ABSTRACT

CUNNINGHAM, SARAH LYNN. Biological and Cultural Stress in a South Appalachian Mississippian Settlement: Town Creek Indian Mound, Mt. Gilead, NC. (Under the direction of Dr. Scott Fitzpatrick).

Town Creek Indian Mound was an important ceremonial center of the Pee Dee culture for approximately 200 years (A.D. 1150 - 1400) before it was abandoned. Often site abandonment is preceded by biological and cultural stress indicators as the population reacts to worsening conditions. Increases in cribra orbitalia and trauma prevalence and decreases in stature attainment from previous generations were used to determine if the Pee Dee population living at Town Creek were, in fact, experiencing biological or cultural stress at the end of their habitation of the site. Comparisons were made between an early habitation phase (Teal/Early Town Creek period) and a late phase (Late Town Creek/Leak period). The Crural (femoral-tibial length) index suggest that the upper to lower leg length ratio changed inversely between males and females, with males gaining 1 mm of length and females losing 1.6 mm, in the later phase. This change was later found to be insignificant through the calculation and statistical analysis of the sexual dimorphism index (ISD), which determines the difference in body size of the sexes. While the ISD increased in the later phase, the nonparametric Spearman rank correlation found no statistical connection of significant change. Neither cribra nor trauma increased significantly in the late phase. Drought reconstructions have shown that, while the area has experienced extended periods of mild drought and even one intense drought, these periods corresponded with increased site activity, including the construction of monumental architecture. All skeletal indicators and

contextual climate reconstructions point to a stable environment and associated population. Issues with nutrition or violence within the culture did not precede the Pee Dee's abandonment of Town Creek, so the cause must lie with other unknown factors.

Biological and Cultural Stress in a South Appalachian Mississippian Settlement: Town Creek Indian Mound, Mt. Gilead, NC

by
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BIOGRAPHY

Sarah Lynn Cunningham was born in a small town in West Virginia and was planning on becoming a lawyer until she took 'Introduction to Anthropology' her freshman year at the University of North Carolina, Wilmington. Three years after assuring her mother, who wasn't sure what kind of money anthropologists made, that it was just a fun class, she graduated with a degree in anthropology and hasn't looked back since.

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Introduction

The Town Creek mound and village site, located in Montgomery County, North Carolina (Figure 1.1), was the largest occupation of the Pee Dee culture in the southern Piedmont, as well as an important ceremonial complex. The site was occupied by the Pee Dee for approximately 200 years before it fell into disuse and little is known about the conditions preceding site abandonment.

In past studies, skeletal indicators, including cribra orbitalia, secular changes in long bone lengths, and trauma rates, have been used to develop an understanding of population health and cultural stress (Neves and Costa 1998, Smith 2003, Sullivan 2005). Health has been assessed at Town Creek previously (Graham 1973, Burke in Coe 1995, Lambert 2000, Driscoll 2001); however, this will be the first attempt to place these particular indicators within a previously developed chronological framework. This analysis will allow for determinations to be made about the temporal changes in the health of the Pee Dee population. If environmental stress is a factor in the site's abandonment (Boudreaux 2005), then an increase in cribra orbitalia and trauma rates and a decrease in stature over time should be found. Climate data from that period, particularly drought indices, will be compiled to determine specific changes in environmental conditions at the time of abandonment.

Occupation of Town Creek began early, starting in the late Woodland period (ca. A.D. 800) with the introduction of the Pee Dee culture by approximately A.D. 1150 (Coe 1995, Boudreaux 2005). It is one of the northern-most expressions of the South Appalachian

Mississippian tradition, as well as the only ceremonial mound and village center of that cultural tradition within North Carolina. The site may contain up to 563 burials based on previous site excavations and mapping efforts, though only 239 burials have been excavated. The sample was drawn from 214 NAGPRA reports available at the Research Laboratories of North Carolina Chapel Hill University. The total sample in this study consists of 70 individuals, after excluding burials with no measureable long bones, an absence of cribra orbitalia or trauma, and burials attributed to cultural periods not pertaining to the Pee Dee occupation.

The primary Pee Dee occupation of Town Creek lasted until approximately A.D. 1400, within a relatively short time of this date, the collapse of various sites occurred throughout the Southeastern United States. This study will analyze different lines of evidence, both skeletal and environmental, in an effort to identify potential causes for the site's eventual disuse. This will increase the understanding of the events leading to Town Creek abandonment, and may also provide insight into the broader context of cultural collapse throughout the Southeast prior to European contact.

Background

Environment

Town Creek is situated above the normal flooding zone on the altavista silt loams parallel to the Little River in the southern Piedmont region (Trinkley in Coe 1999), an area stretching from the mountains in the west to the lowlands of the eastern coastal plain. The Piedmont has been historically used for intensive farming due to suitable soils and a climate

classified as warm temperate, fully humid with seasonally warm summers by the Koppen-Geiger climate classification model (Kottek et al. 2006).

Global temperatures naturally experience cyclical periods of temperature change causing dramatic fluctuations in regional temperatures. Historically, it is known that the Earth was experiencing a general cooling period from the mid-first millennium until A.D. 1000 (Mann et al. 2008). Tree ring reconstructions developed by the National Oceanic and Atmospheric Administration (NOAA) and Cook et al. (2004) have allowed researchers to develop a rough understanding of the environment affecting their areas of focus. One such dendrochronological data point is located in the southern Piedmont of North Carolina, which ensures that the reconstructions are relevant to the local Piedmont region and are not just extrapolations and estimations from a broader study area.

The rise of the South Appalachian Mississippians in the Town Creek area coincides with the documented Medieval Warming Period (ca. A.D. 800 – 1300), a span of several hundred years where global temperatures rose and sea levels declined. This period was particularly felt in the northern hemisphere, where growing seasons lengthened and arable areas spread into more northern elevations (Hughes and Diaz 1994, Stahle and Cleaveland in Hughes and Diaz 1994). There is some debate over the exact dates for this temperature fluctuation. Some cite a time frame of ca. A.D. 800 to A.D. 1300 (Hughes and Diaz 1994), while others describe a later, and shorter, time period of ca. A.D. 1000 to A.D. 1300 (Stahle and Cleaveland cf. Hughes and Diaz 1994). During this time, precipitation levels fluctuated at Town Creek between drought and non-drought conditions. By A.D. 1150, the beginning of the Town Creek occupation, the local environment had recovered from previous drought

conditions, but just 50 years later was facing another extended dry period (Figure 1.2 and 1.3). However, this trend did not continue as rain levels increased during the late Town Creek and Leak phases (A.D. 1250-1350), eventually evening out the water table so that by A.D. 1400, drought conditions were no longer evident (Figure 1.4 and 1.5). Between A.D. 1400 and the end of the late Leak phase in A.D. 1550 (Boudreaux 2005), conditions in the Town Creek region fluctuated between moderate drought and mild precipitation surpluses, ending in A.D. 1550 with mild drought conditions again returning to the area. Despite these fluctuating drought conditions, precipitation reconstructions conducted for the southeastern United States using black cypress trees in North Carolina, South Carolina, and Georgia (Stahle and Cleaveland cf. Hughes and Diaz 1994) found no correlation to the broader warming period.

Archaeology

Located just five miles southeast of the Mt. Gilead town center in Montgomery County, North Carolina, the Town Creek Indian Mound and village site sits on the west bank of the Little River. Excavation has occurred here periodically since 1937 when Joffre Coe (1995) began the first field season funded through the Works Progress Administration program. His efforts were an attempt to study the people and culture responsible for the mound. He named them the 'Pee Dee' after the large river that Little River joins several miles south of the site. Because the mound is an obvious indicator of human activity, relic hunters and amateur archaeologists have looted the site for many years. The mound itself was dug into on several occasions in the early 1920s and 1930s prior to the first official field season (Coe 1995). One of the more damaging projects occurred in 1927 when a local high

school principal dug a trench through the mound down to ground level using a pair of mules and a drag pan (Coe 1995). An amateur excavator who visited the mound in 1929 described the principle's efforts and noted that most of the southeastern corner of the mound had been leveled (Coe 1995).

Fortunately, these activities did not completely destroy the mound and much of the site still remains intact. As such, Town Creek has provided archaeologists with great insight into the function of this important ceremonial center and the daily lives of those responsible for its construction. Comparisons between Town Creek with its cultural sister sites in North Carolina and the Southeast have shown that the Pee Dee have many cultural similarities to prehistoric villages across the region (Coe 1995, Reid 1965, Oliver 1992, Ward and Davis 1999). This places Town Creek within the broader geographic context of the South Appalachian Mississippian culture area (Ferguson 1971).

South Appalachian Mississippian Culture

The Mississippian culture, a tradition that initially developed in the Mississippi River valley (ca. A.D. 900 to as late as approximately A.D. 1600), spread to the broader mid-west and the south by A.D. 1000 (Peregrine 1996). This far-reaching cultural development was characterized by an increase in political centralization to chiefdom level, an intensification of maize agriculture, and the presence of monumental architecture in the form of pyramidical mounds (Smith 1978, Peregrine 1996). This cultural phase replaced the less organized Late Woodland tradition in some areas and is generally thought to have lasted from approximately A.D. 900 to European contact, though some major centers reached their peak by A.D. 1200 (Peregrine 1996). In other places, variations of the Late Woodland culture continued until

European contact. Archaeologists generally consider the South Appalachian Mississippian tradition to be the southeast's variation of these Mississippian characteristics, an idea considered as early as the late 1960s by Griffin (1967).

The South Appalachian Mississippian culture stretched as far north as Town Creek and other Pee Dee sites in the southern piedmont of North Carolina down to northern Florida and parts of eastern Alabama and as far west as portions of eastern Tennessee (Griffin 1967). Its main characteristics are complicated-stamped pottery and temple-mound ceremonialism (Ward and Davis 1999).

The Pee Dee Culture

The Pee Dee culture is the most northern expression of the South Appalachian Mississippians. The earliest radiocarbon dates associated with the culture date to the mid 10th century from the Teal site in North Carolina (Oliver 1992). The Pee Dee share many similarities with other non-Pee Dee sites in ceramic assemblages and site construction and function (Coe 1952, Reid 1965, Oliver 1992, Ward and Davis 1999) (Figure 1.6). These similarities led initial researchers to suggest that the Pee Dee were an intrusive population that came into the southern Piedmont of North Carolina from Georgia or South Carolina (Coe 1952, Oliver 1992). In support of this, several Pee Dee cultural sites have been identified in South Carolina. Alternatively, others believe that the Mississippian culture filtered into North Carolina via trade routes and adopted by the local population (Ward and Davis 1999, Driscoll 2001, Boudreaux 2005). Driscoll (2001) supports this by suggesting that the round houses used at Town Creek, originally identified as mortuary houses, are actually domestic structures. This same domestic style structure was also used by villages following the

Piedmont Village Tradition, a northern Piedmont culture group that flourished concurrently with the South Appalachian Mississippians (Ward and Davis 1999). She further describes Reid and Ferguson's (Driscoll 2001 *sensu* Reid 1967 and Ferguson 1971) findings that some pottery ware types in the Pee Dee ceramic assemblage are missing from South Appalachian Mississippian sites which are considered to be closely linked with Town Creek. The possible presence of these 'missing' ceramic types in villages in western North Carolina may actually indicate influence from a western North Carolina cultural group. While further research into South Appalachian sites may discount parts of Driscoll's (2001) theory, a recent biological distance study by Griffin et al. (2001) provides some support. In this study, non-metric dental and cranial traits were compared between sites in the Southeast and it was found that Town Creek was more skeletally similar to people from their local area (but outside of their cultural group), rather than more geographically distant (but culturally similar) sites like Irene (Griffin et al. 2001).

The Town Creek Site

Town Creek is a simple site consisting of a single mound and plaza (Figure 1.7). Prior to mound construction, the site consisted of public and domestic buildings with an open plaza containing a large post circle. The whole boundary was fenced with a large wooden palisade that extended out in a semi-circle and formed an enclosure with the river (Coe 1995, Boudreaux 2005). The palisade was an important component of the site and was re-built four times before the mound was constructed (Ward and Davis 1999). Mound construction occurred over the previous ceremonial building, the earth lodge. Once the flat-topped

pyramidical mound was completed, a sequence of ceremonial structures called Townhouse I and II, were built on top (Coe 1995).

The site has been occupied since at least the Late Woodland period (approximately A.D. 800) when the Yadkin culture, named for the nearby river, lived on the site (Coe 1995, Boudreaux 2005). While dates from other Pee Dee sites show possible activity during the 10th and 11th centuries (and Town Creek does show some use from this time frame), concentrated Pee Dee occupation likely began around A.D. 1150, pre-dating the construction of the mound (Mountjoy 1989, Oliver 1992, Boudreaux 2005). A large circular post structure was located in the open plaza and a semi-circular palisade surrounded the entire site forming an enclosure with the river.

