Analysis of Plant Remains from 31JK443

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Introduction

Archaeological plant and animal assemblages represent only a small fraction of what was originally used and deposited by humans in open-air settings. Natural and cultural factors can significantly modify organic remains, resulting in recovered assemblages that differ dramatically from the original deposits. As archaeologists, we examine collections that have undergone a series of processes—from the original selection of plants and animals by humans, to food preparation, cooking, discard, animal and insect scavenging, burial, decay, and weathering, to the recovery of food residues by archaeologists. Using standard methodological procedures for sampling, quantification, and analysis allows us to make sense of our assemblages in spite of the deleterious effects of these processes. Here we report on the identification and analysis of the archaeobotanical assemblage from 31JK443, a site in North Carolina that has two components, dating to the Late Archaic and Qualla periods. The plant data from flotation samples are discussed in this report. Plant remains recovered from screened contexts were identified and those data are presented in the Appendix.

Recovery and Preservation Bias

The circumstances under which plants preserve best archaeologically involve extreme conditions (e.g., exceptionally wet, dry, or cold environments) that prohibit decomposition of organic matter (Miksicek 1987). Plants can also preserve through exposure to fire, which can transform plant material from organic matter into carbon (Miksicek 1987). The likelihood that a plant will become carbonized varies according to the type of plant, how it is prepared and used, and whether it has a dense or fragile structure (Scarry 1986). Plants that are eaten whole are less likely to produce discarded portions that may find their way into a fire. Plants that require the removal of inedible portions (e.g., hickory nutshell, corn cobs) are more likely to find their way into a fire, and thus into the archaeological record. Inedible plant parts represent intentional discard that is often burned as fuel. Moreover, because inedible portions tend to be dense and fibrous, they are more likely to survive the process of carbonization than the edible parts (e.g., hickory nutshell vs. nutmeats). Physical characteristics are also important for determining whether or not a plant will survive a fire. Thick, dense nutshells are more likely to survive a fire than smaller, more fragile grass seeds. Food preparation activities also affect potential plant carbonization. The simple process of cooking provides the opportunity for carbonization through cooking accidents. Foods that are conventionally eaten raw, however, are less likely to be deposited in fires than cooked foods. Some plants that find their way into the archaeological record in carbonized form were not eaten at all. Wood fuel is the most obvious example. Other non-food plants that become carbonized are incidental inclusions, such as seeds blown by wind dispersal (Miksicek 1987; Minnis 1981; Scarry 1986). Indeed, most secondary invaders are weedy species with lots of seeds (e.g., cheno/am plants) (Minnis 1981).

While we cannot ever hope to know the absolute quantities or importance of different plants in any past subsistence economy, the preservation and recovery biases discussed above do not prohibit quantitative analyses of archaeobotanical assemblages. The most commonly used plant resources in any subsistence economy are more likely to be subject to activities that result in carbonization (e.g., through fuel use and accidental burning) and ultimately, deposition (Scarry 1986; Yarnell 1982). Thus, we can quantitatively examine the relative importance of commonly-used plant resources through time and across space.

Methods of Quantification

Quantitative methods in archaeobotany have developed significantly over the past several decades, and as a result, have been a subject of much critical discussion (Hastorf and Popper 1988). The most common methods for recording and quantifying plant remains are counts and weights. Because of problems with comparability between different types of plant taxa, however, raw (or absolute) counts and weights are not appropriate comparative measures (Scarry 1986). For example, denser taxa yield higher weights than more fragile taxa, and some taxa yield higher seed counts than others (e.g., grasses versus fruits) (Scarry 1986). Thus, using absolute counts or weights to summarize plant data is highly problematic. Most archaeobotanists agree that absolute counts are inadequate for assessing past people-plant interactions in that they do not control for biases related to preservation and sampling error (Kandane 1988; Miller 1988; Popper 1988; Scarry 1986). Absolute counts and weights are simply raw, unstandardized data.

One way to avoid the problems of absolute counts/weights is through the use of ubiquity measures (Godwin 1956; Hubbard 1975, 1976, 1980; Popper 1988, Willcox 1974). This type of analysis is essentially a presence/absence analysis that sidesteps the problems of counts and weights by measuring the frequency of occurrence instead of abundance. In other words, ubiquity analysis measures the number of samples in which a taxon was identified, as opposed to the number of specimens represented by that taxon. The researcher first records the presence of a specific taxon in each sample, and then computes the percentage of all samples in which the taxon is present (Popper 1988). For example, if acorn shell is present in four out of ten samples, then its ubiquity value is 40%. Thus, each taxon is evaluated independently (Hubbard 1980). Because different types of plants are disposed of differently, direct comparisons of ubiquity values between taxa are problematic (Hubbard 1980:53). For example, a 70% ubiquity value for hickory nutshell would not be equivalent to a 70% ubiquity value for beans as these categories have different preservation opportunities—hickory nutshell represents a processing by-product often used as fuel, while beans represent edible portions.

