RETHINKING TAXONOMIES:
SKELETAL VARIATION ON THE NORTH CAROLINA COASTAL PLAIN

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The current archaeological model of cultural interaction on the North Carolina Coastal Plain during the Late Woodland period (A.D. 800–1650) divides the region into three groups primarily on the basis of language and artifacts. Human skeletal remains were brought into this ethnohistoric model in order to correlate the visual appearance of crania with material culture, even though few of the skeletal populations had been scientifically studied. In spite of mounting evidence in the past decade of increased social complexity in the Late Woodland, some researchers still attempt classification of sites based on a checklist of characteristics. The present study was undertaken in order to assess the current archaeological model as it relates to human skeletal remains on the Coastal Plain. Using biological distance statistics based on cranial nonmetric (epigenetic) trait expression, biological interaction among the various native groups living along the North Carolina Coastal Plain was investigated. Only one statistically significant difference was found among the thirteen skeletal populations, thus hindering easy classification of human skeletal remains into discrete populations. These results indicate that a new model needs to be created to better understand the spheres of interaction among the natives on the North Carolina Coastal Plain.

The Coastal Plain of North Carolina was unique in the Late Woodland period (A.D. 800–1650) because of its location intermediate to the larger cultural and political complexes to the north, west, and south, its retention of material cultural traditions, and its situation as a nexus of three major linguistic groups: the Algonkian, Iroquoian, and Siouan language families. In recent years, North Carolina archaeologists have drawn from both primary and secondary sources of native culture and language to create an ethnolinguistic model that posits significant differences in both material culture and skeletal biology coinciding with linguistic groups during the Late Woodland. The primary problem, however, with population history based on archaeological remains in North Carolina is that, until recently, studies of variation have been outweighed by those that furthered the culture-history model of prehistoric North Carolina. Lack of population studies in the state's Coastal Plain has led archaeologists to view material culture as intimately linked to ethnohistoric and linguistic records of specific Native American groups and further linked to skeletal populations themselves. Archaeologists interested in the prehistory of North Carolina have adopted a tripartite division of native groups on the Coastal Plain into Algonkian-, Iroquoian-, and Siouan-speaking peoples based in large part on European travel diaries describing language differences and on secondary ethnolinguistic literature. Material culture such as pottery and biological remains such as skeletons are interpreted to fit this model. Skeletons, particularly crania, are assumed to be morphologically representative of their “group.” Algonkians are supposedly long-headed and robust, while Siouans are short-headed and more gracile. This model is not flawed in that no physical differences exist among peoples of the Coastal Plain; it is flawed in its assumption that simple categorization of physical remains is possible based on size and shape alone, without regard to the biological diversity within and between populations.

David Phelps (1983) created three Late Woodland phases along the North Carolina Coastal Plain in response to a need for an archaeological model. Based primarily on ceramics and ethnohistoric boundaries, this model has been extended to incorporate physical remains without thorough examination of the skeletons by biological anthropologists. North Carolina archaeology literature is full of statements such as “long-headed population,” “robust Algonquian” (Loftfield 1990:119), and “gracile Siouan” (Coe et al. 1982). Phelps (1983:15) even stated that one can “accurately reconstruct . . . the physical type” of the Carolina Algonkians based on the well-preserved skeletal remains from the Baum (31CK9) site. In their analysis of the Cold Morning (31NH28) site, Coe and coworkers (1982) used metric techniques to compare crania from this population with other regional samples taken by Hrdlička (1916) and Neumann (1952). They found that, based on size, the Cold Morning crania were most similar to an historic Siouan sample, even though nearly eight centuries separated the individuals within these sample populations.

There are obvious problems with applying historical categories directly to prehistoric native populations, especially when examining skeletal remains and material culture that are up to 800 years older than the earliest documents. Considerable biological changes occur in populations in such a span of time as a result of intermarriage, trade, and warfare, all of which can affect the ability to neatly categorize cultures based on material and skeletal remains. There are further
problems with attempting to correlate visual appearances of skeletal remains and material culture in the current model of North Carolina prehistory, as the size and shape of an individual’s cranium does not necessarily dictate his placement in a cultural framework, only in a morphological one.