This palisade was important enough to rebuild several times over the course of the Early Town Creek Phase (A.D. 1150-1250) (Boudreaux 2005). The repeated construction of the palisades was one line of evidence that had led researchers to believe that the Pee Dee, originally thought to be an intrusive group into the southern Piedmont, faced strong outside pressures and constant conflict (Oliver 1992, Coe 1995). However, low levels of skeletal trauma (Driscoll 2001) and evidence that the Pee Dee were actually native to the area (Ward and Davis 1999, Driscoll 2001, Boudreaux 2005) may point to another reason for the palisade's construction. While it may have been used for defense, it may also have acted as a site boundary. The major architectural piece of the site, the mound, was constructed during the early Town Creek phase and completed sometime during the late Town Creek phase, though some mound construction projects apparently continued into the early Leak phase (Boudreaux 2007). Boudreaux (2007) notes a lack of domestic style structures in excavated

areas next to the open plaza beginning in the late Town Creek-Leak phase. This may have been the beginning of site abandonment and he notes that the site was likely completely abandoned during the 1400s (late Leak phase).

Pottery

Pee Dee style pottery is characterized by the use of sand tempered clay and a variety of design finishes including the notable stamp paddle, smooth, burnished and textile-impressed designs (Coe 1995) (Figure 1.8). Pottery styles remained simple with finishes and different methods of punctuate and clay symbol designs used by the population. The clay and punctuate decorations were found to change over time. Less complicated treatments of pottery rims, including incising, rim punctuates, and lip notching were found most often in pre-mound contexts, indicating an early placement in the Pee Dee timeline at Town Creek. The post-mound contexts of the later site occupation contained pottery with clay symbol decorated rims including rosettes, fillets, pellets, and shoulder punctuates. These styles had been completely absent in older contexts (Coe 1995).

Site Use

Because many groups used Town Creek as a permanent or semi-permanent village space, the Pee Dee style of occupation has been in doubt. Early researchers pointed to a lack of domestic occupation evidence as evidence that Town Creek served only as a ceremonial center and that the population likely lived in settlements in surrounding the area (Oliver 1992, Coe 1995). However, the large quantity of artifacts and presence of numerous fire pits point to a more intensive village style use of the site (Ward and Davis 1999). Further, Driscoll's (2001) interpretation of the mortuary structures as originally domestic living areas

strengthen this argument. It is now widely accepted that, for at least part of the Pee Dee cultural occupation at Town Creek, a thriving population resided there (Ward and Davis 1999, Driscoll 2001, Boudreaux 2005).

Food Resources

The Pee Dee exploited a wide range of food resources available in their local environment; including collecting local wild vegetation, such as hickory and walnuts and acorns, hunting and fishing, and agriculture (Trinkley in Coe 1995, Ward and Davis 1999). Corn was the most abundant plant resource found at Town Creek, though squash was also cultivated. Beans, the third cultigen in the agricultural triad seen in the Southeast, were not found at Town Creek, but were available to the Pee Dee during their occupation of the Piedmont as remains of their cultivation were found at the Leak site, a Pee Dee site occupied primarily during the Leak phase (Trinkley in Coe 1995, Ward and Davis 1999).

Burials

As mentioned previously, Town Creek contains a possible 563 identified burials in both the mound and the village, though only 239 individuals have been excavated. Because several different cultural groups used Town Creek, some burials from these non-Pee Dee groups were discovered. Seven burials are associated with the first known inhabitants, the Yadkin, and 14 with a later proto-historic Siouan group; the remaining 218 burials associated with the Pee Dee (Boudreaux 2007). Remains were often interred in the floors of structures circling the plaza. The plaza itself was kept open and no burials have ever been found within its boundaries (Driscoll 2001).

Individuals were buried in the mound and clustered around the plaza in enclosed structures and open area clusters. Remains were placed in either a flexed or extended position in pits lined with bark (Coe 1952). While most burials were single occupancy, several multiple burials have been excavated. Infants were generally interred in large pottery urns (Coe 1952) and this likely accounts for the excellent preservation found in many of the infant remains.

TOWN CREEK REGIONAL CHRONOLOGY

Two types of dating techniques, radiocarbon dating and fluoride testing, were conducted at Town Creek in an effort to establish regional and intra-site context. The date ranges would apply to Town Creek, as well as the Pee Dee sites in the surrounding area.

Fluoride Dating

Because of a lack of intra-site chronology at the time of her research, Driscoll (2001) conducted fluoride testing, a relative dating technique, in an effort to establish an understanding of burial timing within Town Creek. Fluoride dating measures the amount of fluor-apatite within the bone chemistry. This compound is created in the skeleton after deposition, when fluoride from the local environment, found in soil and groundwater, accumulates within the skeletal material. The fluoride ion replaces the native hydroxl ion and creates fluor-apatite (Schurr 1989). In an ideal environment, where fluoride is present, the fluor-apatite will continue to accumulate. The higher the level of fluor-apatite within a sample, the longer the individual has been buried (Schurr 1989). When samples are compared, a basic understanding of time since deposition can be understood. While fluoride does not provide an absolute date, it can provide a relative chronology of burial order. This was an important step in assessing basic age comparisons, as no intra-site chronology existed at the time.

Driscoll (2001) found that the technique worked poorly in the Town Creek population and was unable to distinguish any significant sequential differences between selected individuals who, because of location and layer occupation, should have been temporally

different (Driscoll 2001). Driscoll posits that this may have been the result of low fluoride levels within the local environment.

Radiocarbon and Ceramic Chronology

The original timeline of Town Creek, established by Coe (1952), was created using radiocarbon dating and pottery association. The chronology of the site occupation was broken down into three main segments: the Yadkin, the Pee Dee and the historic Caraway phase (Coe 1995). Pottery sherds also show evidence of an unnamed pre-Yadkin group, further confirmation that Town Creek has long been a favored site for past peoples. Coe's (1952) timeline initially placed the beginning of the Pee Dee occupation in the mid A.D. 1500s, but radiocarbon dating of Town Creek and other Pee Dee sites have pushed back these initial time periods.

A total of 26 samples from Pee Dee sites in North Carolina have been radiocarbon dated. All dates were collected at four Pee Dee sites: Teal (n=16), Town Creek (n=4), Leak (n=3), and Payne (n=3). All samples were from wood charcoal, except for one each from each site that dated bone, shell, and corncobs, respectively (Oliver 1992 *sensu* Reid 1967, Mountjoy 1989, Oliver 1992). Based on these dates, it is now understood that the Pee Dee were present in the area since approximately A.D. 900/A.D. 1000 (Mountjoy 1989, Oliver 1992). Boudreaux (2005) revised the timeline for the Town Creek area proposed by Oliver (1992) using only 15 of the available radiocarbon dates, reducing the number because of discrepancies and wide date ranges, and his seriation of 11 assemblages from Town Creek, Leak, Payne, and Teal sites. Boudreaux (2005) provided calibrations (at 1-σ) for the available radiocarbon dates in an effort provide a more representative date range. While

reporting 1-σ is acceptable, the 2-σ calibrations, which provide a wider age distribution, are generally included in radiocarbon date research as it provides a 96% degree of confidence versus 68% at 1-σ. For this study, the dates were recalibrated for 2-σ using the online calibration system Calib 6.0 and added to Boudreaux's original radiocarbon data table (Table 2.1). The 2-σ calibration gives wider age ranges for the time periods than was previously noted. Figure 2.1 demonstrates some overlap between the time periods, suggesting that the chronological framework developed for the particular time periods may need to be reevaluated.

The seriation of the 11 pottery assemblages conducted by Boudreaux (2005) was done using Nonmetric Multidimensional Scaling (MDS) which creates a graph with units of pottery represented as points in a matrix. The further the points are from one another is a visual representation of the relationship distance between pottery styles. MDS orders the relationships chronologically and trends in pottery style relationships can then be determined (Boudreaux 2005). Boudreaux's pottery seriations and 1-σ calibrated radiocarbon dates resulted in the current timeline used in this study (Table 2.2).

The South Appalachian Mississippian chronology for the Town Creek area is divided into three periods based on Boudreaux's (2005) 1-σ: Teal from A.D. 1000 to 1150, Town Creek from A.D. 1150 to 1300 (with an early phase ending at A.D. 1250), and the Leak from A.D. 1300 to 1550 (with an early phase ending at A.D. 1400 [Boudreaux 2005]).

The Boudreaux timeline is most helpful when the burials themselves are considered. Previously, intra-site comparison was not possible due to a lack of intra-site chronology. Boudreaux (2005) was able to link site structures to site progression by assigning a time

period to building structures based on excavation, radiocarbon dates, and pottery association. Because of this work, burials associated with structure type can also be attributed to that phase. This method may prove to be too broad, particularly when considering certain structures. The burials from Small Circular Structures and the sub-mound area can be confidently placed within the Early Town Creek phase, similarly, those associated with the mound summit, Large Rectangular Structures, Medium Rectangular Structures, and the rectangular enclosure are placed within the Late Town Creek-Early Leak phase. However, the Enclosed Circular Structures provide some difficulties. Though they are understood to be a later construction, they were built upon the older Small Circular Structures (Boudreaux 2005). This may lead to some earlier burials being misplaced in the later phase.

MATERIALS AND METHODS

Curated at the Research Laboratories of Archaeology at UNC-Chapel Hill, a sample of 70 individuals (Table 3.1) was selected from this study from the skeletal analysis records of 214 burials, conducted as part of the NAGPRA inventory by Lambert (Davis et al. 1998). Lambert's sex and age determinations were used for skeletal profile information. Once analysis was completed, each burial was placed within the intra-site chronology according to Boudreaux's (2005) burial-structure association study. Statistical analysis was then applied to the sample to ascertain what, if any, changes occurred over time. The early time periods, Teal and Early Town Creek, were grouped together into an 'early phase' which encompasses the beginning of Pee Dee occupation through part of their time of greatest cultural strength at Town Creek. The 'later phase' consisted of Late Town Creek and Leak phases, which correspond to a decline in site use.

If climatic stresses were occurring locally, this would affect local groups' food production capabilities, which in turn would be reflected in an increase in nutritional deficiencies, including a decrease in adult long bone lengths and an increase in pathologies related to poor nutrition, such as cribra orbitalia. Further, reductions in food resource availability often will increase cultural stress within a group or broader region and lead to an increase in intentional, trauma injuries.

Cribra Orbitalia

Cribra orbitalia is a skeletal pathology that manifests as areas of porosity and pitting lesions in the upper eye orbits of the frontal bone of the skull (Walker et al. 2009). It has largely been attributed to anemia within populations caused by several factors, including

poor nutrition and disease (Sullivan 2005). It is commonly seen in societies that consume large quantities of maize as the chemical compounds within this cultigen block the body's ability to absorb iron. While cribra patterns can indicate social stratification, this pathology can cut across status lines to show population-wide health issues. For example, Sullivan (2005) found that even high status, and therefore generally healthy individuals, possessed skeletal indicators of anemia which she believed pointed to issues with intestinal parasites that reduced their ability to absorb iron and B_{12}. Other research suggests that the presence of cribra orbitalia may be unrelated to anemic conditions; instead it may be associated with other pathologies such as periostitis or osteitis (Wapler et al. 2004).

Most recently, Walker et al. (2009) identified the most likely causes of porotic hyperostosis and cribra orbitalia based on archaeological and clinical evidence. They found that B_{12} deficiency, stemming from a lack of meat foods, caused megablastic anemia, and not iron deficiency anemia. This condition, coupled with infection and disease from poor living conditions, were the likeliest etiology for cribra orbitalia. Breast-feeding children, whose mothers did not consume enough B_{12} rich foods and juveniles of weaning age, who were no longer supplementing their diet with breast milk, were the most susceptible. This accounts for the higher rate of cribra orbitalia within juvenile populations compared to adults. The authors further describe archaeological evidence from Northern Europe where meat resources were domesticated, but which still show a high degree of cribra orbitalia. In these types of cases, Walker et al. (2009) state that endemic, chronic infections were the most likely cause.

While many researchers still use cribra orbitalia as an indicator of iron-deficient anemia (Sanford et al 1983, Sullivan 2005), new research has shown that chronic diseases

and B_{12} deficiency anemia are more strongly correlated to the formation of cribric orbital lesions (Wapler et al. 2004, Walker et al. 2009). Sullivan (2005), even while pointing to the importance of iron-deficiency in cribra cases, found a strong connection between B_{12} deficiency and individuals exhibiting the lesions. This will be helpful in the Town Creek population, as cribra orbitalia, despite its etiological confusion, has been found to correlate strongly overall with nutritional deficiencies and chronic disease. Incidence of this pathology within the sample can be used as a barometer for nutritional health.

