4 | 113.2 | 94.9 | 99.4 |
| R_Date M-1042 | -361 | 382 | 95.4 | 17 | 261 | 95.4 | 111.8 | 93.2 | 99.3 |
| R_Date B-26898 | -356 | 235 | 95.4 | 10 | 255 | 95.4 | 67.5 | 89.5 | 99.2 |
| Phase MandevI | | | | | | | | | |
| Boundary Shorter to MandevI | | | | -36 | 232 | 95.4 | | | 98.8 |
| Interval Shorter | | | | 0 | 423 | 95.4 | | | 99 |
| R_Date Beta-230757 | 140 | 416 | 95.4 | -133 | 208 | 95.4 | 76 | 26.1 | 98.6 |
| R_Date Beta-230756 | -98 | 116 | 95.4 | -96 | 123 | 95.4 | 103 | 94.5 | 99.8 |
| R_Date Beta-230758 | -352 | 18 | 95.4 | -192 | 108 | 95.4 | 80.9 | 84.8 | 99.5 |
| Phase Shorter | | | | | | | | | |
| Boundary Start Shorter | | | | -319 | 97 | 95.4 | | | 97.1 |
| Sequence | | | | | | | | | |
| U(0,4) | 0.02 | 3.98 | 95.4 | 1.98 | 2.812 | 95.4 | 100 | | 97.3 |
| T(5) | -2.65 | 2.65 | 95.4 | -2.37 | 1.9 | 95.4 | 96.4 | | 99 |
| Outlier_Model General | | | | -464 | 385 | 95.4 | | | 98.9 |

## 16. OxCal Results for Outlier Analysis with 76% Model Agreement

### Model Specifications

| Parameter | Name | Type | mu | sigma | llim | Ulim |
|---|---|---|---|---|---|---|
| 0 | intcal04 | Curve | | | -24054.5 | 1970.5 |
| 2 | General | Outlier_Model | -54.6717 | 243.313 | -80000 | 80000 |
| 3 | | Sum | -0.236825 | 1.12819 | -11.55 | 11.65 |
| 4 | | U | 2.37248 | 0.190494 | 0 | 3.96 |
| 6 | Start Shorter | Boundary | -84.1933 | 90.8957 | -1069.5 | 2205.5 |
| 8 | Beta-230758 | R_Date | -32.1564 | 67.8149 | -1069.5 | 2205.5 |
| 9 | Beta-230756 | R_Date | 8.48277 | 46.3116 | -1069.5 | 2205.5 |
| 10 | Beta-230757 | R_Date | 46.4945 | 88.8884 | -1069.5 | 2205.5 |
| 11 | Shorter | Interval | 185.022 | 122.059 | 0 | 3275 |
| 12 | Shorter to MandevI | Boundary | 100.828 | 74.8065 | -1069.5 | 2205.5 |
| 14 | B-26898 | R_Date | 146.009 | 67.0418 | -1069.5 | 2205.5 |
| 15 | M-1042 | R_Date | 155.937 | 64.9882 | -1069.5 | 2205.5 |
| 16 | UGA-7B | R_Date | 171.154 | 55.6092 | -1069.5 | 2205.5 |
| 17 | UGA-1B | R_Date | 173.307 | 54.7566 | -1069.5 | 2205.5 |
| 18 | UGA-3B | R_Date | 169.062 | 59.9247 | -1069.5 | 2205.5 |
| 19 | MandevI | Interval | 121.136 | 85.817 | 0 | 3275 |
| 20 | MandevI to Halloca | Boundary | 221.964 | 54.3595 | -1069.5 | 2205.5 |
| 22 | DIC-3269 | R_Date | 261.053 | 51.47 | -1069.5 | 2205.5 |
| 23 | M-1046 | R_Date | 262.028 | 49.7474 | -1069.5 | 2205.5 |
| 24 | DIC-3268 | R_Date | 257.603 | 54.0595 | -1069.5 | 2205.5 |
