GATHERING IN THE LATE PALEOINDIAN AND EARLY ARCHAIC PERIODS IN THE MIDDLE TENNESSEE RIVER VALLEY, NORTHWEST ALABAMA

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ABSTRACT

Plant foods are a significant component of the diet of modern hunting-and-gathering groups living in non-arctic environments. Accordingly, the decisions and activities associated with gathering and using plants are important considerations for foragers. Little is known, however, about the importance of plant foods – and the role of the women and children who gather them – in the settlement and subsistence strategies of early hunter-gatherers in the southeastern United States.

To address the role of gathering in early foragers' lifeways, I analyzed plant remains from the Late Paleoindian (12,000 – 11,200 cal B.P.) and Early Archaic (11,200 – 8,900 cal B.P.) components at four rockshelter sites in northwest Alabama. The excellent preservation of these deposits enabled me to consider plant foods in concert with peoples' use of both animal and stone resources in the region. The use of plant remains, as well as aquatic resources, appears to be highly dependent on local resource structure.

In order to construct a model of resource procurement , I employed central place foraging theory, which contends that foragers will travel further to obtain resources with higher return rates. Using a geographic information system, I applied central place foraging theory directly to the northwest Alabama landscape.

My results suggest that food resources cannot be usefully divided into "plant" and "animal" resources, but rather should be viewed in terms of high versus low processing costs. Foodstuffs with low processing costs cannot be profitably obtained at significant distances from a campsite, as travel costs rapidly affect the return rates of these items. Thus foragers should site their camps near low-cost resources such as fruits, fish, and leafy greens. These resources are also reliable and predictable foodstuffs, targeted by women and children to meet their high nutritional requirements. I argue, then, that foragers, both in northwest Alabama as well as farther afield in place and time, should organize their mobility patterns according to the needs and activities of gatherers – women, children, and the elderly.

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CHAPTER ONE:
INTRODUCTION

Plants are inarguably a significant component of the diet of foraging peoples in non-arctic environments (Keeley 1999; Kelly 1983; R. Lee 1968; Walthall 1998b). Accordingly, the decisions and activities associated with the gathering and exploitation of plants are important aspects of peoples' subsistence pursuits. In this project I explore how information regarding the activities of gatherers can be gleaned from plant remains and then incorporated into our picture of Late Paleoindian and Early Archaic peoples. In particular, I address how gathering influences mobility patterns and articulates with the exploitation of other resources (*sensu* Zeanah 2000). By examining plant remains from four rockshelters in the Middle Tennessee River Valley, I construct a model of subsistence strategies and mobility patterns that expressly considers the decisions and tasks of gatherers in the Late Paleoindian and Early Archaic periods.

Models of Late Paleoindian and Early Archaic lifeways in the southeastern United States have become increasingly sophisticated. Early models depicted mobile bands roaming the landscape solely in search of large game; researchers now envision dynamic movements of micro- and macrobands who seasonally exploit resources, exchange goods and information, and form social bonds within and across regions. Although sophisticated, current models are grounded on limited evidence. Stone tool data and environmental reconstructions, rather than food remains, are used to suggest subsistence strategies as well as settlement and mobility patterns. This is largely due to the nature of the archaeological record: organic remains are poorly preserved in the acidic soils of the Southeast. Faunal and botanical materials are often limited or absent from open-air sites. Regional data comparable to those available for stone tools are difficult to compile for organic remains.

Archaeological deposits protected within rockshelters provide a clear exception. Organic remains are consistently well preserved in their rain-protected deposits. Furthermore, rockshelters are distinct locations on landscapes that groups repeatedly visited. Because of this repeated use and remarkable preservation, significant quantities of well-preserved faunal and botanical remains can be recovered from rockshelter deposits. While rockshelter sites are unique in terms of their preservation, the activities conducted at rockshelters are comparable to those performed at open-air sites. Early rockshelter sites in the eastern United States can be separated into residential sites and hunting camps, based on artifact assemblages that reflect maintenance and manufacture of bone, wood, and stone tools, preparation of hides, and the use of hearths (Walthall 1998b). Because the artifact assemblages of rockshelter and open-air sites are similar, it is reasonable to assume that faunal and botanical assemblages would be similar, if open-air sites had comparable preservation of organic remains. The rich organic data recovered from rockshelters therefore may be considered representative of general subsistence and settlement strategies, and thus can significantly inform our views of lifeways of Late Paleoindian and Early Archaic peoples.