A bioarchaeological analysis of crania from the Coastal Plain was therefore undertaken in order to clarify the role that skeletal remains should play in archaeological reconstruction of the past. Bioarchaeological studies based on genetically linked traits have previously been done to elucidate population dynamics in the Southeast (e.g., Griffin 1989, 1993; Griffin et al. 2001; Kakaliouras 2003). Kakaliouras (2003) used dental nonmetric data to examine differences among North Carolina coastal populations but found no statistically significant results. North Carolina archaeology can benefit from biodistance studies because of the uncertainty surrounding the role of physical remains in the current archaeological model. Specifically, these studies are beneficial to the history of North Carolina because of the gulf in cultural understanding between native populations and the Europeans who first chronicled their existence. The present study questions the tripartite ethnolinguistic model by testing the hypothesis that statistical analysis of nonmetric cranial traits will show no differences among archaeological populations, thereby falsifying the longstanding assumption that populations can be classified based on the shape and robusticity of their skulls. A revised model of geographical interaction on the North Carolina Coastal Plain during the Late Woodland period, based on all available osteological evidence, is provided to aid archaeologists and ethnohistorians in assessing population relationships immediately prior to European contact.

Prehistory and Archaeology of the North Carolina Coastal Plain

Historically, the Coastal Plain had been the least examined area of the state of North Carolina (Phelps 1983). Over the last several decades, the coastal region has received more archaeological attention than any other portion of the state; however, it is still the least understood area on account of the changing environment, commercial development, and the salvage nature of much archaeology in the region (Ward and Davis 1999).

The Coastal Plain of North Carolina comprises approximately the eastern third of the state, mostly land that is less than 120 m above sea level, including numerous lakes, swamps, and sounds. At the beginning of the Late Woodland period, around A.D. 800, important changes in coastal native societies occurred that affected diet and political organization. Horticulture, particularly corn cultivation, emerged and intensified throughout the period until first contact with Europeans around A.D. 1650. Social complexity also increased during the Late Woodland, as populations centralized and clustered around sedentary villages, ultimately leading to the ranked chiefdoms chronicled by European observers. Archaeologically, this new political organization can be seen from changes in house and village structure, as well as in a new form of mortuary behavior: the ossuary. This form of burial existed in various regions of the United States during the late precontact period, reaching as far west as the Great Lakes. North Carolina is distinguished by having some of the oldest known ossuaries and by its striking variation in ossuary form (Curry 1999).

Three cultural groups have been posited along the Coastal Plain based largely on language and ceramic style: Algonkian, Iroquoian, and Siouan (see Figure 1). Historical records note that the Carolina Algonkians, the southernmost group that belonged to the Algonkian language family, extended from southeastern Virginia to the northern Tidewater zone of North Carolina. In the Late Woodland period, two phases were established to describe the northern Coastal Plain: The Carolina Algonkian phase is called Colington, while the phase of the Tuscarora, Meherrin, and Nottoway is called Cashie (Phelps 1983). Colington phase social structure involved small, organized chiefdoms and a relatively dispersed settlement pattern (Feest 1978; Ward and Davis 1999). The Algonkians engaged in fishing, corn cultivation, and hunting and gathering (Feest 1978). Their pottery consisted mostly of shell-tempered, fabric-impressed, or simple-stamped globular pots (Feest 1978). Algonkian ossuaries are usually situated near the edge of a village, include a large number of individuals, and have few grave artifacts (Loftfield 1990; Ward and Davis 1999).

The Iroquoian-speaking Tuscarora, Meherrin, and Nottoway lay to the west of the Algonkians and to the north of the Siouan speakers (Ward and Davis 1999). Phelps (1983) suggests that the Algonkian and Iroquoian groups were closely related culturally and possibly originated from the same “protoculture,” as there is evidence of borrowing of words between the languages, and pebble-tempered ware indicative of the Iroquoian culture has been found in Algonkian associations (Goddard 1978; Phelps 1983). The territory of the Tuscarora extended from slightly south of the Neuse River to the Roanoke River in North Carolina; the Meherrin and Nottoway occupied the area from the Roanoke River north to Virginia. Iroquoian groups were organized into small villages within a larger tribal society and included a dispersed settlement pattern and seasonal villages (Boyce 1978). They were primarily horticulturists who also relied on hunting and
gathering (Boyce 1978). Cashie phase burials involve deposition of two to five individuals in secondary burial, are often located within village boundaries, and typically include marginella shells as grave goods (Loftfield 1990; Phelps 1983; Ward and Davis 1999).

While the Colington and Cashie phases are presumed to be from the same protoculture, the southern Coastal Plain is thought to have been Siouan territory at least since the beginning of the Woodland period and has been called the Oak Island or White Oak phase (Phelps 1983). This phase extended from the Neuse River south to Cape Fear and is best known for shell-tempered ceramics and a marine-based diet (Ward and Davis 1999). Burials in this phase are ossuaries consisting of low sand burial mounds or ridges located far from the village. The bones show some evidence of burning, and there is a lack of contextual artifacts (Loftfield 1990; Phelps 1983; Ward and Davis 1999). In some areas, the White Oak and Colington phases overlap; thus it is unclear how far south the Algonkian language group extended or how far north the Siouan speakers flourished (Ward and Davis 1999).

