

Analysis of Plant Remains from the Sabal Trail site

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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 Sabal Trail project, which includes three sites from Georgia (GA-FS 94, GA-FS 209, and GA-FS 304), all of which date to the Mississippian period.

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 Sabal Trail 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 addition to sampling a portion of the flotation samples that were sent to UCSB, we also 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 Sabal Trail site. 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 Table 1, aggregated by site (data summary by sample is listed in Appendix A, attached as a separate MS Excel table). 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.

A total of 15 flotation samples were sent to UCSB for analysis. Of the 15 samples sent to the UCSB paleoethnobotany lab, all samples were sorted, representing a total of 235 liters of soil with a total plant weight of 28.41 grams. Combined, these samples yielded 8 plant taxa (identified to the Genus level), including corn, nuts, and some small seeds (Table 1).

Corn (*Zea mays*) and squash/gourd (*Lagenaria/Cucurbita*) are the only definitive field cultigens present in the samples. Corn kernels were the second most ubiquitous and second most dense plant food recovered while bottle gourd remains are not numerous (Table 1). 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 Sabal Trail flotation samples includes acorn (*Quercus* sp.) and hickory (*Carya* sp.). Hickory was the most ubiquitous (80%) nut recovered followed by acorn (40%). Hickory nut also had the highest density (2.61) of all plant remains recovered, and acorn had the third highest density (.31). Hickory nuts and some acorns require extensive processing before they are rendered palatable (Petrucci 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).

A single fruit taxon, Maypop (*Passiflora incarnata*), was recovered from the samples and represented by maypop. Maypop is a wild taxon with a fleshy and edible fruit that has a sweet taste. The maypop seed recovered was uncarbonized, but given the dense nature of the seed it is

possible that it is archaeological. Gremillion (1989) suggests maypop were likely mutualistic weeds rather than tended crops. Historic records demonstrate that maypop was abundant in Native American gardens, but it is uncertain if the species were intentionally planted or mutualistically exploited due to maypop being an aggressive colonizer of disturbed ground (Gremillion 1989:139).

A variety of grain seeds, oil seeds, and greens was also identified in the assemblage (see Tables 1 & 2). These include bearsfoot (*Polymnia uvedalia*) and chenopod (*Chenopodium* sp.). People probably collected and consumed the seeds of bearsfoot and chenopod. Chenopod species may also have been eaten green or as potherbs (Hedrick 1972; Medsger 1966, Ulmer and Beck 1951). Chenopod, a common weed throughout the southeastern U.S., is represented in the assemblage by a single seed. This chenopod seed likely represents a wild variety. Other seeds found include wax myrtle (*Myrica* sp.). Possible seed identifications include single seeds from the knotweed family (*Polygonum* sp.), the grass family (Poaceae), and bedstraw (*Galium* sp.). It was not possible to identify the genus of these remains.

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

Paleoethnobotanical remains recovered from the Sabal Trail site show that the residents of the site were engaged in the cultivation of maize, but still relied heavily on gathering wild or tended resources such as hickory and acorn nuts and edible grass seeds and greens. Hickory nut was the most ubiquitous plant type recovered suggesting that it remained extremely important as a staple resource alongside the cultivation of maize and squash/gourd. The presence of multiple types of edible grains (chenopod, bearsfoot), aquatic plants (wax myrtle), as well as hickory and acorn nuts suggests the residents exploited multiple environmental zones.

Table 1. Counts and weights of plant taxa from Sabal Trail.

N of Samples	15				
Total Volume (l)	235				
Plant Weight (g)	28.41				
Wood Weight (g)	19.71				
	(n)	(g)	Ubiquity	Relative %	Density
COMMON NAME					
Cultigens					
Corn cupule	17	.05	40	1.2	.07
Corn kernel	74	.16	47	5.4	.31
Squash/Gourd	1	.01	7	0.1	.004
Squash/Gourd cf.	4	.01	7	0.3	.017
Nuts					
Acorn nutshell	48	.49	40	3.5	.206
Acorn nutshell cf.	5	.01	13	0.4	.021
Hickory	609	5.24	80	44.5	2.61
Hickory cf.	1	.01	7	0.1	.004
Unidentified nutmeat	4	.01	7	0.3	.017
Fleshy Fruits					
Maypop	1	.01	7	0.1	.004
Edible Seeds					
Bearsfoot	2	.01	7	0.1	.008
Chenopod	1	.01	7	0.1	.004
Knotweed Family	1	.01	7	0.1	.004
Other Seeds					
Bedstraw cf.	4	.01	7	0.3	.017
Grass family	1	.01	7	0.1	.004
Wax myrtle	1	.01	7	0.1	.004
Wax myrtle cf.	3	.02	13	0.2	.012
Miscellaneous					
Pine pitch	433	2.3	60	31.7	1.85
Pine pitch cf.	84	.31	33	6.1	.36
Unidentified					
Unidentifiable	72	.13	47	5.3	.309
Unidentifiable seed	1	.01	7	0.1	.004
Unidentified nutmeat	4	.01	7	0.3	.017

Table 2. Correspondence of common and taxonomic names.

COMMON NAME	TAXONOMIC NAME
Cultigens	
Corn cupule	<i>Zea mays</i>
Corn kernel	<i>Zea mays</i>
Squash/Gourd	<i>Lagenaria/Cucurbita</i>
Squash/Gourd cf.	<i>Lagenaria/Cucurbita</i> cf.
Nuts	
Acorn nutshell	<i>Quercus</i> sp.
Acorn nutshell cf.	<i>Quercus</i> sp. cf.
Hickory	<i>Carya</i> sp.
Hickory cf.	<i>Carya</i> sp. cf.
Fleshy Fruits	
Maypop	<i>Passiflora incarnata</i>
Grains/Oil Seeds & Greens	
Bearsfoot	<i>Polymnia uvedalia</i>
Chenopod	<i>Chenopodium</i> sp.
Knotweed family	<i>Polygonum</i> sp.
Other Seeds	
Bedstraw cf.	<i>Galium</i> sp. cf.
Grass family	<i>Poaceae</i>
Wax myrtle	<i>Myrica</i> sp.
Wax myrtle cf.	<i>Myrica</i> sp. cf.
Miscellaneous	
Pine pitch	<i>Pinus</i> sp.
Pine pitch cf.	<i>Pinus</i> sp. cf.

Table 3. Seasonality of taxa identified at Sabal Trail 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		
Bedstraw					X	X	X	X				
Bottle gourd					X	X	X	X	X			
Bearsfoot							X	X	X			
Corn							X	X	X			
Maypop							X	X	X	X		
Chenopod							X	X	X	X	X	
Knotweed							X	X	X	X	X	
Acorn									X	X	X	
Hickory										X		

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