Animal remains from early deposits in rockshelters have been analyzed (e.g. Fowler 1959; Griffin 1974; Logan 1952; Parmalee 1962; Parmalee et al. 1976; Snyder and Parmalee 1992; Walker 1998) and the resulting data have been consulted in the construction of models of Late Paleoindian and Early Archaic lifeways in the Southeast (e.g. Meltzer and Smith 1986). However, comparable research on plant remains has been performed less often (an exception is Parmalee et al. 1976). This is unfortunate, as plant remains are particularly important for understanding gathering activities, especially because tools used specifically for plant processing either do not preserve well or are not easily recognized (Anderson and Sassaman 1996). Inasmuch as plant foods comprised a significant portion of early foragers' diets, and the gathering and processing of these plant resources occupied a significant proportion of the population, particularly women, children and the elderly, an understanding of gathering activities and how they relate to peoples' use of the landscape is key.

To this end, I examine plant remains from four rockshelter sites in the Middle Tennessee River Valley with deposits dating to the Late Paleoindian/Dalton and Early Archaic periods. I approach the data with three objectives. First, I develop a baseline of plant use in the region from the plant assemblages at the four sites. I compare the assemblages qualitatively and quantitatively to suggest the nature of plant use in the region, and how it varies both across space and through time. Second, I explore the practices associated with the use of these plant foods and the demands that they would make, especially in terms of scheduling and allocation of labor, on mobile foraging groups. Third, I examine the location of these sites with respect to the distribution of resources on the local landscape. I perform this with the assistance of a geographic information system (GIS) from the perspective of central place foraging theory. Using the above information, I construct a model of Late Paleoindian and Early Archaic settlement and subsistence strategies in the Middle Tennessee River Valley that incorporates gathering practices and considers their impact on mobility patterns and subsistence strategies.

I define the project area to include Lauderdale, Colbert, and Franklin counties, Alabama, in which the four rockshelter sites are located (Figure 1.1). Among these sites is Dust Cave, dissolved from the limestone bluff that lines the north shore of the Tennessee River in Lauderdale County. Two bluff shelters, both eroded from the sandstone caps of Little Mountain, are located in Colbert County. LaGrange Bluff Shelter is located on the escarpment between Little Mountain and the uplands of the Tennessee Valley, and Stanfield-Worley Bluff Shelter is nestled in a cove within the mountain hills. The last bluff shelter site, Rollins, is located along the sandstone slopes of the Fall Line Hills in Franklin County.

I organize this study as follows. In Chapter Two, I discuss the background of the research problem, presenting a brief history of previous models of Late Paleoindian and Early Archaic lifeways in the Southeast and noting the data and theory that drive them. I then present the theoretical approach that I pursue, namely evolutionary ecology. I find evolutionary ecology useful, not just because it efficiently organizes economic problems, but also because it encourages researchers to

