

Analysis of Plant Remains from the 31JK164 site

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Report Submitted to TCR Garrow Associates, Inc.

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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 the 31JK164, North Carolina. The site is multicomponent, with occupations spanning from the Middle Archaic period through the early Late Qualla phase.

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 determining feature function.

Standardizing by soil volume, however, does not control for the range of non-plant related activities that contribute to the deposit from which the soil sample derives. In other words, the density measure does not consider plant remains in terms of plant-related activities, but rather in terms of all of the activities that are represented in the deposit. Thus, if the analyst is interested in determining the importance of a specific plant relative to the other plants in a sample or context, then density measures may be inadequate. Rather, standardizing by plant weight might be more appropriate (Scarry 1986). Unlike the density measure, standardizing by plant weight considers the contribution of a specific plant or category of plants solely in terms of plant-related activities. As a result, a plant weight ratio more accurately reflects spatial and temporal differences in plant use. As a quantitative category, plant weight is a sum of weights recorded for all carbonized plant specimens per sample or context. Thus, for each sample, there is a total weight of plant material—this figure is the denominator used to standardize the variable of interest.

Overall, ratios are useful quantitative tools that overcome some of the problems of absolute counts. It is important to understand, however, that ratios reveal only the relative importance of plants within varied depositional contexts, not the absolute dietary contribution of actual resources used in the past (Scarry 1986). For the purposes of the present analysis, we used both plant weight and soil volume to standardize the data – interestingly, both measures yielded similar patterning in the data. Thus, most of the data are presented as density measures.

Laboratory Procedures

Flotation samples from the 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. In some cases, we sub-sampled selected samples that were extremely large. These samples were weighed and then systematically split using a riffle splitter; some samples were split in half and others in quarters depending on the overall weight of the sample. Counts and weights from the selected subsample were extrapolated using the total sample weight.

Basic Results

This section presents the results of the identification of the carbonized plant remains from the 31JK164. Given the limited number of samples from each period that were analyzed from this site, no quantitative analysis was conducted beyond the calculation of basic measures (e.g., density, relative percentages, and ubiquity). Plant data from flotation samples are summarized by period in Table 1 (data summary by sample is listed in Appendix A, which is an electronic excel file; each workbook within the file represents a different period of occupation). Table 2 lists all taxonomic names that correspond to the common names provided in Table 1 and throughout the report. Raw counts and weights are provided for each taxon; plant weight, wood weight, and soil volume are also provided. Seasonality by plant taxon is displayed in Table 3. Measures of ubiquity, density, and relative percents were calculated for the Late Middle-Early Late Qualla period; this was the only period with a sufficient number of samples to perform these calculations.

A total of 27 flotation samples from this site were sent to UCSB for analysis. Of the 27 samples sent to the UCSB paleoethnobotany lab, all samples were sorted, representing a total of 294 liters of soil with a total plant weight of 126.68 grams. Combined, these samples yielded 24 plant taxa (identified to the Genus level), including corn, a variety of nuts and fruits, and numerous small seeds (Table 1).

Potential crop plants identified at the site include corn (*Zea mays*), possible bean (cf. *Phaseolus* sp.), possible sunflower (cf. *Helianthus annuum*), possible bottle gourd rind (*Lagenaria siceraria*), goosefoot (*Chenopodium berlandieri*), little barley (*Hordeum pusillum*), and maygrass (*Phalaris caroliniana*). 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.

Goosefoot (*Chenopodium* sp.), a common weed and native domesticate throughout the southeastern U.S., is represented in the assemblage by 30 seeds. These goosefoot seeds likely represent a combination of wild and domesticated *Chenopodium*. Little barley and maygrass are grain seeds and represent good sources of carbohydrates; sunflower is an oil seed and contains more fat and protein. Grain seeds were probably parched and could be ground down to a meal and baked into bread or incorporated into stew. Similarly, oil seeds could be mixed into bread meal and/or stews.

Nutshell recovered from the 31JK164 flotation samples includes acorn (*Quercus* sp.),

butternut (*Juglans cinerea*), hazelnut (*Corylus* sp.), hickory (*Carya* sp.), and black walnut (*Juglans nigra*). 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.), maypop (*Passiflora incarnata*), and persimmon (*Diospyros virginiana*). All identified fruits are edible.