Cribra orbitalia was scored as present or absent and a determination was made of active versus healed lesions in an effort to establish possible active pathology in adults. While Walker et al. (2009) note that cribra orbitalia is a juvenile disease with no cases of adults showing active lesions, Sullivan (2005) found several possible examples of active criberic lesions in her English sample. Analyzing this aspect of the pathology will add to the understanding of when it initially develops and how long it can remain active. Lambert's (Davis et al. 1998) previous analysis of cribra orbitalia was used as a foundation for this research. My positive identification of cribra orbitalia cases marked by Lambert (Davis et al. 1998) as 'possible' or those that had not been cleaned until after the NAGPRA inventories were included within my count of cribra presence.

Long Bone Lengths

An individual's stature is attained through the interplay of genetics and positive nutritional habits. While 75% to 90% of overall stature attainment is determined by heredity (Kemkes-Grottenthaler 2005), environmental factors during fetal development and childhood are also an important influence. Steckel (2005) used adult femur lengths, along with several

other juvenile health indicators that are present in the adult skeleton, to search for a correlation with adult age at death. He found that childhood growth retardation, in response to nutritional and health stresses, led to a shorter life span. This demonstrated that childhood stress could have a direct effect on adult stature and health. Adult long bone lengths are the consequence of heredity modified by childhood nutrition, and as such are good measurements of past juvenile health within a population.

Though environmental stressors such as poor nutrition affect all limb growth rates, research has shown that the distal elements of the long bones are more vulnerable than others (Jantz and Owsley 1984). In males, the tibiae have been shown to have the greatest variability, while females have shown no difference in the variability between the distal arm and leg elements (Holliday and Ruff 2001).

In this study, all available long bones were measured for maximum length using a standard osteometric board according to *Data Collection Procedures for Forensic Skeletal Material* (Moore-Jansen et al. 1994). The tibial measurement included the malleolus and excluded the intercondyloid eminence.

Trauma

Trauma defined in this project is any skeletal injury not caused by pathology or postmortem forces. In a bioarchaeological setting, trauma can be caused by intentional acts of violence, occupational accidents, cultural mutilation, and bone diseases that leave the bones of older populations prone to fracture (Standen and Arriaza 2000). While trauma can give insight into levels of inter-(between groups) or intra-(within) group violence, it is important not to associate every broken bone with conflict. Good indicators of intentional

violent trauma include: embedded projectile points, sharp and blunt force trauma, trophy taking cut marks such as scalping, and mass interments which could indicate an attack on a village (Smith 2003). Adult males will generally be the most affected (Standen and Arriaza 2000).

However, some Mississippian studies have found the opposite trend. High rates of females exhibiting blunt force trauma to the head were found at the Mississippian sites of Mouse Creek and Chickamouga Dallas (Smith 2003). The prevalence of non-fatal wounds at the two Mississippian sites was found to indicate not warfare, but domestic, intra-group violence. An increase of fatal or non-fatal wounds over time in the Town Creek population could indicate pressure from an outside group or stress within the population causing individuals to act out against one another.

Similar to the cribra sample, Lambert's (Davis et al. 1998) trauma analysis was used as the foundation sample along with several of my own observations. Trauma was scored as present or absent per individual burial and its position noted for pattern analysis. A simple count was used in place of a frequency in an effort to determine an increase in trauma incidences over time. Because the sample, and the number of excavated burials at Town Creek in general, are weighted in favor of the Late Town Creek/Leak phase, there would need to be a significant increase in trauma rates in the later half of the Town Creek occupation for there to be a correlation with cultural stress experienced by the population.

Statistical Analysis

Statistical analysis of cribra orbitalia was carried out using Fishers Exact Test, which involves a simple count of presence and absence within the sample of score-able eye orbits.

The measureable adult long bones created a small pool for statistical analysis. To overcome this issue, adult male and female averages were taken for the humerus, femur, and tibia, the elements most represented in the sample. When an individual had both the left and right of an element present, such as the left and right tibia, only the left was used for analysis.

These measurements were then calculated as limb indices whose results are ratios of limb size that when compared between the two phases, can be noted for changes over time. Mean replacement was used when an element category was missing the same number of measurements as its associated index ratio. For example, the early phase male crural index contained six femoral measurements and four tibial measurements. The tibial lengths were averaged and used as replacements for the two missing measurements, so that each element provided an equal number of data. In this way, the ratio would be balanced without skewing the data.

The two indices used for this study include the humero-femoral and the crural (femoral-tibial) (Steele and Bramblett 1988). A third commonly used measurement, the brachial index (humerus-radius), was not considered due to poor preservation and representation.

Humero-Femoral Index: (maximum humerus length/maximum femur length) x 100

Crural Index: (maximum tibia length/maximum femur length) x 100

Sexual dimorphism between phases was also considered as it has been found to correlate to nutritional stress levels in populations; as stress increases, sexual dimorphism between the sexes decreases (Gray and Wolfe 1980). This was measured using average femur length and calculated using the sexual dimorphism index (ISD) (Lockwood 1999).

ISD = {(male mean/female mean)/1] x100}

The femur was chosen because of its high representation across both sexes and phases and as it experiences different stress due to the differences in male and female body sizes (Purkait and Chandra 2002). The results were then statistically compared using a nonparametric Spearman rank correlation coefficient which determines degree of dependence.

Trauma could not be scored statistically, as it was unclear how many individuals were score-able for each trauma type. Previous statistical analysis assessed by Driscoll (2001) was compared to the trauma results of this study to determine significant changes in frequency. When statistical methods were employed, SAS statistical software (version 9.1.3 for Microsoft and JMP 8 for Apple) was used.

RESULTS

Cribra Orbitalia

Within the Pee Dee period (A.D. 1150 - 1550) 62 individuals had score-able eye orbits, of which 30.7% (n=19) expressed cribric lesions. Separated into time periods, 12.9% (n=8) were in the early phase (A.D. 1150 - 1250) and 17.7% (n=11) in the later phase (A.D. 1250 – 1550) (Table 4.1). Two burials, including one with expressed cribra, were removed from the sample as they could not be placed into a specific phase of occupation. While there appears to be an increase in cribra orbitalia within the later phase, it is only minimal and not statistically significant ($p = 0.743$) (Figure 4.1).

The cribra orbitalia presented in the sample were healing or well-healed, except for two juvenile cases where porosity appears active (Figure 4.2) as previously noted by Lambert (Davis et al. 1998). No adult cases exhibited unhealed cribric lesions.

Long Bone Measurements

The calculated measurements (humerus, femur, and tibia) were separated by sex and phase (Table 4.2 and 4.3). Mean replacement was used to balance the sample size of each index, for instance, in the crural index where a femoral measurement was missing, the mean value was used.

Humeral-Femoral Index

Because of small sample size and representation problems, only the male humeral-femoral index could be calculated and compared between the phases. The Early Town Creek phase consisted of six measurements and the index was calculated at 70.7. The Late Town Creek/Leak phase consisted of ten measurements and the index was calculated to 70.4 (Table

4.4). These calculations show overall stability in the male upper arm to upper leg length ratio between the two time phases.

Crural Index

The male crural index consisted of six measurements in the Early Town Creek phase and was calculated at 81.6. The Late Town Creek/Leak phase consisted of ten measurements and was calculated at 82.6 (Table 4.5). The upper leg to lower leg ratio shows a slight increase in the later time period.

The female crural index consisted of six measurements from the Early Town Creek phase and was calculated at 84.9. The Late Town Creek/Leak phase consisted of nine measurements and was calculated at 83.4 (Table 4.6). The female upper leg to lower leg ratio suggests a slight decrease in the later time period though this may reflect the smaller tibia sample from the Early Town Creek individuals.

Sexual Dimorphism Index (ISD)

The sexual dimorphism calculation consisted of six female and male femur length measurements in the Early Town Creek period with an ISD of 107. The Late Town Creek/Leak phase had seven female and ten male femur measurements with an ISD of 108. Unlike the previous indices, the present sample was balanced and no mean replacement was used. The slight change in male and female crural indices between the time phases is reflected in the slight increase in sexual dimorphism in the later phase. The Spearman rank correlation coefficient was applied to the ISD to determine dependency, but no correlation was found ($r = 0$).

Trauma

Fifteen individuals showed signs of skeletal injury (Table 4.7). Slightly more individuals showed signs of trauma in the early phase (n=9) than the later phase (n=6) (Table 4.8). Two additional traumatic injuries not previously noted by other researchers were recorded (burials 34-6 and 2121-142A) (Figures 4.3 and 4.4). Statistical analysis was not conducted as a count of score-able individuals was not available.

Town Creek individuals affected by trauma were overwhelmingly adult and male with just one juvenile and two females affected. While many of the injuries were to the extremities, including fractures to the arms and legs or hands, fully half (n=6) were to the skull or mandible and split evenly across the early and late phases (three each). The late phase has the most obvious expression of interpersonal violence; one individual had an arrow embedded in their thoracic vertebrae.

DISCUSSION

Drought conditions and its negative effects on crop production in the Southeast have been cited as a possible explanation for the roughly concurrent collapse of formerly strong, culturally significant sites in the mid-1400s (Boudreaux 2005). However, environmental data show that drought conditions were common in the region of Town Creek, occurring every few decades and, occasionally, maintaining mild to moderate drought levels for long periods (Figure 5.1). Ironically, these adverse conditions occurred during active periods for the population, such as the construction of the mound, which was begun in the early Town Creek phase and completed by, and was in use during, the late Town Creek phase (A.D. 1250-1300). In fact, a particularly intense period of drought, not experienced before during the Pee Dee occupation, occurred at approximately A.D. 1270 when site and mound construction was in progress.

Cribra orbitalia was found to increase slightly between the early and late phase skeletal samples, though this was not statistically significant. While the 30% cribric rate found here is higher than the 25% rate found by Lambert and the 21.5% found by Driscoll (2001), it is still lower than contemporary sites in the Northern Piedmont (Lambert 2000). The differences between these findings and those found by Lambert (2000) and Driscoll (2001) are due, in part, to the condition of the skeletal material and interobserver scoring differences.

The humeral-femoral index for males suggests that the upper arm to upper leg length ratio remained stable between the early and later time phases. This changed slightly in the crural index calculations, which showed that in the Late Town Creek/Leak phase the male

upper to lower leg length ratios increased by one millimeter (1 mm), while the female ratio decreased by a little over one and a half millimeters (1.6 mm). However, this decrease may be caused by the small tibia sample for Early Town Creek females.

Further, these slight changes in the crural indices were shown to be insignificant because of the lack of correlation between the sexual dimorphism indices between the two phases. Despite a small increase in the Late Town Creek/Leak phase, sexual dimorphism was found to be relatively stable over time at Town Creek.

While trauma patterns could not be statistically analyzed here, Driscoll (2001) found that of the 14 individuals (score-able n=92) exhibiting evidence of trauma, there was a statistical significance between male and female trauma rates with males exhibiting more traumatic injuries. This trend continues when the two newly identified trauma examples are added to the sample. While one individual with trauma is a young child of indeterminate sex, the second is of an older adult male. In addition to the sex differences, when trauma is separated by phase, it appears to occur more often in the early Town Creek period. This is interesting to note considering the later phase had more skeletal remains available for analysis. If the six head traumas, which appear non-fatal, are evidence of conflict, then the tendency toward interpersonal violence seems relatively stable and of an infrequent nature. It certainly does not appear to have increased during the late phase.

CONCLUSIONS

Environmental data have shown mild to moderate, and one example of extreme, drought conditions persisting throughout the Pee Dee occupation of Town Creek (A.D. 1150 – 1400). The periods of drought were followed by brief periods of precipitation stability and even surpluses that replenished the water table before the next drought occurred. Additionally, the local cultural groups in the area would likely have adapted to such variable conditions, perhaps explaining why non-essential work, such as mound and ritual/public space construction, continued through these difficult periods. While drought conditions may have played a part in the demise of other cultural sites in the Southeast, it does not seem to have been a significant factor in the abandonment of Town Creek.

The skeletal indicators show little evidence of dramatic nutritional or cultural stress. While the crural indices show an inverse relationship between the sexes in each time period, with the males gaining a small amount of leg ratio length (1 mm) and the females losing a similar amount (1.6 mm), these changes were negligible. This determination is supported by the results of the ISD statistical calculation, which found no correlation in the slight increase in sexual dimorphism in the Late Town Creek/Leak phase.

While the indices allowed for a better understanding of changes within the Town Creek population, the sample size is still relatively small and likely suffers from problems with accurate population representation and temporal divisions based on few 14C dates. With approximately half of the Town Creek burials yet to be excavated, it can be hoped that a more temporally representative sample will be available for analysis at some point in the future.

Further, complications may arise with the burial-structure associated time periods, specifically, the Enclosed Circular Structures. Because these particular structures were built over top of the early Town Creek phase Small Circular Structures, there is a strong possibility that burials from the older period have been mistakenly included in the early Town Creek/Leak phase. More intensive dating of these structures and their associated burials would provide a better idea about the temporal phase to which each individual burial belongs.