As with any quantitative measure, ubiquity analysis has its disadvantages. A sufficient number of samples is necessary to provide meaningful results as using too few samples creates a high likelihood of sampling error. Hubbard (1976:60) suggests a minimum of 10 samples. Moreover, although ubiquity analysis may mitigate for preservation biases, it is not immune to them (Hubbard 1980:53; Scarry 1986:193). Most importantly, because ubiquity deals with occurrence frequency and not abundance, it can potentially obscure patterns where occurrence frequency does not change but abundance does (Scarry 1986). As Scarry (1986:193) notes: "the frequency with which a resource is used may remain constant, while the quantity used varies." For example, a family may consistently eat corn on a daily basis, but the quantity they consume may vary from day to day. Despite these weaknesses, ubiquity analysis is a good starting point and can provide meaningful results when used alongside other measures.

While ubiquity measures may sidestep the problems inherent in absolute counts, it does not provide a means for calculating relative abundances of different plant taxa. Using comparative ratios is one way of determining the relative abundances of different plants. Essentially, calculating a ratio is a means of standardizing raw measures. In other words, we can deal with the problems of absolute counts and weights by standardizing them in terms of some constant variable (Miller 1988; Scarry 1986). The density measure standardizes data in terms of soil volume—the absolute count or weight of carbonized plant material (for individual taxa or for larger collapsed categories, e.g., corn kernels or corn) is divided by total soil volume for each sample or context. Density measures calculate the abundance of plants per liter of soil, and it is

generally assumed that larger volumes of soil will yield more plant remains. However, differences in the context and manner of deposition between soil samples structure the relationship between soil volume and the size of the plant assemblage. For example, a 10 L soil sample from an intact house floor would probably yield a smaller sample of carbonized plant remains than a 10 L soil sample from a refuse midden, because people tend to keep their houses cleaner than their trash dumps. Thus, density measures are useful in determing feature function.

Laboratory Procedures

Flotation samples from 31JK443 site were collected with variable volumes. Both the light and heavy fractions of the flotation samples were analyzed. Although the materials from the light and heavy fractions were processed and sorted separately, data from the two fractions were combined for analysis. According to standard practice, the light fractions were weighed and then sifted through 2.0 mm, 1.4 mm, and 0.7 mm standard geological sieves. Carbonized plant remains from both fractions were sorted in entirety down to the 2.0 mm sieve size with the aid of a stereoscopic microscope (10–40 X). Residue less than 2.0 mm in size was scanned for seeds, which were removed and counted; in addition, taxa encountered in the 1.4 mm sieve that were not identified from the 2.0 mm sieve were also removed, counted, and weighed. Corn cupules and acorn nutshell were also collected from the 1.4 mm sieve as these tend to fragment into smaller pieces and can be underrepresented in the 2.0 mm sieve.

Botanical materials were identified with reference to the paleoethnobotanical comparative collection at the University of California, Santa Barbara (UCSB) paleoethnobotany lab, various seed identification manuals (Martin and Barkley 1961; Delorit 1970), the USDA pictorial website (http://www.ars-grin.gov/npgs/images/sbml/), and Minnis (2003) which allowed us to identify the range of taxa native to the region. Taxonomic identification was not always possible—some plant specimens lacked diagnostic features altogether or were too highly fragmented. As a result, these specimens were classified as "unidentified" or "unidentified seed." In other cases, probable identifications were made—for example, if a specimen closely resembled a corn cupule, but a clear taxonomic distinction was not possible (e.g., the specimen was highly fragmented), then the specimen was identified as a probable corn cupule and recorded as "corn cupule cf.".

Once the plant specimens were sorted and identified, we recorded counts, weights (in grams), portion of plant (e.g., corn kernels versus cupules), and provenience information. Wood was weighed but not counted, and no wood identification was conducted. Generally, most of the seeds identified in the samples were too small to weigh, and thus only counts were recorded. Hickory nutshell and corn remains were identified only as fragments, and were both counted and weighed. Other than counts and weights, no other measurements were taken on any specimens.