| 25 | UGA-2B | R_Date | 260.474 | 48.0808 | -1069.5 | 2205.5 |
| 26 | UGA-16B | R_Date | 268.251 | 46.2208 | -1069.5 | 2205.5 |
| 27 | UGA-5B | R_Date | 275.488 | 43.1061 | -1069.5 | 2205.5 |
| 28 | UGA-14B | R_Date | 280.225 | 41.8559 | -1069.5 | 2205.5 |
| 29 | UGA-4B | R_Date | 281.103 | 41.6001 | -1069.5 | 2205.5 |
| 30 | UGA-6B | R_Date | 276.153 | 46.2829 | -1069.5 | 2205.5 |
| 31 | Halloca | Interval | 91.791 | 67.0422 | 0 | 3275 |
| 32 | Halloca to MandevII | Boundary | 313.755 | 42.9683 | -1069.5 | 2205.5 |
| 34 | UGA-9B | R_Date | 338.293 | 45.4933 | -1069.5 | 2205.5 |
| 35 | DIC-3270 | R_Date | 338.687 | 43.1846 | -1069.5 | 2205.5 |
| 36 | UGA-15B | R_Date | 342.96 | 45.7384 | -1069.5 | 2205.5 |
| 37 | M-1045 | R_Date | 345.525 | 48.4995 | -1069.5 | 2205.5 |
| 38 | M-1044 | R_Date | 344.896 | 48.093 | -1069.5 | 2205.5 |
| 39 | MandevII | Interval | 56.826 | 47.5994 | 0 | 3275 |
| 40 | End MandevII | Boundary | 370.581 | 52.6605 | -1069.5 | 2205.5 |
| 41 | MandevII to KolomokiI | Interval | 55.0795 | 46.188 | 0 | 3275 |
| 42 | Start KolomokiI | Boundary | 425.661 | 56.9888 | -1069.5 | 2205.5 |
| 44 | Beta-121909 | R_Date | 469.436 | 56.7319 | -1069.5 | 2205.5 |
| 45 | Beta-25771 | R_Date | 471.487 | 55.724 | -1069.5 | 2205.5 |
| 46 | M-396 | R_Date | 490.597 | 68.0939 | -1069.5 | 2205.5 |
| 47 | KolomokiI | Interval | 133.499 | 91.9464 | 0 | 3275 |
| 48 | KolomokiI to KolomokiII | Boundary | 559.16 | 80.6769 | -1069.5 | 2205.5 |
| 50 | Beta-164309 | R_Date | 671.943 | 48.6211 | -1069.5 | 2205.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 51 | Beta-161790 | R_Date | 701.166 | 52.3711 | -1069.5 | 2205.5 |
| 52 | Span KolomokiII | Interval | 209.169 | 113.497 | 0 | 3275 |
| 53 | End KolomokiII | Boundary | 768.329 | 68.6547 | -1069.5 | 2205.5 |
| 54 | KolomokiII to Sycamore | Interval | 113.826 | 73.4596 | 0 | 3275 |
| 55 | Start Sycamore | Boundary | 882.155 | 62.9286 | -1069.5 | 2205.5 |
| 57 | I-7256 | R_Date | 924.245 | 56.1083 | -1069.5 | 2205.5 |
| 58 | I-7253 | R_Date | 927.374 | 56.5606 | -1069.5 | 2205.5 |
| 59 | I-7252 | R_Date | 927.408 | 56.6463 | -1069.5 | 2205.5 |
| 60 | I-7255 | R_Date | 930.714 | 57.6745 | -1069.5 | 2205.5 |
| 61 | Sycamore | Interval | 89.8461 | 79.7385 | 0 | 3275 |
| 62 | End Sycamore | Boundary | 972.002 | 69.2453 | -1069.5 | 2205.5 |