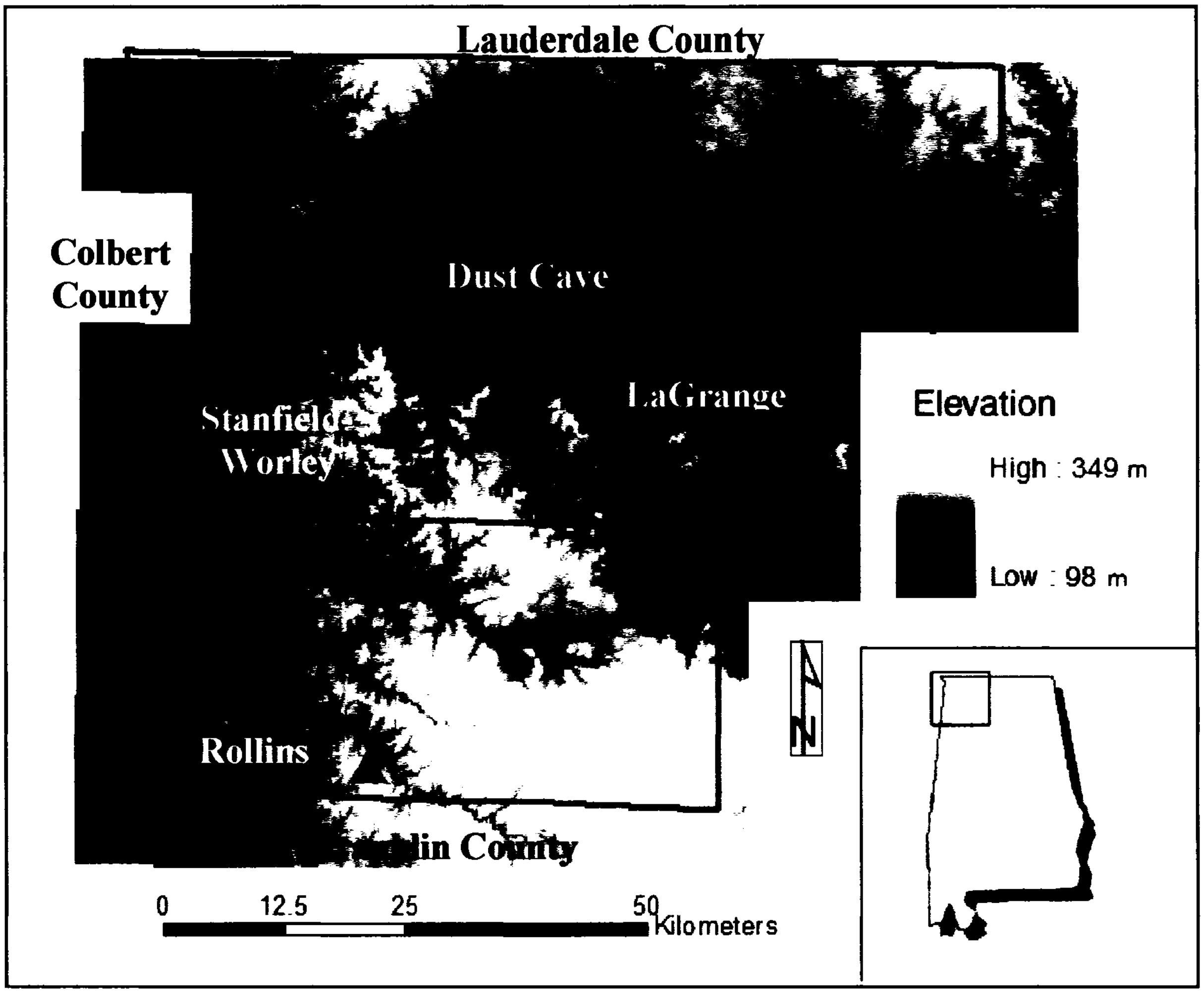


Figure 1.1. Map of project area and the four rockshelter sites considered in this dissertation. Inset shows location of project area in relation to the state of Alabama.

consider the role of individuals and the decisions that they face, and the impact of these decisions of individuals on personal and group behaviors. From evolutionary ecology, I use central place foraging theory to structure my exploration of site placement with respect to resource distribution, and discussions of the gendered division of labor to envision the identities of gatherers.

I collate information about the environment of the project area in Chapter Three. This includes a description of the geography, flora and fauna that presently characterize five physiographic regions within the project areas. I then turn to paleoclimatic data and reconstructions of paleoenvironments to sketch the local environment during the Late Pleistocene/Early Holocene transition, the landscape upon and with which early hunter-gatherers, animals, and plants interacted.

In Chapter Four I present an overview of previous archaeological research performed in the project area, which has a long history of involvement both by professional and avocational archaeologists. I then detail the archaeological investigations carried out at the four rockshelter sites by various crews of the University of Alabama joined by members of the Alabama Archaeological Society. This information provides the site-level and regional context within which I interpret the plant materials and their impact on peoples' mobility patterns and subsistence strategies.

Chapter Five details the nature of the samples included in this study, both in terms of the contexts from which they derive as well as the manner in which they were collected and processed. I also discuss the methods used to analyze the samples and the quantitative measures used to describe the results. I approach the data from the framework of exploratory data analysis, employing graphical displays such as boxplots and correspondence analysis to detect patterning in the data.

In Chapter Six I present the results of my analysis of the plant assemblages from the four rockshelter sites. I discuss the range of taxa present at each site, which include nuts, fruits, edible seeds, and weedy taxa. Further, I explore possible changes through time where applicable. Using correspondence analysis, I compare the assemblages of the four sites, looking for patterns in spatial distribution of taxa.

I discuss salient aspects of use of the plants recovered from the site assemblages in Chapter Seven. This includes the habitats in which each taxon is found, its seasonal availability, and competition with wildlife for its use, as well as the methods used by historic Native Americans to gather, process, and prepare these plant foods. This information provides a framework within which I interpret the use of plants at each site in subsequent discussions.

In Chapter Eight, I explore the ways in which occupants at each site gathered and processed plant food resources. I then articulate these plant-related activities with other subsistence activities performed at each site, including procurement of animal foods, preparation of hides, and manufacture and maintenance of tools made from bone and stone. In concert, these various strands of artifactual evidence provide a suggestive picture of how early groups used each site.

I expand the focus of the study to the regional level in Chapter Nine. Using field notes of US General Land Office surveyors, I approximate the distribution of local plant communities. Comparing these with broader paleoenvironmental reconstructions, I suggest possible changes in these communities as climate and vegetation change through the Pleistocene/Holocene transition. I then apply central place foraging theory to indicate ways in which early foragers might have exploited both plant and animal resources in the project area and organized their placement of sites with respect to these resources. With this information I develop a model of seasonal rounds that may have been practiced by early foragers in the region. I then compare these theoretical observations with the actual distribution of sites in the project area, as derived from the Alabama State Site File Database, to discuss the larger subsistence strategies and mobility patterns of early hunter-gatherers across the landscape of northwest Alabama.