Basic Results: Late Archaic Samples

This section presents the results of the identification of the carbonized plant remains from the Late Archaic contexts. Given the limited number of samples analyzed from this site, no quantitative analysis was conducted beyond the calculation of basic measures (e.g., density, relative percents, and ubiquity). Plant data from flotation samples are summarized by site in Tables 1 and 2, aggregated by site (data summary by sample is listed in Appendix A, along with results from the screened plants). Raw counts and weights are provided for each taxon; plant weight, wood weight, and soil volume are also provided.

A total of 9 flotation samples from Late Archaic contexts were sent to UCSB for analysis. All samples were sorted, representing a total of 114.9 liters of soil with a total plant

weight of 66.85 grams. Combined, these samples yielded 13 plant taxa (identified to the Genus level), including a variety of nuts and fruits, and numerous small seeds (Table 1).

Nutshell recovered from the flotation samples includes acorn (*Quercus* sp.), hickory (*Carya* sp.), and walnut (*Juglans* sp.). Hickory was the most abundant nut recovered, followed closely by acorn and black walnut. While the nutmeats of walnuts can be easily extracted from the shell, hickory nuts and some acorns require extensive processing before they are rendered palatable (Petruso and Wickens 1984). The hickory kernels are so tightly enmeshed in the interior shell that picking the nutshells from the cracked shell casing is a time-consuming task. Instead, hickory nuts were generally pounded into pieces and boiled to extract the oil (Ulmer and Beck 1951). The process of boiling the pounded hickory nuts separates the pieces of shell, which sink to the bottom of the pot, from the oil, which rises to the top as the nutmeats dissolve and can be skimmed off or decanted. This oil or milk would then be used as an added ingredient in soups and stews, as a condiment for vegetables, or as a general sauce or beverage (Scarry 2003; Talalay et al. 1984).

Acorn processing depends upon whether the nuts derive from white or red oak trees. Nuts from the red oak are high in tannin and are extremely bitter as a result. White oaks, however, yield sweeter nuts; the nutmeats from these acorns can be used for cooking immediately after extraction from the shell (Scarry 2003). The tannin present in the bitter acorns, however, requires an additional processing step. Leaching the tannin from acorns can be accomplished either by soaking them in water, or parching and then boiling them with an alkaline substance such as wood ash. Once processed, acorns were generally ground into a fine meal, which could then be used to make gruel, bake bread, or thicken stews. Less often, acorns were boiled and the oil extracted (Swanton 1944:260, 277). In general, nuts account for the bulk of the Late Archaic assemblage at this site by relative percent and density (see Table 2); in addition, hickory nuts are the most ubiquitous taxon in the assemblage, present in 89% of the samples.

Fruit taxa recovered from the samples are represented solely by wild grape (*Vitis* sp.). A variety of edible seeds was also identified in the assemblage (see Tables 1 & 2). These include amaranth (*Amaranthus* sp.), chenopod (*Chenopodium* sp.), smartweed (*Polygonum* sp.), and dogwood (*Cornus* sp. cf.). People probably collected and consumed the seeds of amaranth, chenopod, and smartweed (Hedrick 1972; Medsger 1966, Ulmer and Beck 1951). Chenopod (*Chenopodium* sp.), a common weed throughout the southeastern U.S., is represented in the assemblage by a handful of seeds. These chenopod seeds likely represent wild *Chenopodium*. Some species of dogwood fruit are sweet and edible. Other seeds that were not likely eaten include pokeweed (*Phytolacca americana*), copperleaf (Acalypha sp. cf.), firethorn (Pyracantha sp. cf.), red cedar (Juniperus virginiana cf.), and spiderling (Boerhavia sp. cf.). Pokeweed was likely processed for dyes, but the other seeds likely represent weedy incidental inclusions.

Basic Results: Qualla Samples

This section presents the results of the identification of the carbonized plant remains from the Qualla component at the site. Plant data from flotation samples are summarized by site in Tables 3 and 4, aggregated by site (data summary by sample is listed in Appendix A, along with results from the screened plants). Raw counts and weights are provided for each taxon; plant weight, wood weight, and soil volume are also provided. Raw counts and weights are provided for each taxon; plant weight, wood weight, and soil volume are also provided.

A total of 36 flotation samples dating to the Qualla phase were sent to UCSB for analysis from this site; Of the 36 samples send to the UCSB paleoethnobotany lab, 24 were flotation

samples and 12 were waterscreened samples. The data from both samples are provided site by side in Tables 3 & 4. All samples were sorted, representing a total of 734 liters of soil with a total plant weight of 265.36 grams. Combined, these samples yielded 50 plant taxa (identified to the Genus level), including corn, a variety of nuts and fruits, and numerous small seeds (Table 1).