Classification is not as simple as the above descriptions might imply. The western boundary of the Algonkian groups was ever-moving, often inhabited by Iroquoian-speaking natives throughout the years. Even individual tribal boundaries are difficult to determine, as allied groups were often counted as one tribe by Europeans, and some groups were classified as Algonkian based on characteristics other than language, such as association with known Algonkian groups (Feest 1978). Iroquoian villages formed alliances with each other, causing European colonists to believe these groups were more closely linked than they actually were; however, the alliances only stayed together while there was a common goal (Boyce 1978). Information on the Siouans on the Coastal Plain is exceedingly meager, complicated by Algonkian expansion southward into Virginia and North Carolina (Speck 1935; Swanton 1946).

The Ethnolinguistic Model and North Carolina Bioarchaeology

Historians and archaeologists have gathered information from both primary and secondary sources to form the current ethnolinguistic model of the Late Woodland period of North Carolina history. Thomas Hariot was one of the first Europeans to travel to the southeastern United States and write about his experiences. In 1590, Hariot visited Virginia and was accompanied by John White, who made maps and drawings of the Indian villages. A century later, John Lawson traveled around North Carolina and made key observations about the multitude of languages and
dialects among the Indians. Although historical linguists (e.g., Goddard 1978) agree that three main language groups (Algonkian, Iroquoian, and Siouan) existed in North Carolina around the time of European contact, the number of different, mutually unintelligible languages that existed within those groups is unknown. It is also unclear whether differing languages would have been a hindrance to forming relationships, as Lawson notes that native people often learned several different languages.

Based on both primary colonial linguistic accounts (Hariot 1972 [1590]; Lawson 1967 [1709]) and on secondary ethnolinguistic treatises (Feest 1978; Mook 1944; Swanton 1946), archaeologists working with North Carolina prehistory have continued to split the natives living along the Coastal Plain in the Late Woodland period into three cultural groups primarily on the basis of the aforementioned linguistic differences, which happen to correspond roughly to geographical areas: the Algonkian speakers on the northern Coastal Plain, the Iroquoian speakers on the southern Coastal Plain, and the Siouan speakers on the southern Coastal Plain. In spite of the evidence that significant trade networks existed among these three areas (Phelps 1983), that native people often spoke two or more languages (Lawson 1967 [1709]), and that political interactions were complex and not hindered by linguistic differences (Loffield 1990), archaeologists have persisted in compartmentalizing the Coastal Plain into three culturally specific territories in which no significant interaction took place to affect the cultural or biological development of these linguistically defined populations (Phelps 1983; Ward and Davis 1999). Thus for a period of over eight centuries, the ethnolinguistic model, projected backward into prehistory, assumes that material culture boundaries and linguistic boundaries were synonymous and largely static.

Although early excavations of coastal North Carolina ossuaries occurred in the 1960s, skeletal remains were not brought into the ethnolinguistic model until the 1980s, when Joffre Coe and coworkers concluded that a sample from the Cold Morning ossuary (31NH128) was Siouan in morphology rather than Algonkian based on their interpretation of comparative data from Hrdlička (1916) and Neumann (1952). Hrdlička, in evaluating a skeletal population from historic New Jersey, concluded that individuals from the northern and eastern United States had longer (dolichocephalic) skulls than those from the south and southeast (brachycephalic), and that the Iroquoian and Algonkian skulls were morphologically indistinguishable. Hrdlička (1916:113) was largely concerned with "types" or biological races, and with the "admixture" between these so-called races that was the result of variation brought into a population by outsiders. In a similar fashion, Georg Neumann (1952) developed a taxonomy comprising eight different types of American Indians, all supposedly varieties of the "subspecies" Homo sapiens asiaticus. By lumping the Algonkians and Iroquoians into one group called the Lenapids and distinguishing them from the Siouans, who were called Iswanids, Neumann verified Hrdlička's long-headed and short-headed types. Neither Hrdlička nor Neumann took into account evolution, adaptation, the environment, or change through time in explaining deviations from their defined types (Kakaliouras 2003). True to his time, Hrdlička assumed, based on the concept of pure types, that language, culture, and skeletal morphology could be synonymous. In 1982, Coe and coworkers compared a sample of crania from the Cold Morning site to descriptions provided by Hrdlička and Neumann of the Siouan/Iswanid and Algonkian-Iroquoian/Lenapids. By using these categories, Coe and coworkers validated Hrdlička's and Neumann's assumption that the differences in size and shape among the Siouans, Algonkians, and Iroquoians resulted from variations in linguistic and cultural affiliation. Other researchers have fallen into the same typological trap. Langdon (1995:369), investigating mostly northern Algonkian and Iroquoian groups, notes that based on skeletal metrics the Tuscarora in Virginia and North Carolina experienced "average admixture" in deviating from their types. Loffield (1990), in writing about Algonkian expansion along the North Carolina coast, notes that burials often lack artifacts, thus preventing archaeologists from directly affiliating them with a cultural group. However, he further states that "other aspects of the cultures in the area, including . . . biological attributes of the populations" can help in understanding acculturation (1990:116). Loffield, referencing Coe et al. (1982), says that skeletons from Cold Morning "are of a small gracile stature usually associated with Siouan speaking populations in this region" (1990:117), and that crania from two ossuaries at Camp Lejeune (31ON309) "suggest a long-headed population . . . typical of the robust Algonquian and Iroquoian populations of northeastern coastal North Carolina" (1990:119).