In Chapter Ten, I review the site-level interpretations in light of the model of seasonal rounds and mobility that I developed in Chapter Nine, and suggest ways in which the model can be tested and further refined. Moreover, I explore the value that this model holds for understanding early foraging lifeways not only at the four rockshelter sites and northwest Alabama, but also the broader southeastern United States.

CHAPTER TWO:

MODELING THE LATE PALEOINDIAN AND EARLY ARCHAIC PERIODS IN THE SOUTHEAST

Over the past 40 years, Southeastern archaeologists have given significant attention to the Late Paleoindian and Early Archaic periods. In part, this attention is due to the fact that these cultural periods are among the earliest for which undisturbed sites are regularly discovered in the Southeast. The contextual data derived from the excavation of these sites provide a framework around which models of early lifeways can be, and have been, constructed.

These models not only describe our understandings of how early hunter-gatherers organized their movements across the landscape and procured food and other resources, but also illustrate developments within the field of archaeology. These developments include the availability of new data, as additional sites have been excavated and information from other fields, such as paleoecology, have come to the attention of archaeologists. Various theoretical approaches have also been introduced to and adopted by archaeologists over time, compelling researchers to highlight different facets of the archaeological record.

In this chapter, I explore several approaches to modeling Late Paleoindian and Early Archaic lifeways. First, I describe how these two periods traditionally have been recognized and defined by archaeologists. I then discuss the development of influential models of these periods and how these models have been revised and refined over the past forty years as archaeologists have employed new ideas and data. I also highlight the categories of data that archaeologists used to formulate these interpretations of early lifeways. I then present the theoretical framework from which I approach this project, namely evolutionary ecology. I detail two topics within evolutionary ecology – the division of labor and central place foraging theory – that I use to address my data and construct a model of early hunter-gatherers in the Middle Tennessee River Valley.

DEFINING THE LATE PALEOINDIAN AND EARLY ARCHAIC PERIODS

Archaeologists differentiate between the Late Paleoindian and Early Archaic periods using a series of diagnostic points. Radiocarbon dates from charcoal associated with points provide a chronological framework for these periods. The decision about which points belong to which period is somewhat arbitrary; as new sites are excavated and new dates procured, the lines between the periods are redrawn. Here I follow the scheme suggested by Sherwood and colleagues (2004) and Anderson and colleagues (1996) (Figure 2.1).

The Late Paleoindian period in the Southeast is associated with relatively standardized lanceolate points found at sites throughout the region. At the early end, these include Quad and Beaver Lake points, which Anderson and colleagues (1996:12) suggest are transitional between the Middle and Late Paleoindian period, while Sherwood and colleagues (2004:544) place them within the Middle Paleoindian period (12,900-12,000 cal B.P.). Dalton points may be considered more representative of the Late Paleoindian period (12,000-11,200 cal B.P.) (Anderson et al. 1996:12; Sherwood et al. 2004:544). However, peoples using Quad/Beaver Lake points and Dalton points exhibit broad similarities in toolkits and in land use of (Sherwood et al. 2004:544; see Chapter Three). In this project, I discuss the two as a unit, but keep in mind that they are not coeval.

The subsequent Early Archaic period (11,200-8,900 cal B.P.) is defined by a succession of side-notched, corner-notched, and bifurcate points that are more regionally distinctive in style (Anderson et al. 1996). The sequence in northern Alabama includes Early Side-Notched or Big Sandy points (11,200-10,500 cal B.P.), Kirk Corner-Notched points (10,500-9,800 cal B.P.) and a variety of bifurcate points, such as LeCroy and Kanawha (9,800-8,600 cal B.P.) (Sherwood et al. 2004:546). A number of stemmed forms, including Kirk Stemmed points, come into use at the close of this period (Anderson et al. 1996:15). At Dust Cave, dates from Kirk Stemmed deposits range

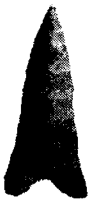
Epoch	Period	Associated Projectile Point Style			
Early Holocene	Early Archaic (11,200-8,900 cal B.P.)	 Early Side-Notched/ Big Sandy (11,200-10,500 cal B.P.)	 Kirk Corner-Notched (10,500-9,800 cal B.P.)	 LeCroy/ Kanawha (9,800-8,600 cal B.P.)	 Kirk Stemmed (8,900-7,800 cal B.P.)
Terminal Pleistocene	Late Paleoindian (12,000-11,200 cal B.P.)	 Quad (12,900-12,000 cal B.P.)	 Beaver Lake (12,900-12,000 cal B.P.)	 Dalton (12,000-11,200 cal B.P.)	