Corn (*Zea mays*), bean (*Phaseolus vulgaris*.), possible sumpweed/sunflower (*Iva annua*/ *Helianthus annuus*), squash/gourd (*Cucurbita* sp.) were the only cultigens present in the samples (We list sumpweed/sunflower in the edible seed category). Corn and beans are often discussed together as they commonly represent partner crops. Whether or not they co-evolved as part and parcel of the same domestication process, corn and beans have a long tradition of inter-cropping and successional cropping in the New World (Lentz 2000).

Inter-cropping corn and beans is often beneficial in that corn stalks support the bean vines throughout plant growth (Smartt 1988:149). Moreover, inter-cropping also reduces the risk of pest and disease outbreaks than in pure stands (Smartt 1988:149). Corn and beans are also complementary in terms of nutritional value; corn is deficient in essential amino acids lysine and isoleucine, which beans have in abundance (Bodwell 1987:264; Giller 2001:140). Thus, in addition to the benefits of cropping corn and beans together, there are also benefits to eating corn and beans together. Bottle gourd fruit, seeds, oil and leaves are edible and the gourds are easy to grow. The rinds can also be hollowed out for storage of water and other substances.

Nutshell recovered from the Qualla-phase flotation samples includes acorn (*Quercus* sp.), hickory (*Carya* sp.), hazelnut (*Corylus* sp.), and walnut (*Juglans* sp.). Hickory was the most abundant nut recovered, followed closely by acorn and black walnut. While the nutmeats of walnuts can be easily extracted from the shell, hickory nuts and some acorns require extensive processing before they are rendered palatable (Petruso and Wickens 1984). The hickory kernels are so tightly enmeshed in the interior shell that picking the nutshells from the cracked shell casing is a time-consuming task. Instead, hickory nuts were generally pounded into pieces and boiled to extract the oil (Ulmer and Beck 1951). The process of boiling the pounded hickory nuts separates the pieces of shell, which sink to the bottom of the pot, from the oil, which rises to the top as the nutmeats dissolve and can be skimmed off or decanted. This oil or milk would then be used as an added ingredient in soups and stews, as a condiment for vegetables, or as a general sauce or beverage (Scarry 2003; Talalay et al. 1984).

The hazelnut identified in the assemblage probably represents the American hazelnut (*Corylus americana*). Unlike the other nuts which come from trees, hazels are shrubs; they prefer open and anthropogenic habitats, and form dense thickets (Scarry 2003). While the nuts begin to ripen in the late summer, they don't fall to the ground until October/November, at which time they are quickly consumed by animals (Scarry 2003). These factors would have resulted in low collection rates for this type of nut (Scarry 2003; Talalay et al. 1984). Hazelnuts are high in fat and were probably processed for the nutmeats themselves, as opposed to the oil they produce (Scarry 2003).

Acorn processing depends upon whether the nuts derive from white or red oak trees. Nuts from the red oak are high in tannin and are extremely bitter as a result. White oaks, however, yield sweeter nuts; the nutmeats from these acorns can be used for cooking immediately after extraction from the shell (Scarry 2003). The tannin present in the bitter acorns, however, requires an additional processing step. Leaching the tannin from acorns can be accomplished either by soaking them in water, or parching and then boiling them with an alkaline substance such as wood ash. Once processed, acorns were generally ground into a fine meal, which could then be used to make gruel, bake bread, or thicken stews. Less

often, acorns were boiled and the oil extracted (Swanton 1944:260, 277).

Fruit taxa recovered from the samples are represented by wild species. Several wild grape (*Vitis* sp.) seeds were also identified, in addition to hawthorn (*Crataegus* sp.). Other fruit taxa identified in the samples are represented by several wild species, including blackberry/raspberry (*Rubus* sp.), blueberry (*Vaccinium* sp.), groundcherry (*Physalis* sp.), maypop (*Passiflora incarnata*), snowberry (*Symphoricarpos* sp.), possible haw (*Viburnum* sp.), possible barberry (*Berberis* sp. cf.), serviceberry (*Amelanchier* sp.), smilax (*Smilax* sp.), and possible silverberry (*Elaegnus* sp. cf.). Most are edible except for snowberry, which can be toxic if ingested in large quantities.