On account of the paucity of material artifacts often associated with coastal ossuaries, it is unsurprising that North Carolina archaeologists sought to include skeletal morphology in a comprehensive model of cultural interaction in the Late Woodland. Although the ethnolinguistic model has had fair success in helping archaeologists categorize ceramic traditions and settlement patterns, the inclusion of human skeletal remains in the model resulted in the creation of typological categories for classification of populations based on the size and length of their skulls. This typological thinking paints the natives as unchanging aggregates of people rather than elucidating the processes and results of population growth, horticultural intensification, ossu-
ary construction, and increased political organization that occurred in the Late Woodland period. By pairing language-culture groups with measurable skeletal attributes, North Carolina archaeologists have in effect validated the same connection that Hrdlička made in the early twentieth century. Archaeologists have essentially conflated an understanding of cultural interaction with an understanding of biological interaction. Whereas cultural interaction on the Coastal Plain is better understood today because of models based on archaeological remains, biological interaction is currently poorly understood because of the mistaken assumption that there is a necessary correlation among language, material culture, and skeletal morphology.

The idea that "types" of people could be discerned by a discrete set of biological and cultural traits was popular in Hrdlička's time but has been replaced in the past several decades by the concept of populational thinking, which "recognizes that all levels of biological difference ... incorporate a range of variation, and no single individual or set of individuals is likely to possess the entire complement of traits" (Ubelaker 1989:132). Single individuals cannot represent a population as fairly as a sample of 100 individuals, as only in the aggregate can the range of variation of a population be seen. A difference in cranial form does not necessarily equal a difference in gene pool, and certainly not a difference in culture. Ontogeny and morphology of bones are affected by numerous processes such as environment, diet, artificial deformation, and gene flow. In order to understand relationships among skeletal populations, and by extension prehistoric North Carolina societies, it is imperative to examine the biological interaction of the Native Americans through genetically linked traits.

Population studies were obviously not the norm in North Carolina bioarchaeology. Analysis of human remains tended to be descriptive and focused on anomalies or case studies, especially in regard to palaeopathology (Larsen 1997). In North Carolina, studies involving the prevalence of treponemal disease in the precontact period (Bogdan and Weaver 1989) and studies dealing with health and status (Driscoll 1995; Kakaliouras 1997; Truesdell 1995) are as numerous as population-based research (e.g., Griffin 1989, 1993; Griffin et al. 2001). Because many large skeletal series have only been excavated in the past few decades, however, prior analysis of skeletal material was precluded until recent syntheses of the data (Hutchinson 2002; Kakaliouras 2003).

The most important aspect of population studies in bioarchaeology for the purposes of this paper is biological distance. Biodistance is the measure of similarity or divergence between two populations (interpopulation) or subgroups within populations (intrapopulation) on the basis of statistical analysis of genetically linked trait manifestation. This theory assumes a priori that populations that share more traits are closer in ancestry than those that share fewer traits. The technique of biological distance analysis allows bioarchaeologists to control for both environmental and cultural influences on bone to determine, based on individual phenotypes, how much interaction occurred among individuals in two or more burial populations. The present study uses biological distance statistics to model interaction among the various native groups living along the North Carolina Coastal Plain through analysis of cranial nonmetric (epigenetic) trait expression.

Materials and Methods

Biological Distance

In the 1960s, Berry and Berry (1967) examined nonmetric traits (immeasurable variations of bone, such as foramina and ossicles) and found that several of these traits in the human cranium appeared to run in lineages. They concluded that population relationships could be inferred based on the prevalence of a variant trait within a population. Because incidents of variant traits in two populations probably reflect underlying genetic differences between those populations, nonmetric variation can be used to differentiate or calculate the biological distance between two populations. A major assumption must be made in order to perform population distance statistics: that gene flow is relatively consistent. That is, any change in the gene pool would affect phenotypic expression of traits (Griffin 1993). If the change in the gene pool is small, then the biological distance is low. If there are numerous significant changes, biological distance is assumed to be great.