Town Creek did not appear to suffer from any dramatic changes in climate during its occupation. Cribric lesion rates and traumatic injury occurrences were not found to increase significantly over time. Previous research has shown that Town Creek may have been abandoned for another occupation site north along the Pee Dee River called the Leak site (Oliver 1992). If this is the case, then the general local area must have still been relatively hospitable to sedentary farmers, as corn, beans, and squash were grown at the nearby Leak site, a late Pee Dee culture period (Leak phase) village. Future research techniques may shed more light on the Pee Dee and other potential issues that caused them to abandon Town Creek. This analysis suggests that the main cause of the site falling into disuse was not nutritional or cultural stressors and the local environmental conditions, while they cannot be ruled out all together, were likely not major contributing factors to the abandonment of Town Creek.

Figure 1.1: Location of Town Creek Indian Mound in North Carolina

Drought indices color bar, negative numbers indicate less precipitation and drought conditions, while positive numbers indicate periods of increased precipitation.

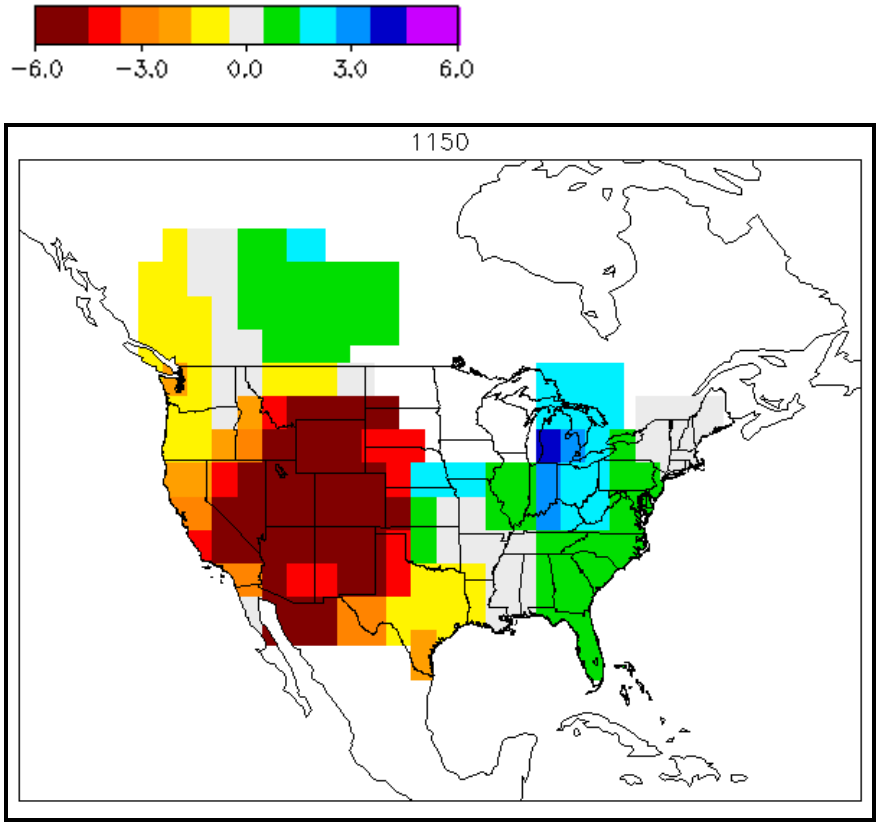

Figure 1.2: Drought index for A.D. 1150 (Cook et al 2004, NOAA http://www.ncdc.noaa.gov/cgi-bin/paleo/pd04plot.pl)

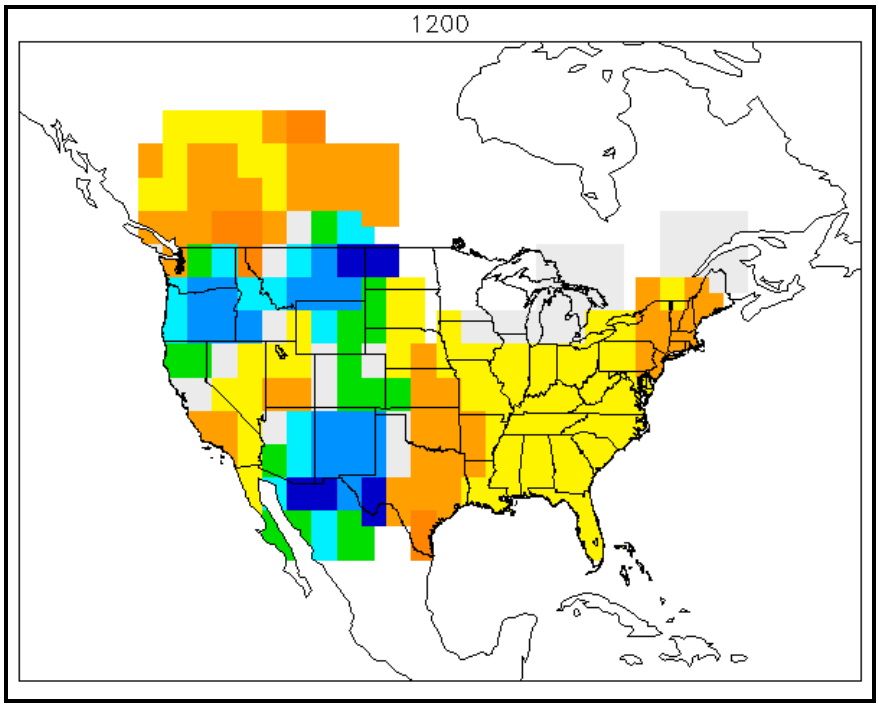

Figure 1.3: Drought index for A.D. 1200 (Cook et al 2004, NOAA http://www.ncdc.noaa.gov/cgi-bin/paleo/pd04plot.pl)

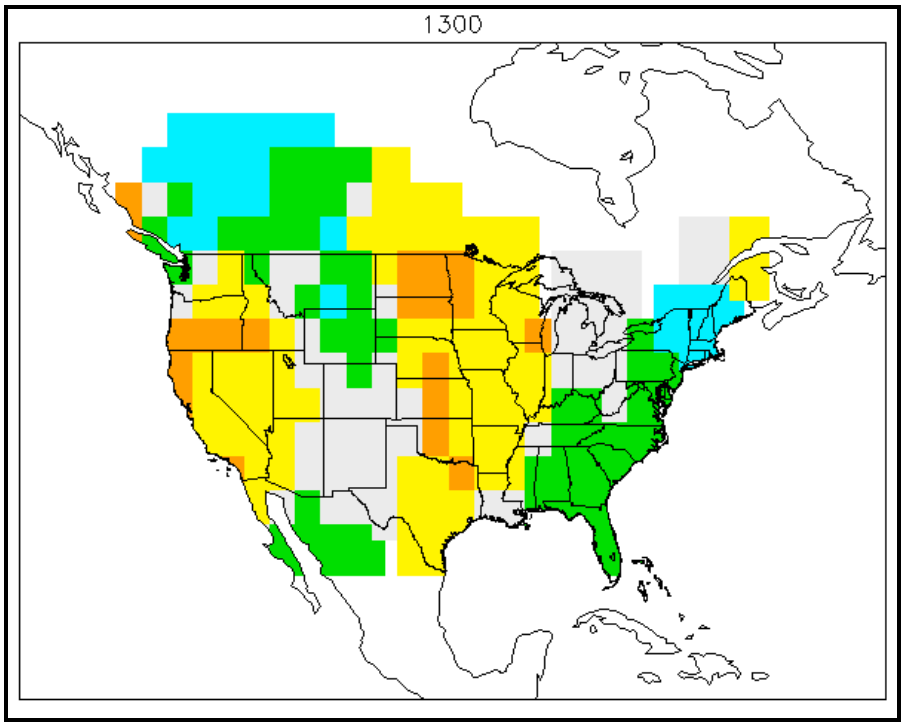

Figure 1.4: Drought index for A.D. 1300 (Cook et al 2004, NOAA http://www.ncdc.noaa.gov/cgibin/paleo/pd04plot.pl)

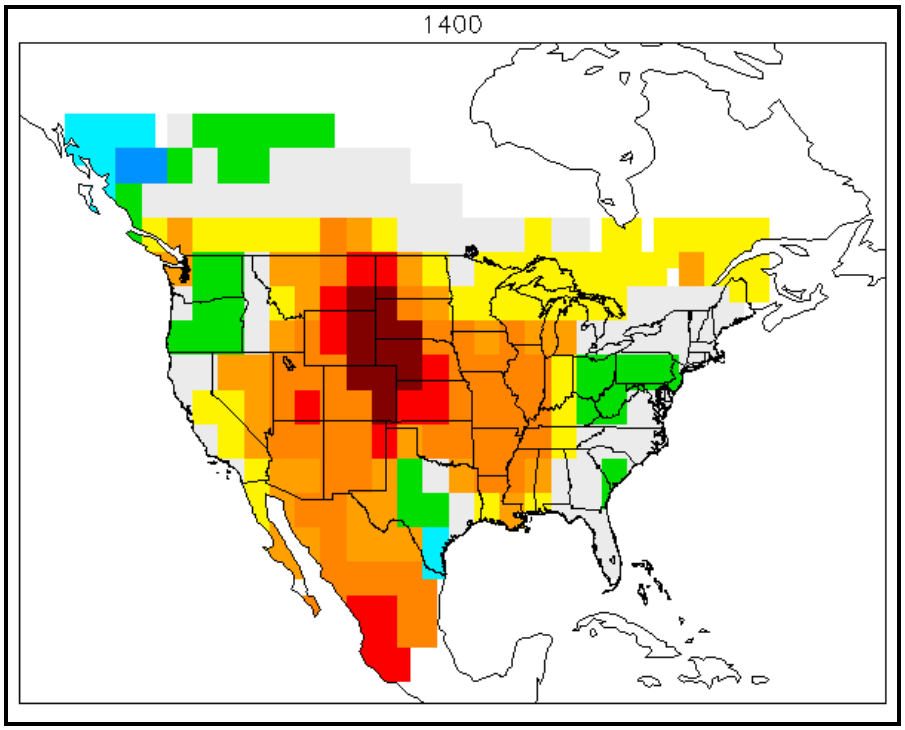

Figure 1.5: Drought Index for A.D. 1300 and 1400 (Cook et al 2004, NOAA http://www.ncdc.noaa.gov/cgibin/paleo/pd04plot.pl)

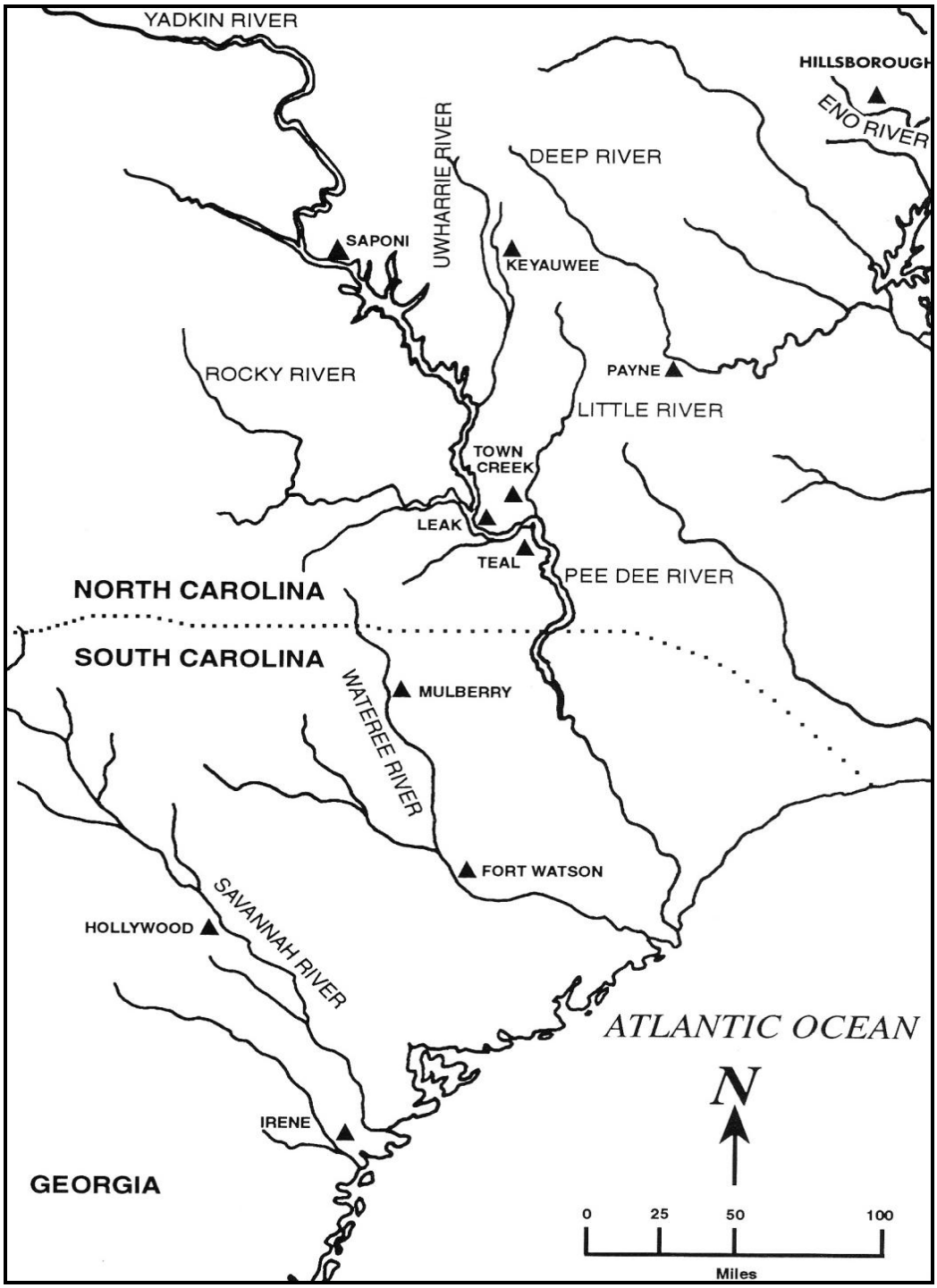

Figure 1.6: Town Creek and associated South Appalachian Mississippian sites in North Carolina, South Carolina, and Georgia (Coe 1995)