A variety of seeds was also identified in the assemblage (see Tables 3 & 4). These include amaranth (*Amaranthus* sp.), bearsfoot (*Polymnia uvedalia*), bedstraw (*Galium* sp.), bulrush (*Scirpus* sp.), chenopod (*Chenopodium* sp.), possible holly (*Ilex* sp. cf.), purslane (*Portulaca* sp.), sage (*Salvia* sp.), sedge (*Carex* sp.), smartweed (*Polygonum* sp.), tickclover (*Desmodium* sp.), among others. People probably collected and consumed the seeds of amaranth, bearsfoot, chenopod, knotweed, smartweed, and sumpweed. Amaranth, chenopod, knotweed, purslane, and smartweed, in addition to doveweed and wildbean, may also have been eaten green or as potherbs (Hedrick 1972; Medsger 1966, Ulmer and Beck 1951). Chenopod (*Chenopodium* sp.), a common weed throughout the southeastern U.S., is represented in the assemblage by more than a thousand seeds. These chenopod seeds likely represent a combination of wild and domesticated *Chenopodium*. Other potential grain/oil seeds and green seeds identified include pokeweed (*Phytolacca americana*) and seeds from the mallow family (Malvaceae). Pokeweed (also a dye plant) and mallow family seeds were most likely gathered for their edible greens (Scarry 2003).

Other seeds that probably represent incidental inclusions in the assemblage include bedstraw, bulrush, sedge, and tickclover. Bedstraw may also have been consumed as a tea and the weedy legume may have been used as food (Hedrick 1972; Peterson 1977). Possible clover seeds (Trifolium sp.) may indicate clover leaves were being consumed. Notable are possible *Ilex* seeds identified at the site; although these holly seed could not be confidently identified, it is possible that it represents yaupon holly (*Ilex vomitoria*), a ritual plant known as the primary ingredient in the native Black Drink. Additionally, sage seeds were identified in the samples; the particular species of sage is not certain, but there are four species of the genus *Salvia* that are native to region. These sage seeds may represent an incidental inclusion or they might have been used medicinally. Other seeds include spurge (*Euphorbia* sp.) and wax myrtle (*Myrica* sp.). Spurge is not usually consumed by humans, but wax myrtle leaves can be dried and used for seasoning; their berries are edible but bitter (http://hubpages.com/hub/Common-Edible-Wild-Plants---Part-I).

Conclusions

In general, there is a shift from a reliance on nuts during the Late Archaic period to a focus on crop plants during the Qualla phase. During both occupations, however, other plant food categories (fruits and edible seeds) represent only a very small supplement to the overall staple foods (nuts during the Archaic occupation, and crops and nuts during the Qualla occupation). Moreover, a comparison between the Qualla flotation samples and the Qualla waterscreened samples indicates that both recovery methods are fairly comparable in terms of plant recovery.

References Cited

Austin, Daniel F.
2004 *Florida Ethnobotany*. CRC Press.

Bodwell, C. E.
1987 Nutritional Implications of Cereals, Legumes, and Their Products. In *Cereals and Legumes in the Food Supply*, ed. by J. Dupont and E. M. Osman, pp. 259–276. Iowa State University Press, Ames.

Cleveland, William S.
1994 *The Elements of Graphing Data*. AT&T Bell Laboratories, Murray Hill, New Jersey.

Delorit, R. J.
1970 *Illustrated Taxonomy Manual of Weed Seeds*. Wisconsin State University, River Falls.

Giller, Ken E.
2001 *Nitrogen Fixation in Tropical Cropping Systems*. CABI Publishing, New York.

Godwin, H.
1956 *The History of British Flora*. Cambridge University Press, Cambridge.

Gremillion, Kristen J.
1993 Adoption of Old World Crops and Processes of Cultural Change in the Historic Southeast. *Southeastern Archaeology* 12(1):15-20.

Hastorf, Christine A., and Virginia S. Popper (editors)
1988 *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*. The University of Chicago Press, Chicago and London.

Hedrick, U.P.
1972 *Sturtevant's Edible Plants of the World*. Dover Publications, New York.

Hubbard, R.N.L.B
1975 Assessing the botanical component of human paleoeconomies. Bulletin of the Institute of Archaeology 12:197–205.

1976 On the strength of the evidence for prehistoric crop processing activities. *Journal of Archaeological Science* 3:257–265.

1980 Development of Agriculture in Europe and the Near East: Evidence from Quantitative Studies. *Economic Botany* 34:51–67.

Kandane, Joseph B.
1988 Possible Statistical Contributions to Paleoethnobotany. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, ed. by

C. H. Hastorf and V. S. Popper, pp. 206–214. The University of Chicago Press, Chicago and London.

Lentz, David L.
2000 Anthropocentric Food Webs in the Precolumbian Americas. In *Imperfect Balance: Landscape Transformations in the Precolumbian Americas*, ed. by D. L. Lentz, pp. 89–120. Columbia University Press, New York.