A variety of miscellaneous seeds was also identified in the assemblage (see Tables 1 & 2). These include bulrush (*Scirpus* sp.), purslane (*Portulaca* sp.), smartweed (*Polygonum* sp.), tickclover (*Desmodium* sp.). People probably collected and consumed the smartweed seeds, which could have been eaten green or as potherbs (Hedrick 1972; Medsger 1966, Ulmer and Beck 1951). 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>).

A general assessment of seasonality for these plants indicates the harvesting and collection of resources from April through November. Regardless to temporary or permanent occupation, most plants do not bloom in the winter months, between December and March, which make plant seasonality data difficult to assess length of occupation without other complementary datasets. A perusal of the seasonality table, however, reveals that most plants are ripe and ready for collection between May and October. Clearly, there is a bounty of wild plant foods that can be collected fresh throughout the spring, summer, and fall months. Many of these can be stored for later use in the winter.

Conclusions

Overall, the flotation samples from 31JK164 produced a diverse array of plants that represent mainly food plants and herbs. The pre-Qualla assemblages are dominated by nut resources. Of interest is the possible corn cupules in the Archaic sample; given the fragmentary nature of these three specimens, it is impossible to securely identify them to species. The Qualla phase assemblage is dominated by corn and hickory. While corn production clearly was important during this period, it is clear that nut collection remained a dominant subsistence activity of the farmer-foragers living at the site.

Table 1. Counts and weights of plant taxa by period.

	Middle Archaic	Middle Woodland Conestee	Early Pisgah	Late Middle to Early Late Qualla	Undifferentiated Qualla	Mixed Contexts	Unclear Contexts	Totals								
No of samples	2	1	2	15	2	3	2	27								
N of features	1	1	2	9	2	--	2	17								
Soil Volume (L)	18	22	24	160	19	27	24	294								
Plant Weight (g)	3.55	16.14	7.25	95.79	0.51	1.69	1.75	126.68								
Wood Weight (g)	0.89	5.17	2.4	90.88	0.4	1.52	1.43	102.69								
	N	g	N	g	N	g	N	g	N	g	N	g	N	g	N	g
Crops																
Bean cf.							1	0							1	0
Bottle gourd rind cf.							6	0.01							6	0.01
Goosefoot	1	0	1	0	1	0	16	0.01	7	0	2	0	2	0	30	0.01
Goosefoot cf.							1	0							1	0
Corn cupule			1	0	20	0.01	296	1.38	3	0.01	11	0.02	24	0.12	355	1.54
Corn cupule cf.	3	0.01					14	0.09	1	0	2	0			20	0.1
Corn kernel			1	0			57	0.17			7	0.05	2	0	67	0.22
Corn kernel cf.	3	0			1	0	1	0							5	0
Little barley			1	0			1	0							2	0
Maygrass															0	0
Sunflower cf.							1	0							1	0
Nuts																
Acorn	3	0.02	25	0.06	12	0.06	20	0					1	0	61	0.14
Butternut			3	0.2			1	0.09							4	0.29
Butternut/Walnut							5	0.18			1	0			6	0.18
Hazelnut			26	0.23											26	0.23
Hickory	199	2.37	722	5.71	352	4.67	212	1.96	16	0.1	26	0.09	15	0.15	1542	15.05
Walnut	1	0.07	176	4.4	2	0	17	0.46							196	4.93
Walnut family	3	0.03	1	0			3	0							7	0.03
Fruits																
Grape							1	0							1	0
Hawthorn							1	0							1	0
Maypop			1	0	18	0.01									19	0.01
Persimmon							3	0.02							3	0.02
Miscellaneous																
Bulrush					1	0									1	0
Carpetweed							2	0							2	0
Cheno/am							1	0							1	0
Grass family							1	0.01							1	0.01
Purslane							7	0	2	0					9	0
Skullcap													1	0	1	0
Smartweed							1	0							1	0
Tick Clover					1	0									1	0
Wax myrtle							1	0	1	0	5	0			7	0
Unidentified																
Bean/Persimmon							1	0.01							1	0.01
Unidentifiable	23	0.16	99	0.37	36	0.1	129	0.52	1	0	15	0.01	9	0.04	312	1.2
Unidentified seed					1	0	3	0					2	0	6	0

Table 2. Correspondence of common and taxonomic names.