## Model Results

| **Name** | **Unmodelled (BC/AD)** | | | **Modelled (BC/AD)** | | | **Indices<br>Amodel<br>75.6<br>Aoverall<br>75.6** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **from** | **to** | **%** | **from** | **to** | **%** | **Acomb** | **A** | **L** | **P** | **C** |
| Boundary End Sycamore | | | | 815 | 1111 | 95.4 | | | | | 98.1 |
| Interval Sycamore | | | | 0 | 254 | 95.4 | | | | | 99.6 |
| R_Date I-7255 | 728 | 1183 | 95.4 | 784 | 1030 | 95.4 | | 118.2 | | 94.9 | 99.5 |
| R_Date I-7252 | 695 | 1155 | 95.5 | 803 | 1025 | 95.4 | | 124.7 | | 95.4 | 99.6 |
| R_Date I-7253 | 695 | 1155 | 95.5 | 803 | 1025 | 95.4 | | 124.8 | | 95.4 | 99.6 |
| R_Date I-7256 | 675 | 1146 | 95.4 | 803 | 1023 | 95.4 | | 120.8 | | 95.4 | 99.6 |
| Phase Sycamore | | | | | | | | | | | |
| Boundary Start Sycamore | | | | 755 | 999 | 95.4 | | | | | 99.4 |
| Interval KolomokiII to Sycamore | | | | 0 | 249 | 95.4 | | | | | 99.9 |
| Boundary End KolomokiII | | | | 651 | 912 | 95.4 | | | | | 99.7 |
| Interval Span KolomokiII | | | | 0 | 408 | 95.4 | | | | | 99.8 |
| R_Date Beta-161790 | 635 | 892 | 95.4 | 600 | 820 | 95.4 | | 109.9 | | 93.9 | 99.9 |
| R_Date Beta-164309 | 565 | 779 | 95.4 | 582 | 773 | 95.4 | | 107.9 | | 95.6 | 99.8 |
| Phase KolomokiII | | | | | | | | | | | |
| Boundary KolomokiI to KolomokiII | | | | 395 | 705 | 95.4 | | | | | 99.5 |
| Interval KolomokiI | | | | 0 | 304 | 95.4 | | | | | 99.7 |
| R_Date M-396 | -168 | 963 | 95.4 | 357 | 627 | 95.4 | | 136 | | 92.9 | 99.7 |
| R_Date Beta-25771 | 255 | 540 | 95.4 | 356 | 560 | 95.4 | | 95.9 | | 93.8 | 99.6 |
| R_Date Beta-121909 | 251 | 537 | 95.4 | 353 | 557 | 95.4 | | 87 | | 92.9 | 99.6 |
| Phase KolomokiI | | | | | | | | | | | |
| Boundary Start KolomokiI | | | | 321 | 529 | 95.4 | | | | | 99.6 |
| Interval MandevII to KolomokiI | | | | 0 | 149 | 95.4 | | | | | 99.9 |
| Boundary End MandevII | | | | 270 | 472 | 95.4 | | | | | 99.5 |
| Interval MandevII | | | | 0 | 157 | 95.4 | | | | | 99.8 |
| R_Date M-1044 | 259 | 964 | 95.4 | 258 | 439 | 95.4 | | 71.6 | | 40.9 | 99.7 |
| R_Date M-1045 | 238 | 893 | 95.4 | 258 | 440 | 95.4 | | 54.2 | | 88.6 | 99.7 |
| R_Date UGA-15B | 144 | 565 | 95.5 | 260 | 427 | 95.4 | | 117.9 | | 95.4 | 99.7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| R_Date DIC-3270 | 90 | 432 | 95.4 | 260 | 420 | 95.4 | 115.6 | 95.4 | 99.7 |
| R_Date UGA-9B | -35 | 340 | 95.4 | 255 | 428 | 95.4 | 73.5 | 37.5 | 99.7 |
| Phase MandevII | | | | | | | | | |
| Boundary Halloca to MandevII | | | | 241 | 404 | 95.4 | | | 99.6 |
| Interval Halloca | | | | 0 | 224 | 95.4 | | | 99.7 |
| R_Date UGA-6B | 263 | 632 | 95.4 | 180 | 375 | 95.4 | 72.4 | 31.4 | 99.8 |
| R_Date UGA-4B | 240 | 571 | 95.4 | 203 | 380 | 95.4 | 69.3 | 91 | 99.9 |
| R_Date UGA-14B | 234 | 584 | 95.4 | 198 | 380 | 95.4 | 73.4 | 91.7 | 99.9 |
| R_Date UGA-5B | 135 | 534 | 95.4 | 186 | 372 | 95.4 | 113 | 95 | 99.9 |
| R_Date UGA-16B | 29 | 529 | 95.4 | 170 | 366 | 95.4 | 122.1 | 95.3 | 99.8 |
| R_Date UGA-2B | 18 | 382 | 95.4 | 158 | 358 | 95.4 | 86 | 93.5 | 99.8 |
| R_Date DIC-3268 | -174 | 123 | 95.4 | 111 | 368 | 95.4 | 88.8 | 13.1 | 99.7 |
| R_Date M-1046 | -396 | 330 | 95.4 | 158 | 366 | 95.4 | 72.2 | 41.4 | 99.7 |
| R_Date DIC-3269 | -357 | 55 | 95.5 | 152 | 371 | 95.4 | 96.4 | 2.2 | 99.7 |
| Phase Halloca | | | | | | | | | |
| Boundary MandevI to Halloca | | | | 96 | 326 | 95.4 | | | 99.3 |
| Interval MandevI | | | | 0 | 281 | 95.4 | | | 99.7 |
| R_Date UGA-3B | -37 | 540 | 95.4 | 34 | 277 | 95.4 | 112.8 | 93.8 | 99.6 |
| R_Date UGA-1B | 68 | 398 | 95.4 | 56 | 269 | 95.4 | 110.5 | 94.8 | 99.6 |
| R_Date UGA-7B | 53 | 400 | 95.4 | 54 | 267 | 95.4 | 114.7 | 95 | 99.7 |
| R_Date M-1042 | -361 | 382 | 95.4 | 18 | 262 | 95.4 | 110.9 | 93 | 99.6 |
| R_Date B-26898 | -356 | 235 | 95.4 | 12 | 255 | 95.4 | 66.6 | 89.2 | 99.5 |
| Phase MandevI | | | | | | | | | |
| Boundary Shorter to MandevI | | | | -35 | 233 | 95.4 | | | 99.3 |
| Interval Shorter | | | | 0 | 405 | 95.4 | | | 99.1 |
| R_Date Beta-230757 | 140 | 416 | 95.4 | -123 | 204 | 95.4 | 75.6 | 26.3 | 98.9 |
| R_Date Beta-230756 | -98 | 116 | 95.4 | -91 | 121 | 95.4 | 102.8 | 95.1 | 99.7 |
| R_Date Beta-230758 | -352 | 18 | 95.4 | -173 | 115 | 95.4 | 79.6 | 84.1 | 99.6 |
| Phase Shorter | | | | | | | | | |
| Boundary Start Shorter | | | | -272 | ... | 95.4 | | | 97.6 |
| Sequence | | | | | | | | | |
| U(0,4) | 0.02 | 3.98 | 95.4 | 1.988 | 2.772 | 95.4 | 100 | | 97.9 |
| T(5) | -2.65 | 2.65 | 95.4 | -2.34 | 1.955 | 95.4 | 95.9 | | 99.3 |
| Outlier_Model General | | | | -464 | 388 | 95.4 | | | 99.3 |

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# VITA

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