Martin, A. C., and W. D. Barkley
1961 *Seed Identification Manual*. University of California Press, Berkeley.

McGill, Robert, John W. Tukey, and Wayne A. Larsen
1978 Variations of box plots. *The American Statistician* 32:12–16.

Medsger, Oliver Perry
1966 *Edible Wild Plants*. Collier Books, New York.

Miksicek, Charles H.
1987 Formation Processes of the Archaeobotanical Record. In *Advances in Archaeological Method and Theory*, Vol. 10, ed. by M. Schiffer, pp. 211–247. Academic Press, New York.

Miller, Naomi F.
1988 Ratios in Paleoethnobotanical Analysis. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, ed. by C. H. Hastorf and V. S. Popper, pp. 72–85. The University of Chicago Press, Chicago and London.

Minnis, Paul E.
1981 Seeds in Archaeological Sites: Sources and Some Interpretive Problems. *American Antiquity* 46(1):143–152.

Minnis, Paul E. (editor)
2003 *People and Plants in Eastern North America*. Smithsonian Books, Washington and London.

Peterson, Lee Allen
1977 *A Field Guide to edible wild plants of Eastern and Central North America*. Houghton Mifflin Company, Boston.

Petruso, Karl M., and Jere M. Wickens
1984 The Acorn in Aboriginal Subsistence in eastern North America: A Report on Miscellaneous Experiments. In *Experiments and Observations on Aboriginal Wild Plant Food Utilization in Eastern North America*, edited by P. Munson, 360-378. Indiana Historical Society, Indiana.

Popper, Virginia S.
1988 Selecting Quantitative Measures in Paleoethnobotany. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, ed. by C. H. Hastorf and V. S. Popper, pp. 53–71. The University of Chicago Press, Chicago and London.

Reid, Fiona A.
1997 *A Field Guide to the Mammals of Central America and Southeast Mexico*. Oxford University Press, New York.

Reitz, Elizabeth J., and Elizabeth S. Wing
1999 *Zooarchaeology*. Cambridge University Press, Cambridge, U. K.

Scarry, C. Margaret
2003 Patterns of wild plant utilization in the prehistoric Eastern Woodlands. In *People and Plants in the ancient eastern North America*, ed. by P. J. Minnis, pp. 50-104. Smithsonian Institution Press, Washington D.C.

1986 Change in Plant Procurement and Production during the Emergence of the Moundville Chiefdom. Unpublished Ph.D. dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

Scarry, C. Margaret, and Vincas P. Steponaitis
1997 Between Farmstead and Center: The Natural and Social Landscape of Moundville. In *People, Plants, and Landscapes: Studies in Paleoethnobotany*, ed. by K. J. Gremillion, pp. 107–122. The University of Alabama Press, Tuscaloosa.

Smartt, J.
1988 Morphological, Physiological, and Biochemical Changes in *Phaseolus* Beans under Domestication. In *Genetic Resources of Phaseolus Beans*, ed. by P. Gepts, pp. 143–162. Kluwer Academic Publishers, Boston.

Smith, Bruce D.
1985 Chenopodium berlandieri ssp. jonesianum: Evidence for a Hopewellian domesticate from Ash Cave, Ohio. *Southeastern Archaeology* 4(1):107-133.

Sutton, Ann and Myron Sutton
1985 *The Audubon Society Nature Guides: Eastern Forests*. Alfred A. Knopf, Inc., New York.

Swanton, John R.
1944 The Indians of the Southeastern United States. Bureau of American Ethnology Bulletin 137. Government Printing Office, Washington.

Talalay, Laurie, Donald R. Keller, and Patrick J. Munson
1984 Hickory Nuts, Walnuts, Butternuts, and Hazelnuts: Observations and Experiments Relevant to Their Aboriginal Exploitation in Eastern North America. In *Experiments and*

Observations on Aboriginal Wild Plant Utilization in Eastern North America, edited by P. J. Munson, pp. 338-359. Indiana Historical Society, Indianapolis.

Ulmer, Mary and Samuel E. Beck
1951 *Cherokee Cooklore*: *Preparing Cherokee Foods*. Museum of the Cherokee Indian, Cherokee.

Wilkinson, Leland, MaryAnn Jill, Stacey Miceli, Gregory Birkenbeuel, and Erin Vang
1992 *Systat Graphics*. SYSTAT, Inc., Evanston, Illinois.

Willcox, G. H.