Figure 2.1. Point styles associated with the Late Paleoindian and Early Archaic periods in northwest Alabama (points adapted from Sherwood et al. 2004: Figure 8).

between 10,200 and 7,800 cal B.P.; elsewhere in the Southeast, they generally date between 8,900-8,300 cal B.P. (Sherwood et al. 2004:548).

Based on these diagnostic point sequences and differences between the technologies associated with them, archaeologists have traditionally considered the lifeways of Late Paleoindian and Early Archaic peoples to be distinctly different from each other. They interpreted the relative uniformity of specialized Late Paleoindian toolkits across the Southeast as indicative of greater mobility: highly-mobile hunters require a flexible technology that can be adapted to the task at hand

(Cleland 1976:69; Goodyear 1982:384, 1989:2-4). In addition, Late Paleoindian points tend to be made from high-quality, sometimes non-local stone. The use of non-local stone suggests broad movements and/or trading relationships with neighboring groups (Goodyear 1989; Walthall 1980:35). Researchers have argued that this highly mobile lifestyle was organized around the focal hunting of larger game, such as deer (Caldwell 1958; Cleland 1976; Dragoo 1976). These lanceolate points require a significant investment of time and skill to make. The reasoning follows that the prey felled by these labor-intensive points must have been worth the effort it took to make them; the prey, then, were probably larger in size and significant to Late Paleoindian peoples' subsistence.

In contrast, Early Archaic peoples were thought to have practiced a more generalized subsistence strategy, having adapted to locally available resources over the course of the preceding Paleoindian period (Caldwell 1958). This interpretation of local adaptations is based upon the appearance of regional point styles, suggesting contact with a more limited group of neighbors. The more frequent use of local stone for the manufacture of tools is also interpreted as indicating local adaptations (Anderson and Schuldenrein 1983; Futato 1983). This reorganization from widespread to regionally-defined subsistence strategies was often attributed to the shift from Pleistocene to Holocene climatic and environmental conditions. Significant changes in plant communities presumably led to changes in the game available to hunter-gatherers on a regional level. Local variation in hunting strategies therefore gave rise to regional varieties of stone tools (Cleland 1976; Dragoo 1976).

Indeed, the division between the Late Paleoindian and Early Archaic periods has traditionally been defined as coincident with the Pleistocene/Holocene climatic transition (Anderson et al. 1996:14). This transition is marked by the close of the Younger Dryas event (ca. 12,900-11,650 cal B.P.), the last period of significant cooling (Sherwood et al. 2004:544). More recent radiocarbon dates, as well as calibrations of these dates, indicate that the division between the two cultural periods is not as distinct as once supposed. Dalton materials, dating between 12,000 and 11,200 years ago, span this transition (Sherwood et al. 2004). Furthermore, differences between Late Paleoindian and

Early Archaic subsistence strategies do not appear to be as significant as once thought (e.g. Detwiler 2001; Elston and Zeanah 2002; Renee Walker et al. 2001).

CONSTRUCTING MODELS OF THE LATE PALEOINDIAN AND EARLY ARCHAIC PERIODS

While early work focused on the description of formal attributes of stone tools, particularly diagnostic points, and the construction of cultural trait lists (e.g. Lewis and Kneburg 1959), research on the Late Paleoindian and Early Archaic periods in the 1950s through 1970s focused on developing the chronological sequence of diagnostic artifacts in the Southeast (Anderson and Sassaman 1996; Mason 1962). Archaeologists targeted sites with multiple cultural components, where the stratigraphic context of various points could reveal their relative chronological placement. Much of the early work was conducted at open-air sites, such as the Hardaway site in North Carolina (Coe 1964). Deeply buried components were also excavated at sites in river bottomlands, including the Doerschuk site in North Carolina (Coe 1964), the St. Albans site in West Virginia (Broyles 1971) and the Little Tennessee River sites – namely Icehouse Bottom, Rose Island, Calloway Island, and Bacon Farm – in eastern Tennessee (Chapman 1973, 1975, 1976, 1977, 1978). Excavators also targeted the extensive deposits of rockshelter sites. Among these are Stanfield-Worley Bluff Shelter (DeJarnette et al. 1962) and Russell Cave in Alabama (Griffin 1974), Modoc Shelter in Illinois (Fowler 1959), and Graham Cave (Logan 1952) and Rodgers Shelter (Wood and McMillan 1976) in Missouri (Figure 2.2).