COMMON NAME	TAXONOMIC NAME
Crops	
Bean	<i>Phaseolus</i> sp.
Bottle gourd	<i>Lagenaria siceraria</i>
Corn/Maize	<i>Zea mays</i>
Goosefoot	<i>Chenopodium berlandieri</i>
Little Barley	<i>Hordeum pusillum</i>
Maygrass	<i>Phalaris caroliniana</i>
Sunflower	<i>Helianthus annuus</i>
Nuts	
Acorn	<i>Quercus</i> sp.
Butternut	<i>Juglans cinerea</i>
Butternut/Walnut	<i>Juglans cinerea/nigra</i>
Hazelnut	<i>Corylus</i> sp.
Hickory	<i>Carya</i> sp.
Walnut	<i>Juglans nigra</i>
Walnut family	Juglandaceae
Fleshy Fruits	
Grape	<i>Vitis</i> sp.
Hawthorn	<i>Crataegus</i> sp.
Maypop	<i>Passiflora incarnata</i>
Persimmon	<i>Diospyros virginiana</i>
Miscellaneous Seeds	
Bulrush	<i>Scirpus</i> sp.
Carpetweed	<i>Mollugo</i> sp.
Cheno/am	<i>Chenopodium/Amaranthus</i>
Grass family	Poaceae
Purslane	<i>Portulaca</i> sp.
Skullcap	<i>Skutellaria</i> sp.
Smartweed	<i>Polygonum</i> sp.
Tickclover	<i>Desmodium</i> sp.
Wax myrtle	<i>Myrica</i> sp.
Miscellaneous	
Bean/persimmon	<i>Phaseolus/Diospyros</i>

Table 3. Seasonality of taxa in order of bloom.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Wax myrtle				X	X	X	X	X	X	X		
Little barley					X	X	X					
Bottle gourd					X	X	X	X	X			
Purslane					X	X	X	X	X			
Carpetweed						X	X	X				
Bulrush							X	X	X			
Corn							X	X	X			
Common bean							X	X	X	X		
Maypop							X	X	X	X		
Sunflower							X	X	X	X		
Goosefoot							X	X	X	X	X	
Smartweed							X	X	X	X	X	
Grape								X	X	X		
Tickclover								X	X	X		
Hawthorn									X	X		
Persimmon									X	X		
Acorn									X	X	X	
Hickory										X		
Walnut										X		

Table 4. Ubiquity Values, Densities, and Relative Percents of Plant Taxa from the Late Middle Qualla to Early Late Qualla plant assemblage.

	Count	Wt (g)	Ubiquity	Relative %	Density
<u>Crops</u>					
Bean cf.	1	0	6.67	0.12	0.006
Bottle gourd rind cf.	6	0.01	20	0.75	0.038
Goosefoot	16	0.01	33.33	1.99	0.100
Goosefoot cf.	1	0	6.67	0.12	0.006
Corn cupule	296	1.38	93.33	36.86	1.850
Corn cupule cf.	14	0.09	13.33	1.74	0.088
Corn kernel	57	0.17	53.33	7.10	0.356
Corn kernel cf.	1	0	6.67	0.12	0.006
Little barley	1	0	6.67	0.12	0.006
Sunflower cf.	1	0	6.67	0.12	0.006
<u>Nuts</u>					
Acorn	20	0	40	2.49	0.125
Butternut	1	0.09	6.67	0.12	0.006
Butternut/Walnut	5	0.18	6.67	0.62	0.031
Hickory	212	1.96	100	26.40	1.325
Walnut	17	0.46	26.67	2.12	0.106
Walnut family	3	0	6.67	0.37	0.019
<u>Fruits</u>					
Grape	1	0	6.67	0.12	0.006
Hawthorn	1	0	6.67	0.12	0.006
Persimmon	3	0.02	13.33	0.37	0.019
<u>Miscellaneous</u>					
Carpetweed	2	0	6.67	0.25	0.013
Cheno/am	1	0	6.67	0.12	0.006
Grass family	1	0.01	6.67	0.12	0.006
Purslane	7	0	26.67	0.87	0.044
Smartweed	1	0	6.67	0.12	0.006
Wax myrtle	1	0	6.67	0.12	0.006
<u>Unidentified</u>					
Bean/Persimmon	1	0.01	6.67	0.12	0.006
Unidentifiable	129	0.52	80	16.06	0.806
Unidentified seed	3	0	6.67	0.37	0.019

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