1974 A history of deforestation as indicated by charcoal analysis of four sites in Eastern Anatolia. Anatolian Studies *24:117–133.*

Yarnell, Richard A.
1982 Problems of interpretation of archaeological plant remains of the eastern woodlands. *Southeastern Archaeology* 1(1):1–7.

Table 1. Summary of plant data for all taxa for the Late Archaic period

Total Samples	**9**				
Soil Volume (L)	**114.9**				
Plant Weight (g)	**66.85**				
Wood Weight (g)	**63.66**				
		Count	Weight (g)	Ubiquity (%)	Density (count/liters)
Nuts					
Acorn	*Quercus* sp.	12	0.07	33.3	0.10
Acorn cap	*Quercus* sp.	2	0.03	11.1	0.02
Hickory	*Carya* sp.	238	1.75	88.9	2.07
Walnut	*Juglans nigra*	5	0.07	11.1	0.04
Fruits					
Grape	*Vitis* sp.	4	0.02	33.3	0.03
Edible Seeds					
Amaranth	*Amaranthus* sp.	1		11.1	0.01
Chenopod	*Chenopodium* sp.	4		33.3	0.03
Smartweed	*Polygonum* sp.	1		11.1	0.01
Miscellaneous Seeds					
Copperleaf cf.	*Acalypha* sp. cf.	1		11.1	0.01
Dogwood cf.	*Cornus* sp. cf.	3		22.2	0.03
Firethorn cf.	*Pyracantha* sp. cf.	1		11.1	0.01
Pokeweed	*Phytolacca americana*	7		55.6	0.06
Red cedar cf.	*Juniperus virginiana* cf.	1		11.1	0.01
Spiderling cf.	*Boerhavia* sp. cf.	1		11.1	0.01
UIDs					
Unidentifiable		261	1.2	88.9	2.27
Unidentifiable seed		4		22.2	0.03
TOTALS		546	3.16		

Table 2. Summary measures of plant groups for the Late Archaic period

Total Samples	**9**		
Soil Volume (L)	**114.9**		
Total plant density (plant wt/liters)	**0.58**		
Total wood density (wood/liters)	**0.55**		
	Count	**Relative %**	**Density**
Nuts	257	91.5	2.24
Fruits	4	1.4	0.03
Edible Seeds	6	2.1	0.05
Miscellaneous Seeds	14	5.0	0.12
UIDs	265		2.31
TOTALS	**546**		**4.75**

Table 3. Summary of plant data for all taxa for the Qualla period

		Flotation				Waterscreened			
Total Samples		**24**				**12**			
Soil Volume (L)		**423**				**311**			
Plant Weight (g)		**174.04**				**91.32**			
Wood Weight (g)		**152.73**				**76.01**			
Crops		Count	Weight (g)	Ubiquity (%)	Density	Count	Weight (g)	Ubiquity (%)	Density
Common Bean	*Phaseolus vulgaris*	5	0.05	4.17	0.012	2	0.06	8.3	0.006
Common Bean cf.	*Phaseolus* sp. cf.	11	0.11	12.50	0.026				
Corn cupule	*Zea mays*	2093	11.08	95.83	4.948	1103	7.1	91.7	3.547
Corn kernel	*Zea mays*	195	1.42	83.33	0.461	216	1.21	66.7	0.695
Corn kernel cf.	*Zea mays* cf.	1	0.01	4.17	0.002				
Squash/gourd rind	*Cucurbita* sp.	19	0.13	8.33	0.045	5	0.1	8.3	0.016
Squash/gourd rind cf.	*Cucurbita* sp. cf.					19	0.14	8.3	0.061
Nuts									
Acorn	*Quercus* sp.	21	0.12	41.67	0.050	11	0.08	25.0	0.035
Hazelnut	*Corylus* sp.	12	0.07	16.67	0.028	9	0.09	33.3	0.029
Hickory	*Carya* sp.	746	4.98	95.83	1.764	396	3.62	91.7	1.273
Walnut	*Juglans nigra*	146	2.17	58.33	0.345	42	0.98	33.3	0.135
Walnut cf.	*Juglans nigra* cf.	1	0.03	4.17	0.002				
Walnut family nutmeat	Juglandaceae	2	0.03	4.17	0.005				
Fruits									
Barberry cf.	*Berberis* sp. cf.	1		4.17	0.002				
Blackberry/raspberry	*Rubus* sp.	8		12.50	0.019	1		8.3	0.003
Blueberry	*Vaccinium* sp.	2		8.33	0.005				
Coral/Snowberry	*Symphoricarpos* sp.	1	0.01	4.17	0.002				
Grape	*Vitis* sp.	3		4.17	0.007	5	0.04	16.7	0.016
Groundcherry	*Physalis* sp.	3		4.17	0.007				
Hawthorn cf.	*Crataegus* sp. cf.	40	0.08	25.00	0.095				