Biodistance studies based on nonmetric variation depend on traits that are largely under genetic control, are minimally affected by diet or the environment, can be scored reliably, and are independent of one another such that they can provide statistically valid information on biological distance (Griffin 1993; Molto 1983; Rissing 1984). Although Berry and Berry concluded that sex and age differences only minimally affected nonmetric trait manifestation, other researchers found significant intersex (Corruccini 1974; Grüneberg 1952) and age (Molto 1983; Ossenberg 1969) variation in frequencies of expression. These issues will be discussed briefly below in specific connection with the present study.

Sample Selection

Eleven archaeological sites from the Coastal Plain of North Carolina and two sites from the inner coastal area of Virginia were examined for this study (Fig-
The ossuary from an archaeological site was chosen as the unit of analysis because of the assumption of the ethnolinguistic model that one can distinguish the linguistic group of a population based solely on the morphology of the skulls. Populations for this study were initially chosen based on minimum number of individuals present in the collection and ease of access to the remains. When collections from East Carolina University, Wake Forest University, and UNC Chapel Hill were exhausted, further skeletal samples were added from the National Museum of Natural History and the North Carolina Office of State Archaeology. As a result, all Late Woodland ossuaries along the North Carolina Coastal Plain with a minimum number of individuals greater than ten were examined for this study. Two Virginia skeletal samples were added later to increase the sample size from the inner plain. All adult individuals with cranial remains were examined.

Table 1 presents the sites used in this research along with supposed linguistic affiliation based on published archaeological studies and personal communication with Mark Mathis (2002). The date of many of the sites can only be placed within the Late Woodland time period, although 14C intercept dates are available for four of the sites. Algonkian or outer coastal sites include Baum (31CK9), West (31CK22), Garbaco Creek (31CR86), Broad Reach (31CR218), Flinta* (31ON305), and Jarretts Point (31ON309); Iroquoian or inner coastal sites include Sans Souci (31BR5) and Jordan's Landing (31BR7) in North Carolina and Abbyville (44HA65) and Hand (44SN22) in Virginia; and Siouan or southern coastal sites include McFayden (31BW67) and Cold Morning (31NH28). These linguistic labels are retained throughout the data analysis because, as mentioned, it is supposed to be possible to distinguish crania on the basis of size and shape into one of the groups.

Data Collection and Analysis

Nonmetric traits were selected for use in this study primarily because the samples at hand came from secondary interment in archaeological contexts. Whereas some researchers have used upwards of thirty nonmetric variants in biodistance studies (Berry and Berry 1967), others have discovered valid relationships using as few as eleven nonmetric traits (Buikstra 1976). For this study, the 25 nonmetric cranial traits listed in Table 2, mostly sutures, ossicles, and foramina, were selected based on the ease of recording and completeness of description in nonmetric trait literature.

Issues with nonmetric trait analysis were taken into account and controlled for, including bilaterality of traits, age and sex effects on trait correlation, observer error, and low trait frequency. Bilaterality of traits was not taken into account when noting presence of a trait. This technique has been used varying in biological distance studies, although most studies score simply "presence" and "absence" without regard to which side expresses the trait (Buikstra 1976; Saunders 1989; Suchey 1975). The problem with the "total side frequency" is that it is more realistic to think of individuals as part of a population rather than sides of a cranium, and this method exaggerates sample size while lending redundant information to the analysis (Griffin 1993). Three different coefficients ($\chi^2$, $\phi$, $\tau_{p}$) for trait associations were performed to determine sex bias of nonmetric traits. Only gonial eversion was eliminated due to sex bias based on moderate relationships among all three coefficients. Intraobserver error was tested at the end of the data collection period per Nichol and Turner (1986) by comparing an original sample from different populations with the final data collection, performed
several months after the sample collection. One trait, highest nuchal line, had an error of over 20 percent and was eliminated from subsequent analysis. Finally, standard data reduction techniques were employed to eliminate rare traits with low incidences in pairwise population comparisons. Sjøvold (1977) suggests that removing traits with no significant differences in pairwise comparisons eliminates background noise that can confound a biodistance analysis. Ten traits were found to have no significant differences in trait frequencies by using another transformation, that is, Freeman and Tukey (1950), which allows samples of archaeological populations as small as n = 10 (Green and Suchey 1976).