The excavation of deep sites provided not only a sequence of points, but also yielded faunal and plant remains largely absent from shallow open-air sites. Among the deep open-air sites at which organic materials were preserved and recovered are the Koster site in Illinois (Asch et al. 1972; Neusius 1982) and several of the Little Tennessee River sites (Chapman and Shea 1981). Rockshelter sites are particularly known for their remarkable preservation of organic remains. In-depth faunal analyses were conducted at Stanfield-Worley Bluff Shelter (Parmalee 1962) and Russell Cave

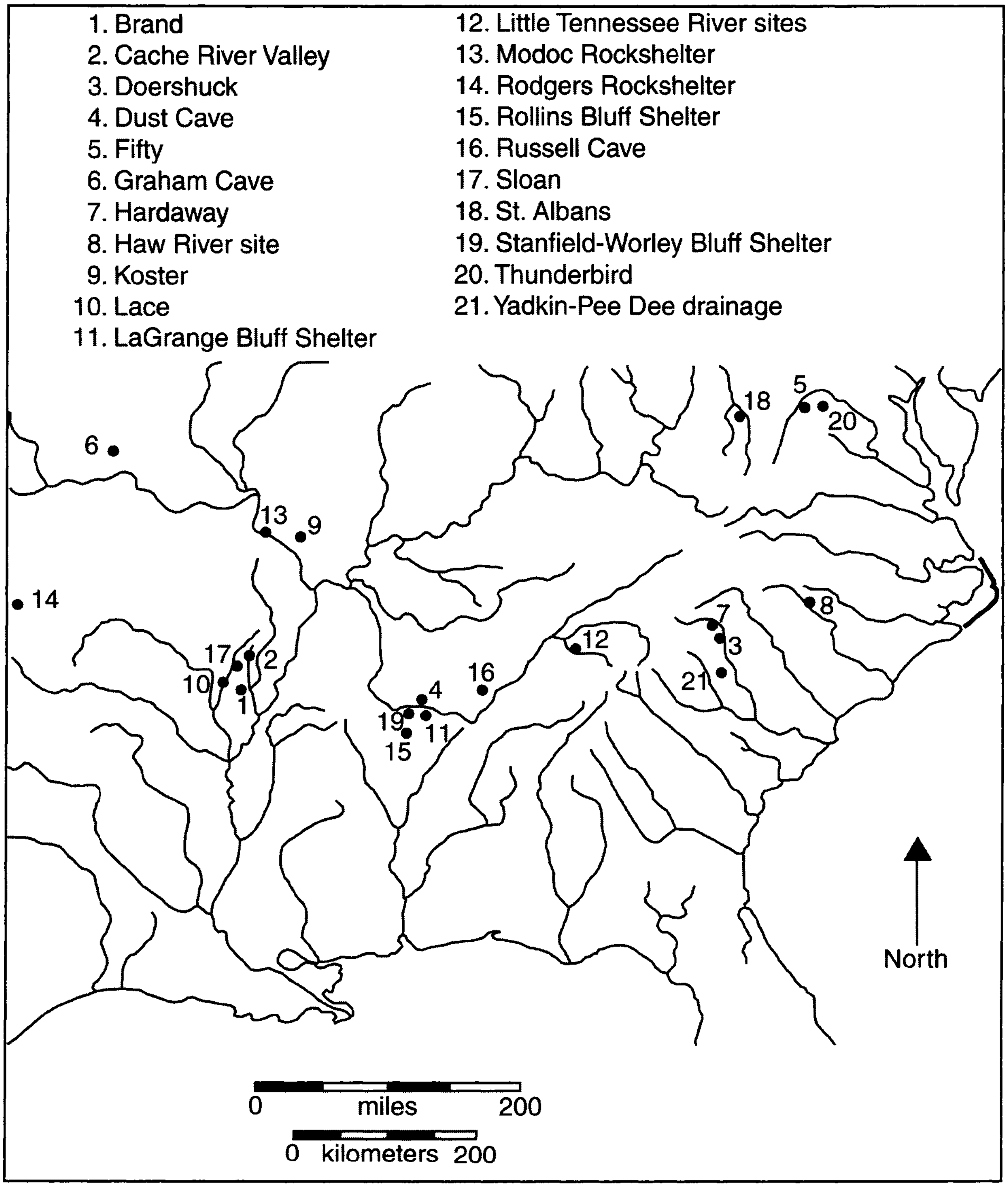


Figure 2.2. Map of Late Paleoindian and Early Archaic sites discussed in text.

(Griffin 1974), Modoc Shelter (Fowler 1959), Graham Cave (Logan 1952), and Rodgers Shelter (Parmalee et al. 1976). The plant assemblage from Rodgers Shelter was also reported in some detail (Parmalee et al. 1976).

With a chronological sequence in place, research efforts turned towards the interpretation of site use and the construction of regional models. These efforts were prompted by a series of advances in theory and supporting evidence. These include the development of middle-range theories in the mid-1970s, the availability of more sophisticated environmental reconstructions in the early 1980s, and the consideration of biocultural needs in the late 1980s. More recent endeavors attempt to refine previous models, as researchers view similar data from slightly different perspectives.