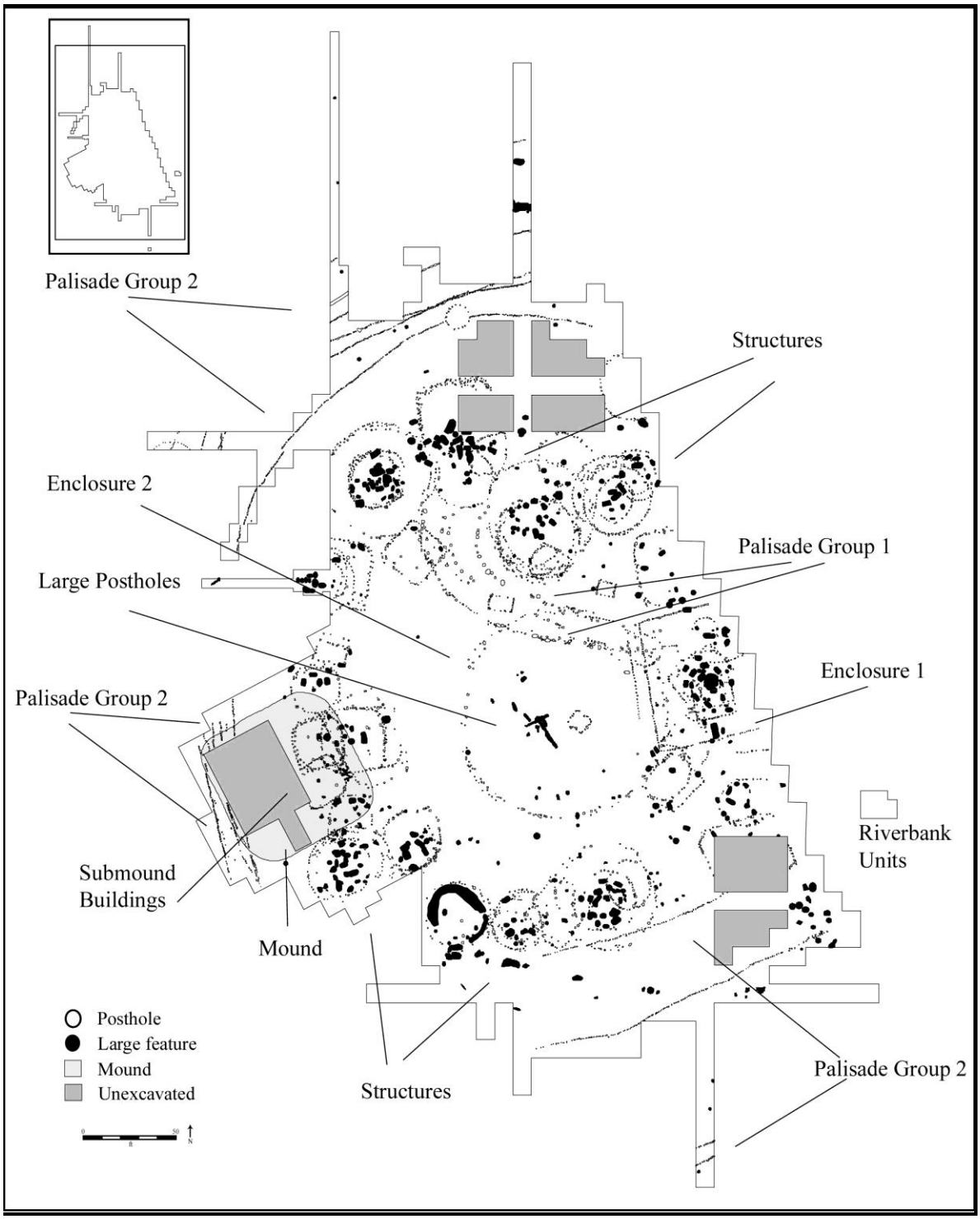

Figure 1.7: Map of Town Creek (Boudreaux 2005)

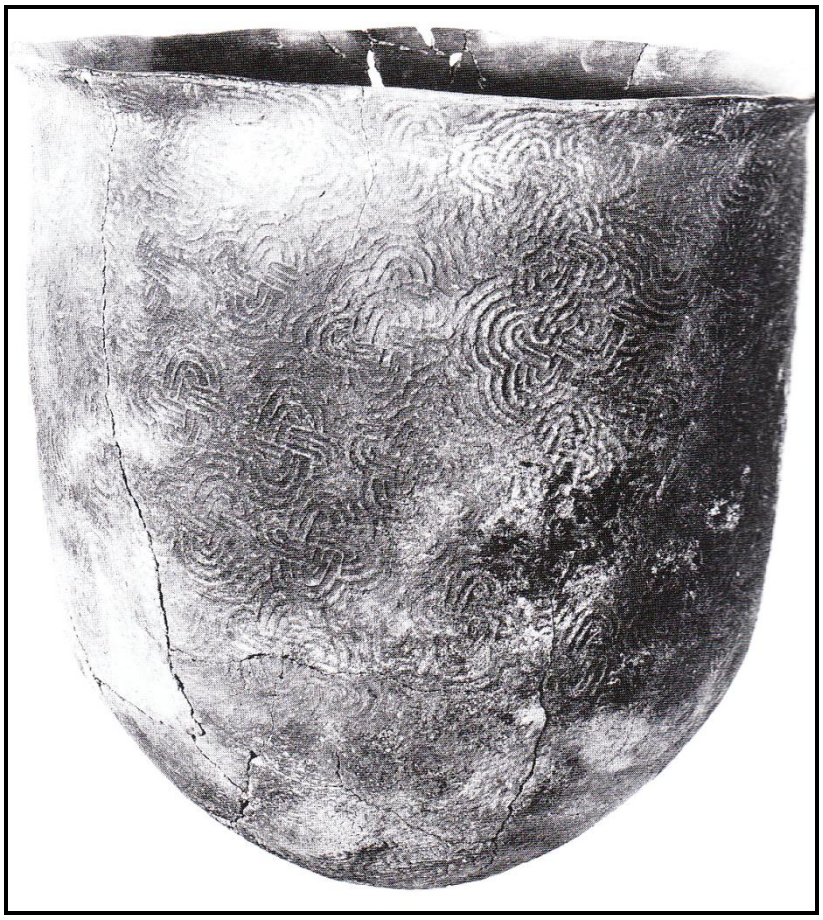

Figure 1.8: Filfot-cross design on infant burial urn (Coe 1995, p. 182)

Table 2.1: Radiocarbon dates used in adjusted timeline (Boudreaux 2005)
*Calibrated by Boudreaux (2005)
**Calibrated by Cunningham (2010)
Phase association based on Boudreaux (2005) 1-σ calibrations

Sample Code	Site	Age (BP)	Standard Deviation	Uncalibrated Intercept	Uncalibrated 1-Sigma	Calibrated 1-Sigma (AD)*'	Calibrated 2-Sigma (AD)** (rounded)	Probability Distribution	Phase Association
Beta-184061	Town Creek	300	60	1650	1590-1710	1496-1651	1450-1680	0.952	Late Leak
Uga-5645	Leak	525	65	1425	1360-1490	1319-1443	1290-1470	1.000	Early Leak
FSU-185/FSU-175	Town Creek	595	50	1355	1305-1405	1305-1405	1290-1420	1.000	Early Leak
Uga-5644	Leak	485	175	1465	1290-1640	1297-1632	1200-1700	1.000	Early Leak
FSU-186/FSU-176	Town Creek	670	40	1280	1240-1320	1279-1386	1270-1400	1.000	Early Leak
FSU-145/FSU-154	Town Creek	600	140	1350	1210-1490	1262-1448	1160-1640	0.999	Early Leak
Uga-6050	Leak	680	50	1270	1220-1320	1274-1387	1260-1400	1.000	Late Town Creek
Beta-201468	Town Creek	820	40	1130	1090-1170	1187-1261	1160-1280	0.988	Early Town Creek
Beta-18411	Payne	820	70	1130	1060-1200	1158-1274	1120-1290	0.837	Early Town Creek
FSU-184/FSU-174	Town Creek	745	140	1205	1065-1345	1155-1397	1020-1440	1.000	Early Town Creek
Beta-18412	Payne	860	70	1090	1020-1160	1051-1255	1030-1270	1.000	Early Town Creek
Beta-18410	Payne	910	60	1040	980-1100	1040-1173	1020-1230	0.986	Early Town Creek
Uga-6047	Teal	950	50	1000	950-1050	1025-1154	1010-1210	0.994	Teal
Uga-6048	Teal	950	50	1000	950-1050	1025-1154	1010-1210	0.994	Teal
Uga-6046	Teal	1000	55	950	895-1005	987-1150	940-1160	0.962	Teal

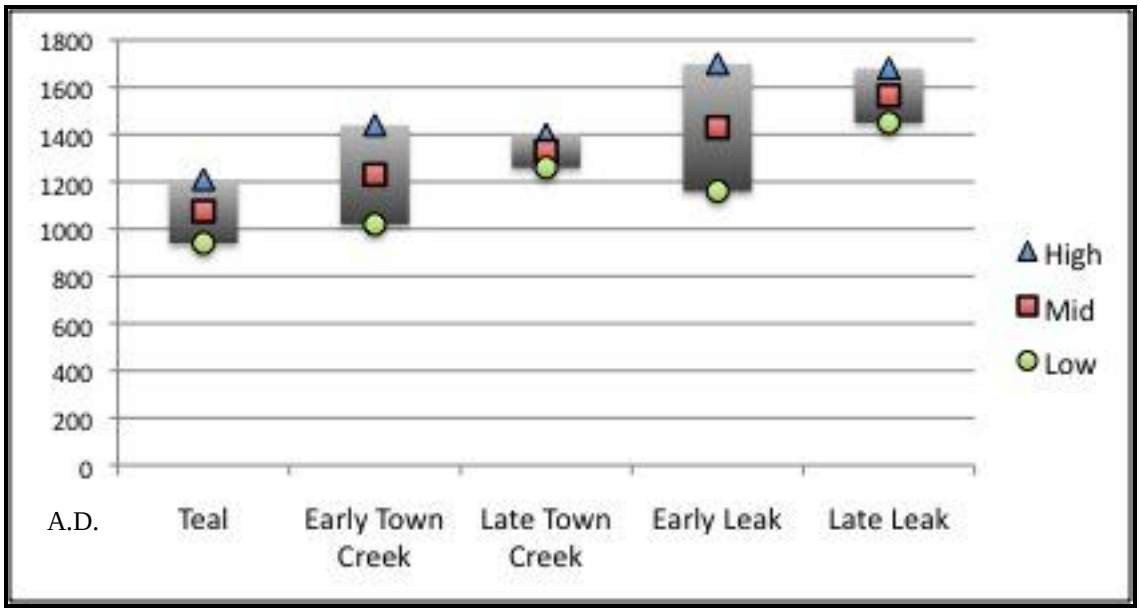

Figure 2.1: Range of 2-σ calibrated radiocarbon dates; high, medium and low dates shown

Table 2.2: Boudreaux Timeline

Phase	Time Period
Late Woodland	A.D. 800 - 1000
Teal	A.D. 1000 - 1150
Town Creek (Early)	A.D. 1150 - 1250
Town Creek (Late)	A.D. 1250 - 1300
Leak (Early)	A.D. 1300 - 1400
Leak (Late)	A.D. 1400 - 1550
Protohistoric	A.D. 1550

Site Sample =	70 individuals
Mound	16
Village	54
Teal/Early Town Creek	26
Late Town Creek/Leak	44
Adult	48
Juvenile	21
Indeterminate	1
Male	22
Female	23
Indeterminate	25