The MMD statistic used in this study is as follows:

\[ MMD = \sqrt{\frac{\sum_{i=1}^{r} (\Theta_{i1} - \Theta_{i2})^2 - \left(\frac{1}{n_1 + \frac{1}{2}} + \frac{1}{n_2 + \frac{1}{2}}\right)}{r}} \]

in which \( r \) is the number of traits used, \( \Theta_{i1} \) and \( \Theta_{i2} \) are the transformed frequencies in radians of the \( i \)th trait in the comparison groups, and \( n_1 \) and \( n_2 \) are the numbers of individuals who are scored for the \( i \)th trait in the group.

Freeman and Tukey’s angular transformation is as follows:

\[ \Theta = \frac{1}{2} \sin^{-1} \left(1 - \frac{2k}{n + 1}\right) + \frac{1}{2} \sin^{-1} \left(1 - \frac{2(k + 1)}{n + 1}\right) \]

in which \( k \) is the number of individuals scored as “yes,” and \( n \) is the total number of individuals scored in the population (i.e., scored as either “yes” or “no”).

Finally, the variance and standard deviation of the MMD are calculated using the following formulae based on Sofaaer et al. (1986):

\[ Var_{MMD} = \frac{2}{r^2} \sum_{i=1}^{r} \left(\frac{1}{n_{1i} + \frac{1}{2}} + \frac{1}{n_{2i} + \frac{1}{2}}\right)^2 \]

\[ sd_{MMD} = \sqrt{Var_{MMD}} \]

According to Sjøvold (1977), when the MMD is equal to or greater than twice the amount of the standard
deviation, the value is significant at the \( p \leq 0.05 \) level. Negative MMD values are an artificial byproduct of the Freeman and Tukey transformation and occur when two samples are closely associated or when the sample population is too small (Turner and Bird 1981). For this analysis, both MMD and standardized MMD were calculated and are presented in Table 4. The latter value can be obtained by dividing the MMD by the standard deviation and helps eliminate differences in variance caused by different sample sizes (Sofaer et al. 1986).

Two methods are commonly used to represent biodistance graphically and to elucidate the underlying structure of the data: cluster analysis and multidimensional scaling (Griffin 1993). Cluster analysis (Ward’s minimum variance [1963]) serves to demonstrate population affinity by organizing similar sites into groups. Using the arcsine-transformed trait prevalence rates (\( \Theta \) values) mentioned above, groups are formed based on agglomeration. Theta values are used in cluster analysis instead of raw MMD data because a distance matrix is unnecessary for clustering. Cluster analysis is best used to group data, and the theta values are the end result of multivariate statistics that produce one value by which to compare one population to another. Clustering is used in this study not as a test of statistical significance but rather as a way to understand groupings of the data that are not obvious in the MMD.

Multidimensional scaling (MDS) has also been used by researchers to study biodistance relationships by attempting to position populations, in this case based on the standardized MMD dissimilarity matrix, in two- or three-dimensional space. Suchey (1975) and Molto (1983) found that MDS was valuable to the interpretation of their data, although other researchers have found mixed results in utility (e.g., Kakaliouras 2003). MDS can reveal correlations between MMD and factors such as geography and time. In this study, the majority of the standardized MMD values are negative (Table 4), and most of the positive values are very small. This dissimilarity matrix results in an MDS graph in which most of the sites cluster tightly around zero. MDS is not a test of statistical significance but rather an interpretive method used to better understand the data at hand. Because an MDS graph of these data contributes no interpretive value to this study, it is not included here. Rather, cluster analysis alone is used to represent the data visually and to help display relationships among these archaeological populations.

**Results**

The mean measure of divergence statistic was calculated from nonmetric trait data to test two hypotheses: First, that there is no biological information
to support a tripartite linguistic taxonomy of archaeological sites, and second, that so-called border sites that are difficult to type archaeologically can be clarified based on MMD data.

When the MMD statistics for all possible combinations of the 13 archaeological populations were tabulated (Table 4), only one statistically significant measure of divergence was obtained, between Abbyville (44HA65) and Baum (31CK9). The first hypothesis is thus supported by the paucity of statistically significant biological distances among the populations that archaeologists have delineated on the North Carolina Coastal Plain. Abbyville and Baum are separated by nearly 200 miles, and Abbyville is located in the Virginia Piedmont rather than the North Carolina Coastal Plain. The statistically significant MMD between these two populations indicates there was little biological interaction between these people and little to no gene flow.