Applying Middle-Range Theories

Once the chronology of individual point styles had been worked out, archaeologists focused their efforts on understanding the nature of toolkits and their relationship to site function. While archaeologists had interpreted the activities occurring on sites from the recovered artifacts for some time, they did not tie these activities into larger subsistence strategies and settlement systems until the 1970s. This trend was spurred by the development of middle-range theories, which used ethnographic and ethnoarchaeological observations to link toolkits and site patterns with settlement and subsistence modes. These theories organized settlement and subsistence strategies along logistical-residential, collecting-foraging, and focal-generalized continua (*sensu* Binford 1979, 1980; Cleland 1976). Following middle-range theory, Binford (1979, 1980) characterized hunter-gatherer societies as *foragers* or *collectors*, which use distinctly different toolkits. *Foraging* groups frequently move their residences to new patches of food as current patches are depleted, while *collecting* groups establish a single home base and launch logistical forays to gather resources from distant patches. *Foragers* with high residential mobility should use and discard more generalized, expedient tools, made on the spot as needs arise. *Collectors* with logistical mobility should have more specialized tools, designated for particular tasks, that are highly curated. In addition, markedly different toolkits should be found at the home bases and logistical camps of *collectors*, due to the different range of activities undertaken at each site.

Using these middle-range theories, archaeologists ideally could interpret whether a site was used logistically or residentially, by *collectors* or *foragers*, based upon the nature and function of the artifact assemblage. An example of such a site-level approach is the study of the Brand site in Arkansas, where Goodyear (1974) used the diversity and spatial arrangement of the stone toolkit to argue that the site served as a hunting and butchering camp for a group of hunters.

A distinct advantage of these middle-range theories was that they simultaneously determined the probable functions of individual sites and placed them within the context of larger settlement systems, thus encouraging a regional perspective. Attempts to develop regional models of settlement and subsistence were further bolstered by large-scale survey and excavation projects, including those prompted by cultural resource management legislation. These projects facilitated the identification and exploration of multiple sites on a regional level. Examples include surveys and excavation of sites on Crowley's Ridge (Morse 1973, 1975a, 1975b) and in the Cache River Valley (Price and Krakker 1975) in northeastern Arkansas; the Little Tennessee River Valley in eastern Tennessee (Chapman 1973, 1975, 1976, 1977, 1978); and the Flint Run complex in Virginia (W. Gardner 1974, 1977).

Dan Morse developed one of the earliest settlement models, detailing the Dalton occupation of Crowley's Ridge in northeastern Arkansas. Based upon a broad survey combined with excavation of several key sites, including Lace (Redfield and Moselage 1970), Brand (Goodyear 1974; Morse 1973, 1975b), and Sloan (Morse 1975b, 1997b), Morse linked interpretations of stone tool clusters and densities, stone tool function, and environmental richness to understandings of hunter-gatherer lifeways. He suggested that bands organized their subsistence activities within the confines of watersheds, which provided an abundance of resources. Groups established base camps, like the Lace site, from which they set out on logistical forays to hunt, gather, and visit quarry and cemetery sites (Morse 1975a, 1975b, 1997a, 1997b; Morse and Morse 1983).

Using similar artifact data from Crowley's Ridge and the Cache River basin, Michael Schiffer (1975) developed a contrasting model for the region, suggesting instead that band territories crosscut river basins. He further contended that group mobility varied seasonally. Summer campsites were moved frequently, while during winter and early spring people established base camps near rivers, where resources were comparatively plentiful. Sites with high artifact densities such as Lace (Redfield and Moselage 1970) should therefore represent winter/spring camps, or summer campsites that were repeatedly revisited.

Rather than orient group movements to watersheds, William Gardner (1974, 1977, 1983) tethered settlement patterns in the Shenandoah Valley of Virginia to stone tool resources. He defined several site types in the Flint Run complex, including quarries, reduction stations, base camps, and hunting sites. These site types were based on the spatial relationship between local jasper outcrops and sites with extensive lithic assemblages, such as Thunderbird and Fifty, which Gardner included among base camps and quarries. He classed other sites with low artifact densities as reduction stations and hunting sites. Gardner (1974, 1977, 1983) hypothesized that movement between base camps, quarries, and hunting sites was directed by the need to periodically replenish toolkits.

Considering Environmental Impact

As more detailed environmental reconstructions became available in the 1980s (e.g., H. Delcourt and Delcourt 1985; P. Delcourt and Delcourt 1981; Watts 1980; Watts and Stuiver 1980), researchers began to incorporate climatic shifts and local environmental conditions in their models of Paleoindian and Early Archaic lifeways. For example, Claggett and Cable's (1982) model of effective temperature and technological organization drew on paleoclimatic reconstructions as well as cross-cultural surveys linking hunter-gatherer subsistence strategies with environmental indicators. They postulated that residential mobility should increase with the warming trend at the transition from the Late Pleistocene to the Early Holocene, in conjunction with a shift from boreal spruce to more productive oak-hickory forests. This accounted for the shift to a more expedient toolkit at the Haw River site in the Early Archaic than was used in the Late Paleoindian period.