Table 3.1: Breakdown of research sample

Table 4.1: Cribra orbitalia presence by phase, sex, and age

Cribra Orbitalia Count				
Score-able eye orbits: **62**	*Male*	*2*	*Male*	*2*
	Female	*4*	*Female*	*4*
	Indeterminate	*2*	*Indeterminate*	*5*
			Adult	*6*
	Adult	*6*	*Juvenile*	*4*
	Juvenile	*2*	*Indeterminate*	*1*
	Early Town Creek	**8**	Late Town Creek-Leak	**11**
			Site Total	**19**

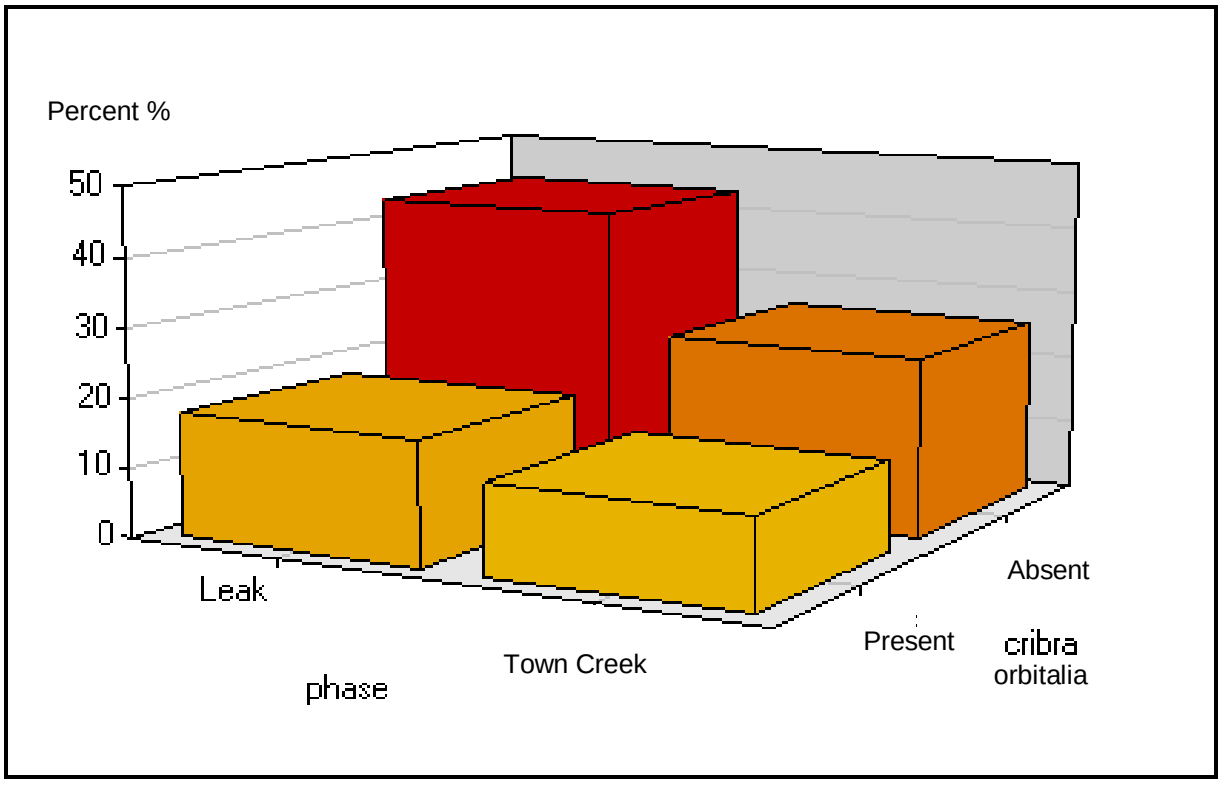

Figure 4.1: Cribra orbitalia percentage by phase

Figure 4.2: Burial 70-46 (juvenile) – Active cribra orbitalia

Table 4.2: Early Town Creek: statistical breakdown of calculated elements

Early Town Creek	Sex	Element	Mean	Std. Deviation	Total
	M	Femur	447.08	20.26	6
	M	Tibia	365	15.63	4
	F	Femur	417.75	16.91	6
	F	Tibia	354.50	12.73	2
	M	Humerus	316.17	26.38	3
Total	7				21

Table 4.3: Late Town Creek/Leak: statistical breakdown of calculated elements

Late Town Creek/Leak	Sex	Element	Mean	Std. Deviation	Total
	M	Femur	468.10	21.22	10
	M	Tibia	386.81	13.83	8
	F	Femur	434.57	13.29	7
	F	Tibia	362.29	9.14	9
	M	Humerus	329.57	17.41	7
Total					41

Table 4.4: Male Humero-Femoral Index

Phase	Humero-Femoral Index
Early Town Creek	70.72
Late Town Creek/Leak	70.41

Table 4.5: Male Crural Index

Phase	Crural Index
Early Town Creek	81.64
Late Town Creek/Leak	82.63

Table 4.6: Female Crural Index

Phase	Crural Index
Early Town Creek	84.86
Late Town Creek/Leak	83.37

Table 4.7: Trauma description by individual

Burial	Phase	Sex	Age	Description
34-4	Early Town Creek	M	45 ± 5	Proximal left ulna, semi-lunar facet has been fractured into two separate facets
34-6	Early Town Creek	M	40 ± 5	Posterior right parietal, healed depression above lambdoidal suture
70-25	Late Town Creek/Leak	M	40 +	Distal right tibia, well-healed bony callus
70-26	Late Town Creek/Leak	M	49 ±11	Left frontal bone, well-healed depression above left eye orbit
70-29	Late Town Creek/Leak	M	>30	Left tibia, distal diaphysis, well-healed fracture
71-19	Early Town Creek	M	>30	Right femur, proximal diaphysis, well-healed fracture
71-47	Early Town Creek	Ind.	15 ± 3	Left femur, mid-shaft, well-healed depression
71-48	Early Town Creek	M	45 ± 5	Right phalanx, proximal mid-shaft, well-healed fracture
71-50	Early Town Creek	M	35 ± 6	Mandible, left-side, healed sharp force trauma
1040-84	Late Town Creek/Leak	F	24 ± 4	Left frontal bone, healing depression
1040-110	Late Town Creek/Leak	M	40 ± 5	Right frontal, small healed depression
1040-125	Late Town Creek/Leak	M	35 ± 5	Thoracic vertebrae, arrow head embedded through spinous process; related small sharp force trauma on rib (from arrow)
2121-142 A	Early Town Creek	Ind.	4.5 ± 1	Mid-left parietal, medium sized depression; associated reactive bone indicative of active healing on inner cranial table
70-34	Early Town Creek	M	40 ± 5	Right ulna/radius fused on distal end; C6-C7 psuedo facet on transverse process caused by trauma
71-46	Early Town Creek	M	45 ± 5	Right clavicle, midshaft fracture

Table 4.8: Breakdown of trauma by phase, sex and age

Trauma	
Early Town Creek	**9**
Male	*7*
Female	*0*
Indeterminate	*2*
Adult	*8*
Juvenile	*1*
Late Town Creek/Leak	**6**
Male	*5*
Female	*1*
Adult	*6*
Juvenile	*0*
Total	**15**

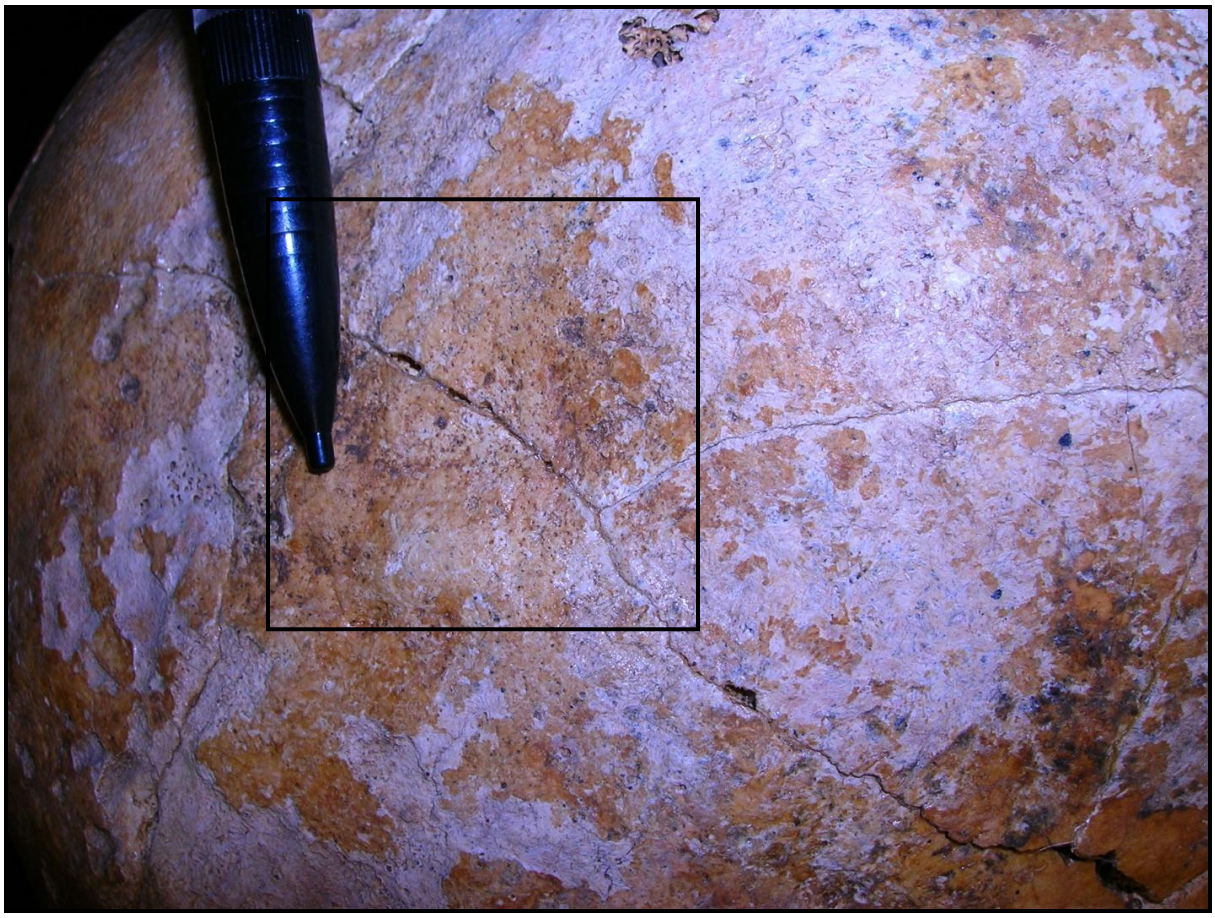

Figure 4.3: Burial 34-6 - Depression on posterior right parietal above lambdoidal suture