In order to further examine the distance data generated by the MMD statistic, a cluster analysis graph was created from theta values. Figure 2, a cluster graph based on individual archaeological populations, shows three major groups that roughly correlate with geographic proximity to one another. In reading the cluster graph from top to bottom, the first group includes the two southernmost coastal sites, McFayden and Cold Morning, which appear to be different from the remainder of the sites, as they cluster very late. The middle cluster includes mostly northern coastal sites (West, Baum, and Garbacon Creek) in addition to an inner coastal site (Sans Souci) and two more southern coastal sites (Jarretts Point and Broad Reach). Jarretts Point has a mixture of archaeological traits that led archaeologists to posit either Algonkian or Iroquoian
affiliation (Loftfield and McCall 1986), and Broad Reach is a mixture of Algonkian and Siouan characteristics (Mathis 1993). Sans Souci remains unpublished, having been excavated by amateur archaeologists in the 1970s (Hutchinson 2002), and the limited information available indicates Tuscarora-style pottery. This clustering indicates a closer biological distance between the geographically proximal sites of Jarretts Point and Broad Reach and a relationship with the three northern coastal sites. The geographic proximity of these sites and their clustering as a group lends support to the idea that these populations shared more than just material culture. The bottom cluster consists of interior sites (Jordan’s Landing, Hollowell, Hand, and Abbyville) plus the coastal site of Flynt. These sites are all thought to be Iroquoian, except Flynt. The Flynt site is generally assumed to be an Algonkian ossuary, yet the site yielded ceramic evidence pointing to Iroquoian influence (Bogdan and Weaver 1989). Flynt’s small biological distance with the interior coastal sites indicates a genetic relationship among these five populations. Cluster analysis shows that, even in the absence of statistically significant distance relationships, there is an underlying structure to the distance data, one that roughly corresponds with geographic areas of the Coastal Plain.

There are several so-called border sites from the Late Woodland that included archaeological evidence of more than one cultural affiliation. Hollowell, Flynt, and Jarretts Point all presented Algonkian and Iroquoian elements, and Broad Reach had elements of Algonkian and Siouan type ceramics and burial styles. In the absence of clear archaeological evidence, the MMD statistics and data visualization can theoretically aid in relating these sites osteologically to other archaeological populations. The MMD statistic does not definitively position any of the border sites with respect to any other population, indicating that these sites are not significantly biologically different from other populations. Cluster analysis using theta values (Figure 2), however, groups Hollowell and Flynt with interior sites and groups Jarretts Point and Broad Reach with northern coastal sites.

In this case, the cluster analysis of theta values was quite useful in helping to clarify a largely insignificant and negative MMD matrix. The MMD data indicate that populations on the North Carolina Coastal Plain were, for the most part, sharing genetic material, resulting in very close biological distances among the 13 populations examined. Cluster analysis, however, revealed a geographic dimension to the data. It would appear that there could be some skeletal basis to the current culture-history model, likely the result of geographic proximity between breeding populations. Nevertheless, it remains difficult to statistically differentiate Native American populations on the Coastal Plain prior to Contact. Without tighter chronological control, we cannot fully understand the complexity of border sites or track population changes during the Late Woodland period.

**Discussion**

The lack of biological diversity shown in the between-sites MMD statistic could be predicted for populations inhabiting the North Carolina Coastal Plain during the Late Woodland period. The Late Woodland spans a time period from A.D. 800 to contact—approximately A.D. 1650 in this area of the country. It is highly unlikely that no interaction between cultural groups occurred during this 800-year period, in spite of any language barriers that may have existed. Pairings between people of different populations are likely to have happened, resulting in gene flow across populations.

The ethno-linguistic model of North Carolina prehistory was developed partly as a way to classify archaeological sites on the basis of language, artifacts, and skeletons. In spite of mounting evidence in the past decade of social interconnections on the Coastal Plain in the Late Woodland, some researchers still attempt classification of sites based on a checklist of characteristics. In addition to the present report, however, two other studies have recently called into question the function of language as a cultural barrier. Joseph Herbert’s (2003) dissertation on ceramics in coastal North Carolina covers an impressive time frame, from 2000 B.C. to A.D. 1600, a span that includes the Late Woodland period. In this work, he reexamined the canonical pottery types on the coast, specifically the attribute sets that supposedly distinguish traditions of pottery making in specific areas in specific time periods. Variation of pottery types in time and space was thought to represent different ethnic groups, whereas homogeneous styles supposedly indicated a homogeneous culture. Herbert found, however, that the distribution of ceramic series crosscut ethnic and linguistic subgroups, leading him to conclude that diffusion of different ceramic technologies was a method to mitigate risk in areas of low population density and high residential mobility.