Maypop	*Passiflora incarnata*	10		20.83	0.024	3		16.7	0.010
Serviceberry	*Amelanchier* sp.	2		8.33	0.005				
Silverberry cf.	*Elaeagnus* sp. cf.	1	0.01	4.17	0.002				
Smilax sp.	*Smilax* sp.	1		4.17	0.002				
Viburnum sp. cf.	*Viburnum* sp. cf.	1		4.17	0.002				
Edible Seeds									
Amaranth	*Amaranthus* sp.	5		12.50	0.012				
Chenopod	*Chenopodium* sp.	265		66.67	0.626				
Chenopod cf.	*Chenopodium* sp. cf.					1		8.3	0.003
Purslane	*Portulaca* sp.	13		12.50	0.031				
Sage	*Salvia* sp.	1		4.17	0.002				
Smartweed	*Polygonum* sp.					4		8.3	0.013
Sumpweed/Sunflower	*Iva*/*Helianthus* sp.					1		8.3	0.003
Miscellaneous Seeds									
Arrowhead cf.	*Sagittaria* sp.	2		4.17	0.005				
Bearsfoot	*Polymnia uvedalia*					2		8.3	0.006
Bearsfoot cf.	*Polymnia* sp. cf.	5		4.17	0.012				
Bedstraw	*Galium* sp.	2		8.33	0.005	18		16.7	0.058
Bumelia cf.	*Sideroxylon* sp. cf.					4		8.3	0.013
Bulrush	*Scirpus* sp.	12		4.17	0.028				
Cheno/am	*Chenopodium/amaranthus*	20		12.50	0.047				
Dogwood cf.	*Cornus* sp. cf.					1		8.3	0.003
Elm cf.	*Ulmus* sp. cf.					4		8.3	0.013
Grass family	Poaceae	28		29.17	0.066				
Grass family cf.	Poaceae cf.	1		4.17	0.002				
Holly cf.	*Ilex* sp. cf.					16		8.3	0.051
Honeysuckle cf.	*Lonicera* sp. cf	2		4.17	0.005				
Mallow family	Malvaceae	1		4.17	0.002				
Mustard family	Brassicaceae	2		4.17	0.005				
Pokeweed	*Phytolacca americana*	126		58.33	0.298	354		58.3	1.138
Pondweed	*Potamogeton* sp.	20		4.17	0.047				

Poppy	*Papaver* sp.	1		4.17	0.002				
Saltbush cf.	*Atriplex* sp. cf.	2		4.17	0.005				
Sedge	*Carex* sp.	6		4.17	0.014				
Sedge family cf.	*Cyperaceae* cf.	3		4.17	0.007				
Spiderling cf.	*Boerhavia* sp. cf.	2		8.33	0.005				
Spurge	*Euphorbia* sp.	1		4.17	0.002				
Sumac cf.	*Rhus* sp. cf.					2		8.3	0.006
Tarweed cf.	*Madia* sp. cf.	2		8.33	0.005				
Tickclover	*Desmodium* sp.	2		4.17	0.005				
Wax myrtle	*Myrica* sp.	1		4.17	0.002	30	0.25	16.7	0.096
Wax myrtle cf.	*Myrica* sp. cf.	2		4.17	0.005				
UIDs									0.000
Unidentifiable		521	1.74	83.33	1.232	316	1.42	83.3	1.016
Unidentifiable seed		168		50.00	0.397	30		33.3	0.096
Unidentified peduncle		1		4.17	0.002	4		8.3	0.013
TOTALS		**4542**	**22.04**		**10.738**	**2599**	**15.09**		**8.357**

Table 4. Summary measures of plant groups for the Qualla period

	Flotation			Waterscreened		
Total Samples	**24**			**12**		
Soil Volume (L)	**423**			**311**		
Total plant density (plant wt/liters)	**0.41**			**0.29**		
Total wood density (wood wt/liters)	**0.36**			**0.24**		
	Count	Relative %	Density	Count	Relative %	Density
Crops	2324	60.3	5.49	1345	59.8	4.32
Nuts	928	24.1	2.19	458	20.4	1.47
Fruits	73	1.9	0.17	9	0.4	0.03
Edible Seeds	284	7.4	0.67	6	0.3	0.02
Miscellaneous Seeds	243	6.3	0.57	431	19.2	1.39
UIDs	690			350		
TOTALS	**4542**			**2599**		