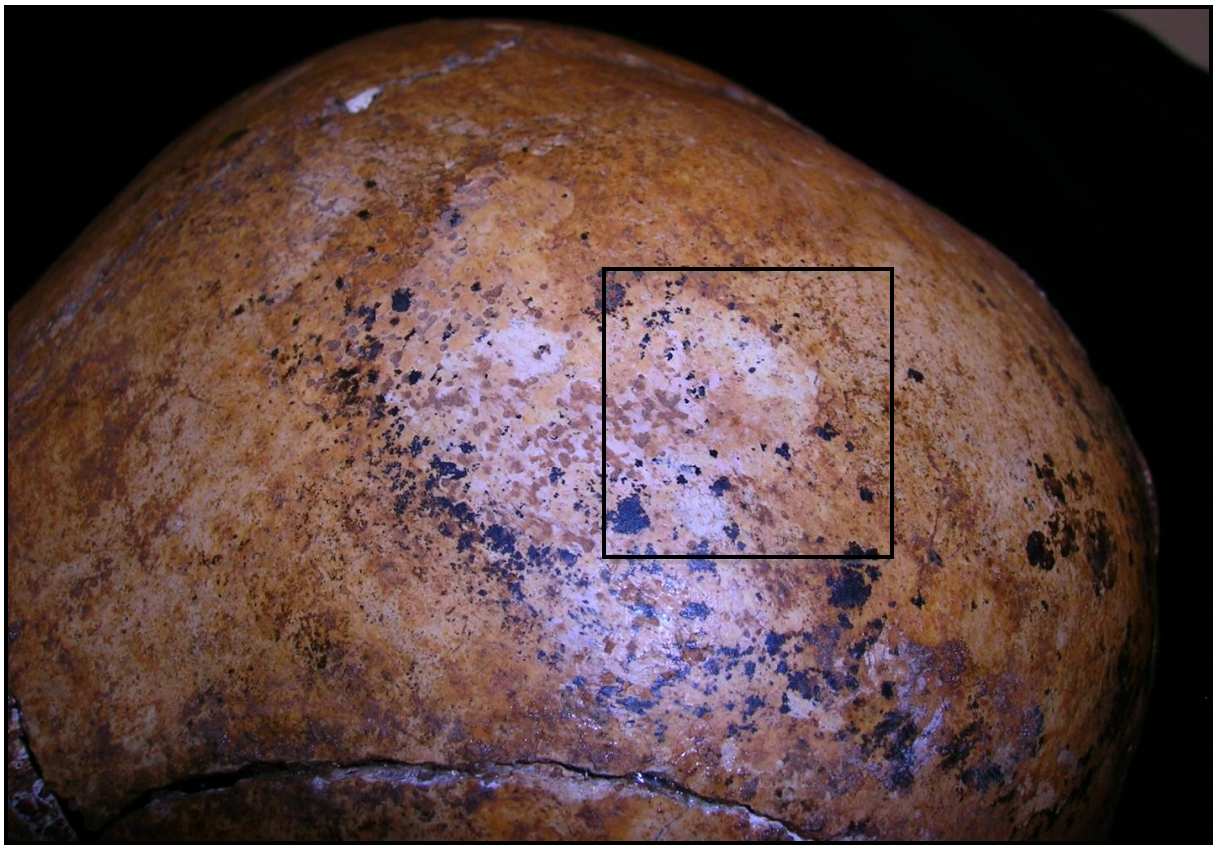

Figure 4.4: Burial 2121-142A (Juvenile) – Depression to mid left parietal

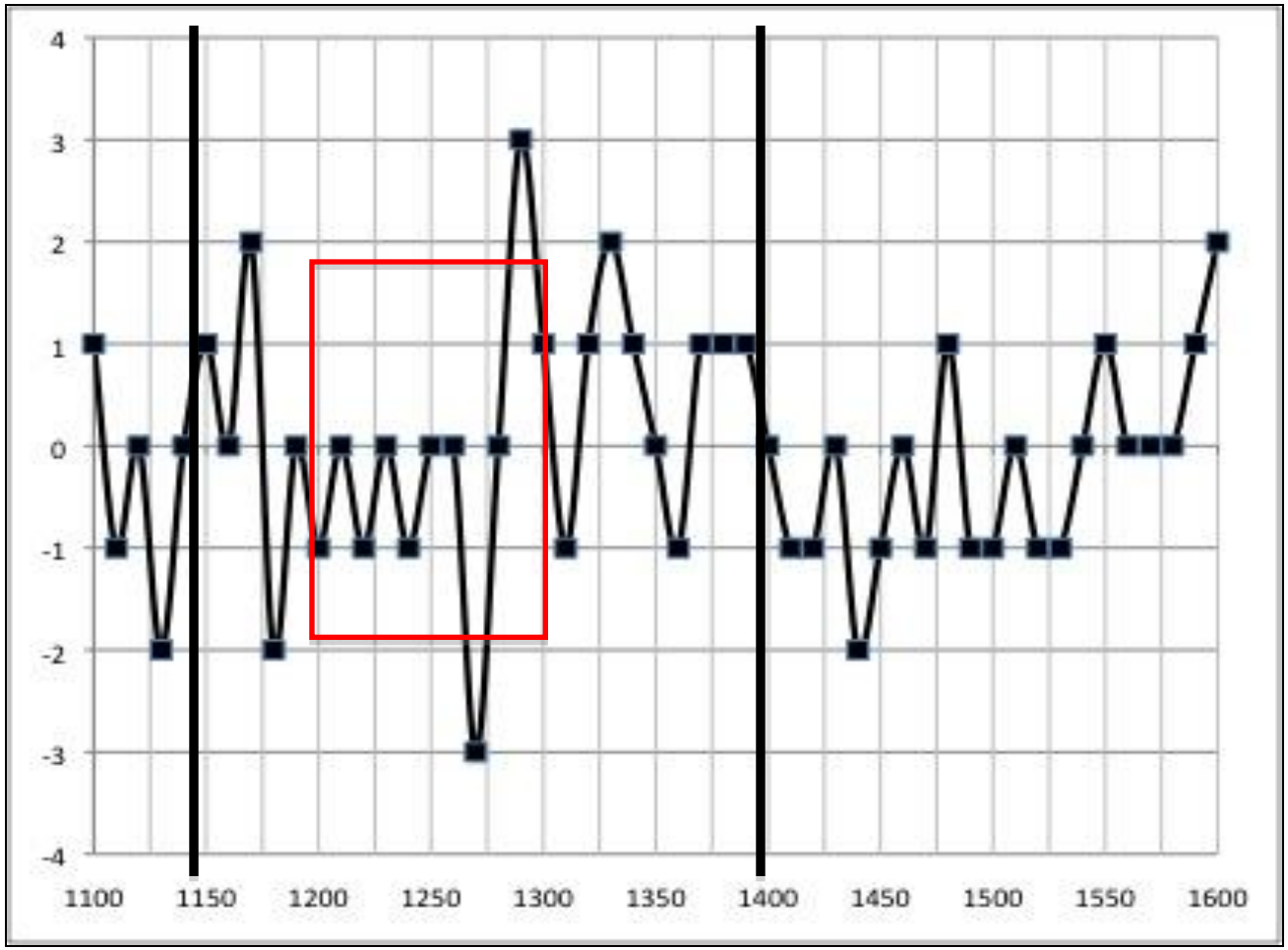

Figure 5.1: Drought index from A.D. 1100 to A.D. 1600 (data adapted from Cook et al. 2004); lines mark the range of primary Pee Dee occupation at Town Creek, red box indicates period of increased site activity

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APPENDIX

Skeleton	Area	Structure	Phase	Sex	Age	Age Category
34-1A	Mound	St 1	Late TC/Leak	Indeterminate	>30	Adult
34-4	Mound	St 24	Early TC	M	45 +/- 5	Adult
34-6	Mound	St 24	Early TC	M	40 +/- 5	Adult
34-10	Mound	St 23a	Early TC	Indeterminate	4-6 months	Juvenile
70-25	Mound	St 1	Late TC/Leak	M	40 +	Adult
70-26	Mound	St 1	Late TC/Leak	M	49 +/- 11	Adult
70-29	Mound	St 1	Late TC/Leak	M	>30	Adult
70-36	Mound	St 4a	Early TC	F	32 +/- 5	Adult
70-41	Mound	St 41	Early TC	F	27 +/- 6	Adult
70-42	Mound	St 23a	Early TC	Indeterminate	1 month	Juvenile
70-43	Mound	St 23a	Early TC	Indeterminate	1-5 months	Juvenile
70-44	Mound	St 4a	Early TC	Indeterminate	4 +/- 1	Juvenile
70-46	Mound	St 4b	Early TC	Indeterminate	2 yrs +/- 8 mon	Juvenile
314-53A	Mound	St 2	Early TC	Indeterminate	1 month	Juvenile
314-57	Mound	St 2	Early TC	F	19 +/- 3	Adult
71-1	Village	Burial Cl. 11	Late TC/Leak	F	20 +/- 3	Adult
71-4	Village	Burial Cl. 11	Late TC/Leak	Indeterminate	> 2 < 18yrs	Indeterminate
71-8	Village	Burial Cl. 11	Late TC/Leak	M	40 +/- 5	Adult
71-19	Village	St 12	Early TC	M	>30	Adult
71-37	Village	Burial Cl. 13	Late TC/Leak	F	28 +/- 4	Adult
71-43	Village	St 14	Early TC	F	29 +/- 5	Adult
71-45	Village	St 14	Early TC	F	18 +/- 2	Adult
71-47	Village	St 14	Early TC	Indeterminate	15 +/- 3	Adult
71-48	Village	St 14	Early TC	M	45 +/- 5	Adult
71-49	Village	St 14	Early TC	F	45 +/- 5	Adult
71-50	Village	St 14	Early TC	M	35 +/- 6	Adult
700-69	Village	St 49	Early TC	F	36 +/- 6	Adult

Skeleton	Area	Structure	Phase	Sex	Age	Age Category
700-76	Village	St 28	Leak	Indeterminate	10 +/- 2.5	Juvenile
700-83	Village	St 30b	Late TC/Leak	F	40 +/- 5	Adult
1040-84	Village	St 28	Late TC/Leak	F	24 +/- 4	Adult
1040-86	Village	St 7	Late TC/Leak (ECS)	F	37 +/- 5	Adult
1040-87	Village	St 7	Late TC/Leak (ECS)	M	37 +/- 5	Adult
1040-87A	Village	St 7	Late TC/Leak (ECS)	Indeterminate	>18	Adult
1040-89	Village	St7	Late TC/Leak (ECS)	M	42 +/- 7	Adult
1040-91	Village	St 7	Leak	Indeterminate	3 - 9 months	Juvenile
1040-92	Village	St 7	Late TC/Leak (ECS)	M	50 +/- 10	Adult
1040-93	Village	St 7	Leak	Indeterminate	0 - 6 months	Juvenile
1040-95	Village	St 7	Late TC/Leak (ECS)	F	26 +/- 5	Adult
1040-99	Village	St 7	Late TC/Leak (ECS)	F	45 +/- 7	Adult
1040-100	Village	St 7	Leak	Indeterminate	12 +/- 2.5	Juvenile
1040-101	Village	St 7	Late TC/Leak	F	40 +/- 5	Adult
1040-102 A	Village	St 7	Leak	Indeterminate	5 yrs +/- 6 mon	Juvenile
1040-105	Village	St 7	Late TC/Leak	M	20 +/- 3	Adult
1040-106	Village	St 7	Late TC/Leak	M	27 +/- 6	Adult
1040-108 A	Village	St 7	Leak	Indeterminate	8 +/- 2	Juvenile
1040-110	Village	St 7	Late TC/Leak	M	40 +/- 5	Adult

Skeleton	Area	Structure	Phase	Sex	Age	Age Category
1040-111	Village	St 7	Leak	Indeterminate	18 mon +/- 6	Juvenile
1040-112	Village	St 7	Leak	Indeterminate	11 +/- 2.5	Juvenile
1040-114	Village	St 7	Late TC/Leak	M	37 +/- 5	Adult
1040-115	Village	St 7	Late TC/Leak	M	40 +/- 5	Adult
1040-116	Village	St 7	Late TC/Leak	M	22 +/- 4	Adult
1040-117	Village	St 7	Late TC/Leak	F	30 +/- 5	Adult
1040-118 A	Village	St 7	Leak	Indeterminate	2.5 +/- 10 mon	Juvenile
1040-118 B	Village	St 7	Leak	Indeterminate	2 yrs +/- 8 mon	Juvenile
1040-118 C	Village	St 7	Leak	Indeterminate	6 mon +/- 3	Juvenile
1040-119	Village	St 7	Late TC/Leak	F	35 +/- 5	Adult
1040-123	Village	St 7	Late TC/Leak	F	40 +/- 5	Adult
1040-124	Village	St 7	Leak	Indeterminate	6 mon +/- 3	Juvenile
1040-124 A	Village	St 7	Leak	Indeterminate	3.5 +/- 1 yr	Juvenile
1040-125	Village	St 7	Late TC/Leak	M	35 +/- 5	Adult
1040-125 A	Village	St 7	Leak	Indeterminate	1 yr +/- 6 mon	Juvenile
2121-130	Village	St 6	Early TC	F	27 +/- 6	Adult
2121-137	Village	St 6	Early TC	F	42 +/- 5	Adult
2121-142	Village	St 6	Early TC	F	45 +/- 7	Adult
2121-142 A	Village	St 6	Early TC	Indeterminate	4.5 +/- 1	Juvenile
70-34	Mound	St 2	Early TC	M	40 +/- 5	Adult
71-10	Village	Burial Cl. 11	Late TC/Leak	F	25 +/- 5	Adult
71-28	Village	St 30b	Late TC/Leak	M	27 +/- 3	Adult
71-30	Village	St 12	Early TC	F	21+	Adult
71-46	Village	St 14	Early TC	M	45 +/- 5	Adult

Skeleton	HumL	HumR	UlnaL	UlnaR	RadiusL	RadiusR	FemurL	FemurR	TibiaL	TibiaR	FibulaL	FibulaR
34-1A	0.00	0	0	0	0	0	446.50	0	0.00	0	0	0
34-4	0.00	0	0	0	0	0	444.00	0	0.00	0	0	0
34-6	0.00	0	0	286.5	0	0	0.00	461	0.00	0	0	0
34-10	75.50	0	0	0	0	0	0.00	90	0.00	0	0	0
70-25	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
70-26	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
70-29	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
70-36	0.00	0	0	0	0	0	0.00	412	0.00	0	0	0
70-41	0.00	0	0	249	0	230	0.00	414	345.50	0	229.5	0
70-42	0.00	66	0	0	0	0	0.00	0	0.00	0	0	0
70-43	70.00	0	0	0	0	0	83.50	85	74.00	74	69.5	69.5
70-44	0.00	0	0	0	0	0	0.00	0	155.50	0	0	0
70-46	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
314-53A	0.00	0	0	0	0	0	75.50	0	0.00	0	0	0
314-57	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
71-1	294.50	0	0	0	0	0	0.00	0	0.00	0	0	0
71-4	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
71-8	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
71-19	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
71-37	312.00	0	0	0	242	0	444.50	437	376.00	374.5	0	0
71-43	0.00	0	0	0	0	0	0.00	403	0.00	0	0	0
71-45	0.00	0	0	0	205	0	403.50	0	0.00	0	0	0
71-47	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
71-48	0.00	325	0	0	0	0	467.50	456.5	0.00	374.5	0	365
71-49	0.00	0	0	0	0	240.5	0.00	0	0.00	0	0	0
71-50	337.00	339	272	0	0	249	459.50	469.5	379.50	380.5	0	0
700-69	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
700-76	0.00	0	0	0	0	0	0.00	0	0.00	248	0	0