Ann Kakaliouras’s (2003) dissertation on biological distance on the North Carolina Coastal Plain based on nonmetric dental traits also reevaluated the accepted model of population interaction in the Late Woodland in order to refute the previously assumed connection between skeletal morphology and linguistic affiliation. Using a similar MMD calculation, she found no significant divergence among any of the dental populations she examined, most of which overlap with the populations assessed in the current study. Cluster
analysis (Kakaliouras 2003:126) found three main groups: outer coastal, southern coastal, and inner coastal populations. Kakaliouras's further analysis of these groups, however, indicated that not all sites clustered based on geographical location. Hollowell, on the inner coast, clustered with West, an outer coastal site; two of the Baum ossuaries from the outer coast clustered with Jordan's Landing and Sans Souci of the inner coast (Kakaliouras 2003:127). Cluster analysis from the present study (Figure 2) articulates well with Kakaliouras's site cluster (2003:126) based on dental data, and MMD statistics from both studies show few statistically significant differences among the populations at hand.

Nonmetric trait variation can distinguish between closely related groups of individuals, so it is not always straightforward to dismiss the lack of variation. Possibilities for lack of significant results include biases to the biodistance statistic based on the sample size of archaeological populations and the representativeness of the samples. Four populations (31BR5, 31NH28, 31CO5, 31ON309) consistently yielded negative MMD values, which can indicate that populations were very close biologically or that the sample sizes were too small. The numbers of individuals examined from these four populations were not the smallest samples in the study, however, ranging from 13 to 37 individuals, and the trait frequencies for these populations vary considerably. A statistically valid MMD value was also found when comparing Baum with Abbyville (n = 16). It is likely, however, that for these North Carolina populations sample size does not matter as much as consistency and preservation of the available sample. The Baum site (31CK9), for instance, is unique on the North Carolina coast in that it is a large, well-preserved collection of individuals who were most likely interred in a short time period. These crania were excellently preserved, resulting in more definitive observations of nonmetric traits and fewer instances of coding individual traits as indeterminate. One of the strengths of nonmetric trait analysis is that it can be performed on incomplete crania such as are often found at archaeological sites. If the number of individuals examined for a single trait is very small, however, consistency of the sample must be questioned. The implication of this lack of cohesiveness and smallness of size in archaeological samples is that we must be careful in performing statistical analyses to take into account all factors that could influence a sample.

Based on the cranial and dental nonmetric analysis, there are two potential explanations for the lack of biological distance among the three ethnohistoric cultural groups. First, it is possible that the groups were never very different to begin with. Even if the tripartite division of the North Carolina Coastal Plain was perceived at Contact, the differences that Europeans saw could have been the result of centuries of cultural and biological changes during and after the Late Woodland. Second, if there were three groups of Native Americans living in the North Carolina Coastal Plain during the Late Woodland, it is probable that gene flow was significant and was not hindered by linguistic or cultural differences.

**Conclusions**

Statistical analysis is a better way to discover associations among groups than merely visually examining a few specimens from each archaeological population. The limitations of this method due to sample size and continuity should not discourage further statistical analysis of skeletal data from North Carolina. The mean measure of divergence statistic amalgamates data on intrapopulation variation and, through multivariate statistical techniques, estimates the similarity of pairs of populations. The fact that some archaeological sites have too small a sample size or continuity to obtain significantly different MMD values serves as further warning to anyone who would classify populations based in whole or in part on skeletal remains. If an entire population is too small to calculate a statistically significant MMD, choosing one individual as a representative of that population is statistically invalid. In the past, archaeologists have avoided the sample size problem by collecting populations into cultural groups and then attempting to select one "type skull." While cluster analysis suggests that there might be a relationship between geographical location of a site and the biology of its population, only one statistically significant result was obtained from cranial data for distance.

The Late Woodland period in North Carolina was important for the changes in diet and political organization that took place at the beginning and for the changes that colonization brought at the end. During these eight centuries, variations in ceramic technique, architectural style, and burial program have been noted by archaeologists, and linguistic differences noted at Contact have been inferred for prehistory. Yet the Coastal Plain of North Carolina defies easy partitioning into closed cultural areas based on any combination of language, artifacts, and skeletal morphology. Disparate groups may have existed but interacted with one another, as shown in this study by the general lack of biological distance among skeletal remains. The future focus in this interesting and complicated time period in North Carolina prehistory should be on understanding the spheres of interaction among Native Americans.

**Note**

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Interestingly, when 10 additional skeletons from Broad Reach were analyzed by the author in July 2008 and added to the 2002 data, a previously significant MMD result between Broad Reach and Baum was rendered insignificant. The issue of small sample size is important in biodistance studies, but adding further skeletons will not necessarily indicate more differences among populations. The osteological record is neither a perfect cross-section nor the entirety of a once-living people, and the skeletons analyzed from each archaeological population may not be a representative sample of the Native American group that buried them. Each new cranium and its unique array of nonmetric traits, therefore, has the potential to change the MMD matrix, allowing us to understand more about the distribution of epigenetic traits in the archaeological population.

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