Skeleton	HumL	HumR	UlnaL	UlnaR	RadiusL	RadiusR	FemurL	FemurR	TibiaL	TibiaR	FibulaL	FibulaR
700-83	0.00	0	0	230	219	0	411.00	411	0.00	0	0	0
1040-84	0.00	0	0	0	0	0	423.00	0	0.00	0	0	0
1040-86	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
1040-87	344.50	336	291	285.5	0	264.5	475.00	471.5	395.00	392	380	0
1040-87A	0.00	0	0	0	0	232.5	0.00	0	0.00	0	0	0
1040-89	0.00	346	0	0	0	0	473.00	0	383.50	0	0	0
1040-91	74.00	74	0	0	0	0	87.00	87	0.00	0	0	0
1040-92	0.00	0	275	0	0	0	0.00	0	0.00	0	0	0
1040-93	0.00	65	0	0	0	0	75.00	74.5	0.00	0	0	0
1040-95	324.00	329.5	255.5	259	238	241	443.00	443	363.00	371	354	0
1040-99	0.00	288.5	0	243.5	0	0	0.00	0	0.00	354.5	0	0
1040-100	0.00	243.5	0	0	0	0	0.00	341.5	0.00	0	0	0
1040-101	298.00	0	0	0	228.5	0	0.00	0	352.50	0	0	0
1040-102 A	0.00	0	0	0	0	0	0.00	0	0.00	190.5	0	0
1040-105	302.00	0	0	0	237.5	0	425.50	417	360.00	356	0	346
1040-106	338.00	338	277.5	0	261.5	0	474.00	473.5	0.00	383.5	0	0
1040-108 A	0.00	204.5	0	0	0	0	0.00	0	0.00	0	0	0
1040-110	0.00	0	0	0	0	249.5	466.00	462	409.00	412	0	0

Skeleton	HumL	HumR	UlnaL	UlnaR	RadiusL	RadiusR	FemurL	FemurR	TibiaL	TibiaR	FibulaL	FibulaR
1040-111	119.50	119	0	99	87	88	138.00	0	0.00	117	0	0
1040-112	0.00	228	0	0	0	0	0.00	318	269.00	0	262.5	0
1040-114	328.00	330	0	281	0	0	472.00	461.5	0.00	389.5	0	0
1040-115	0.00	339	282	0	263.5	0	492.00	487	0.00	391	0	0
1040-116	0.00	0	0	0	0	245	442.50	446	383.00	387	0	0
1040-117	315.50	318	265	270.5	0	249.5	448.00	445	373.00	374	0	0
1040-118 A	0.00	0	0	0	0	0	0.00	0	0.00	134	0	0
1040-118 B	0.00	0	0	0	0	0	0.00	152	0.00	127	0	0
1040-118 C	0.00	0	0	0	0	0	0.00	0	0.00	83	0	0
1040-119	0.00	293	0	0	0	0	0.00	0	0.00	0	0	0
1040-123	310.00	315	0	274	0	251.5	439.00	435	368.00	365	0	355.5
1040-124	0.00	0	0	0	0	0	0.00	96	0.00	0	0	0
1040-124 A	0.00	140.5	0	0	0	0	0.00	0	0.00	0	0	0
1040-125	309.50	310.5	0	271	246	247	463.50	0	0.00	0	0	0

Skeleton	HumL	HumR	UlnaL	UlnaR	RadiusL	RadiusR	FemurL	FemurR	TibiaL	TibiaR	FibulaL	FibulaR
1040-125 A	0.00	0	0	0	0	0	0.00	136	0.00	0	0	0
2121-130	0.00	0	0	0	0	0	0.00	447.5	0.00	363.5	0	349
2121-137	0.00	0	236.5	242.5	224	226.5	426.50	423	0.00	0	0	0
2121-142	0.00	302	0	0	0	0	0.00	0	0.00	0	0	0
2121-142 A	0.00	0	0	0	0	0	0.00	0	0.00	0	0	0
70-34	0.00	0	267	0	0	0	0.00	438	0.00	361.5	0	0
71-10	315.50	0	0	0	232	0	433.50	429.5	0.00	349	0	0
71-28	0.00	0	0	297	0	0	497.50	0	0.00	0	0	0
71-30	0.00	0	0	0	0	235.5	0.00	0	0.00	0	0	0
71-46	286.50	285	0	0	0	0	0.00	412.5	344.50	0	0	335.5

Skeleton	Hum Measured	Septal Aperture Score-able	Left Present	Right Present	Sept Ap present	Orbits Score-able	Cribra Present	Remodeled
34-1A	No	No	X	X	X	Right	No	X
34-4	No	No	X	X	X	No	X	X
34-6	No	Both	Yes	No	Yes	Both	No	X
34-10	Yes	Left	No	X	No	Both	No	X
70-25	No	No	X	X	X	No	X	X
70-26	No	No	X	X	X	Right	No	X
70-29	No	No	X	X	X	No	X	X
70-36	No	No	X	X	X	No	X	X
70-41	No	Right	X	Yes	Yes	Both	No	X
70-42	Yes	Right	X	No	No	Left	No	X
70-43	Yes	Left	No	X	No	Both	No	X
70-44	N	No	X	X	X	No	X	X
70-46	N	No	X	X	X	Left	Yes	Active
314-53A	N	No	X	X	X	No	X	X
314-57	N	No	X	X	X	Both	Yes	Healed
71-1	Y	Left	Yes	X	Yes	No	X	X
71-4	N	No	X	X	X	Both	Yes	Healed
71-8	N	No	X	X	X	Both	Yes	Healed
71-19	N	No	X	X	X	Left	No	X
71-37	Y	Both	Yes	Yes	Yes	Both	Yes	Healed
71-43	N	Left	Yes	X	Yes	Both	Yes	Healed
71-45	N	No	Yes	X	Yes	Left	Yes	Healed
71-47	N	No	X	X	X	No	X	X
71-48	Y	Both	Yes	Yes	Yes	Both	No	X
71-49	N	Both	Yes	Yes	Yes	Right	No	X

Skeleton	Hum Measured	Septal Aperture Score-able	Left Present	Right Present	Sept Ap present	Orbits Score-able	Cribra Present	Remodeled
71-50	Y	Both	Yes	No	Yes	Both	Yes	Healed
700-69	N	Right	X	Yes	Yes	Left	Yes	Healed
700-76	N	No	X	X	X	Left	Yes	Active
700-83	N	Both	Yes	Yes	Yes	Both	Yes	Healed
1040-84	N	Both	No	No	No	Both	No	X
1040-86	N	No	X	X	X	Right	Yes	Healed
1040-87	Y	Both	No	No	No	Right	No	X
1040-87A	N	Right	X	No	No	No	X	X
1040-89	Y	Right	X	Yes	Yes	No	X	X
1040-91	Y	Both	No	No	No	Both	No	X
1040-92	N	Right	X	No	No	Both	No	X
1040-93	Y	Right	X	No	No	No	X	X
1040-95	Y	Both	No	Yes	Yes	Both	No	X
1040-99	Y	Right	X	No	No	Both	Yes	Healed
1040-100	Y	Right	X	No	No	No	X	X
1040-101	Y	Left	No	X	No	Both	X	X
1040-102 A	N	No	X	X	X	Both	Yes	Healed
1040-105	Y	Both	Yes	Yes	Yes	Both	No	X
1040-106	Y	Both	No	No	No	Both	No	X
1040-108 A	Y	Right	X	No	No	Both	No	X
1040-110	N	Right	X	No	No	Both	No	X
1040-111	Y	Both	No	No	No	Both	No	X

Skeleton	Hum Measured	Septal Aperture Scoreable	Left Present	Right Present	Sept Ap present	Orbits Scoreable	Cribra Present	Remodeled
1040-112	Y	Both	Yes	No	Yes	Both	Yes	Healed
1040-114	Y	Both	No	No	No	Both	No	X
1040-115	Y	Both	Yes	Yes	Yes	No	X	X
1040-116	N	Both	No	No	No	Both	No	X
1040-117	Y	Both	Yes	Yes	Yes	Both	No	X
1040-118 A	N	No	X	X	X	Both	Yes	Healed
1040-118 B	N	No	X	X	X	No	X	X
1040-118 C	N	No	X	X	X	No	X	X
1040-119	Y	Left	Yes	X	Yes	Both	No	X
1040-123	Y	Both	Yes	Yes	Yes	Both	No	X
1040-124	N	Left	No	X	No	No	X	X
1040-124 A	Y	Both	No	No	No	Right	No	
1040-125	Y	Both	Yes	No	Yes	Both	Yes	Healed
1040-125 A	N	No	X	X	X	No	X	X
2121-130	N	No	X	X	X	No	X	X
2121-137	N	Both	No	No	No	Both	No	X
2121-142	Y	Right	X	Yes	Yes	Left	No	Healed
2121-142 A	N	No	X	X	X	Left	Yes	Healed
70-34	N	Left	Yes	X	Yes	No	X	X
71-10	Y	Left	Yes	X	Yes	Left	No	X
71-28	N	Both	Yes	No	Yes	No	X	X
71-30	N	No	X	X	X	No	X	X
71-46	Y	Left	Yes	X	Yes	Both	Yes	Healed

Skeleton	Trauma	Where/Type	Trauma Notes
34-1A	No	X	
34-4	Yes	Proximal left ulna	Head is abnoramlly wide, semi-lunar facet has separated into two articular areas
34-6	Yes	Posterior right parietal	Depression above lambd. suture. Possible scalping trauma (added during this study)
34-10	No	X	
70-25	Yes	Distal right tibia	Well-healed bony callus
70-26	Yes	Left frontal bone	Well-healed, 75.80 mm above left eye orbit
70-29	Yes	Distal left tibial shaft	Well-healed
70-36	No	X	
70-41	No	X	
70-42	No	X	
70-43	No	X	
70-44	No	X	
70-46	No	X	
314-53A	No	X	
314-57	No	X	
71-1	No	X	
71-4	No	X	
71-8	No	X	
71-19	Yes	Prox. Right femur shaft	Well-healed
71-37	No	X	
71-43	No	X	
71-45	No	X	
71-47	Yes	Mid-shaft left femur	Shallow and well-healed
71-48	Yes	Prox. Right hand phalanx	Well-healed mid-shaft fracture
71-49	No	X	

Skeleton	Trauma	Where/Type	Trauma Notes
71-50	Yes	Mandible (left side)	Healed fracture (gash to chin)
700-69	No	X	
700-76	No	X	
700-83	No	X	
1040-84	Yes	Right side of frontal	Small healing depression
1040-86	No	X	
1040-87	No		
1040-87A	No	X	
1040-89	No	X	
1040-91	No	X	
1040-92	No	X	
1040-93	No	X	
1040-95	No	X	
1040-99	No	X	
1040-100	No	X	
1040-101	No	X	
1040-102 A	No	X	
1040-105	No	X	
1040-106	No	X	
1040-108 A	No	X	
1040-110	Yes	Depression on right frontal	small, healed depression directly above brow ridge
1040-111	No	X	

Skeleton	Trauma	Where/Type	Trauma Notes
1040-112	No	X	
1040-114	No	X	
1040-115	No	X	
1040-116	No	X	
1040-117	No	X	
1040-118 A	No	X	
1040-118 B	No	X	
1040-118 C	No	X	
1040-119	No	X	
1040-123	No	X	
1040-124	No	X	
1040-124 A	No	X	
1040-125	Yes	Arrow in t-vert, superior margin of right rib	Arrow embedded in T-vert (maybe T1), nick on right rib from projectile
1040-125 A	No	X	
2121-130	No	X	
2121-137	No	X	
2121-142	No	X	
2121-142 A	Yes	Mid left parietal	Medium sized depression, associated reactive bone indicative of active healing on inner cranial table (added during this study
70-34	Yes	Right ulna/radius distally fused, C6-C7 pseudo facet on transverse process	
71-10	No	X	
71-28	No	X	
71-30	No	X	
71-46	Yes	Right mid-shaft clavicle	fracture