Meltzer and Smith (1986) built their argument around environmental reconstructions, noting that although ecological communities in the Southeast were rapidly changing during the last several millennia of the Pleistocene, the habitats associated with this change were highly complex, diverse, and species-rich. They argued that such conditions favored generalized foraging rather than focal collecting strategies, not only in the Early Archaic but also throughout the Paleoindian period. They interpreted stone tool assemblages in the Southeast as relatively expedient in nature, particularly compared to highly curated assemblages from the Northeast, where Paleoindians appear to have focally exploited caribou herds.

Regarding Biocultural Needs

In the late 1980s and 1990s, researchers joined the above considerations of environment and technological organization with explicit concern for biocultural needs and demographic structures. Group mobility and territorial organization were viewed not only in light of resource distribution, but also with respect to the exchange of ideas, information, raw materials, and mates in regions with relatively low population densities (Anderson 1995).

A prime example is Anderson and Hanson's (1988) band-macroband model for the South Atlantic Coast. Addressing band-level subsistence strategies as well as social and biological needs for macroband aggregations, they postulated that territories coincided with river drainages, within which seasonal movements took place. During winter, bands established base camps in the more hospitable coastal plain, from which logistical forays were launched. These camps dispersed into the highly productive region above the Fall Line during spring and summer. Several bands from neighboring drainages aggregated in autumn at sites along the Fall Line, taking advantage of abundant nuts, seeds, and rutting deer. These meetings were opportunities to exchange raw materials, share information and technology, and find potential mates. In addition to minimum population estimates necessary to sustain bands and macrobands, Anderson and Hanson (1988) relied on reconstructions of regional environmental structures, as well as patterns of stone tool assemblages and raw material use along and across drainages, to support their model.

Revisiting and Refining Models

Recent models of Late Paleoindian and Early Archaic settlement and subsistence strategies largely constitute further refinements of existing models. Cable (1996) revisits the Haw River data (Claggett and Cable 1982) and reinterprets the Late Paleoindian occupation as a field camp, rather than a base camp, within a logistical system that may be seasonally limited. He proposes that while groups likely behaved as collectors during the winter, targeting deer in particular, they may have adopted more generalized strategies during the warm season. These generalized strategies may then have been employed throughout the year as winters began to warm during the Early Holocene. Walthall (1998b) argues that winter base camps, posited in models such as Anderson and Hanson's (1988) and Schiffer's (1975), could not have been supported by the meager food resources available during the winter. Instead, he uses several ethnographic examples to suggest that after aggregating with other bands during autumn, early prehistoric groups dispersed into the uplands to hunt deer and turkeys that were subsisting on the remaining mast resources. Daniel (1998, 2001) objects more broadly to the river-basin focus of seasonal rounds, particularly those hypothesized by Anderson and Hanson (1988). Examining patterns of raw material frequency across the Carolina piedmont and along Yadkin-Pee Dee drainage, he argues that band territories were organized around the distribution of raw materials used to make stone tools, crosscutting – rather than being defined by – river drainages.

Modeling Rockshelter Use

Because the data I use in this project derive from rockshelter sites, it is worthwhile to briefly consider their place within existing models of early Southeastern lifeways. While data from rockshelter sites have been used to inform the subsistence bases discussed in these models, rockshelters themselves are often not expressly included as site types within the proposed settlement systems. In part, this is due to the fact that rockshelters are not common landscape features in some of the regions for which models have been developed, particularly the Atlantic Coast. Notably, Walthall (1998a) does specifically address the use of rockshelters by Dalton peoples. Fitting these sites into his overwinter model, he suggests that hunting parties and family groups used rockshelters during their dispersal into the uplands from late autumn through winter (Walthall 1998a:232-4). However, Walthall uses little faunal or botanical evidence to support this claim, relying instead on ethnographic patterns of winter dispersion. Rockshelter sites, in both upland and riverine locales, and the faunal and botanical data recovered from them, have yet to be fully considered within models of regional subsistence and settlement systems.

Summary

The overarching trends in the construction of models for Late Paleoindian and Early Archaic lifeways in the last 40 years demonstrate a broadening in both data and the theoretical arguments used to underpin these models. Archaeologists began to apply ethnographically- and ethnoarchaeologically-informed middle-range theory to the considerable data, particularly in the form of stone tools and debitage, derived from excavation and regional surveys in the 1960s and 1970s. A more explicit concern with ecological arguments developed as more detailed environmental reconstructions became available in the 1980s. Thereafter, researchers began to consider various resources, including biocultural, faunal, and tool-stone resources, in further detail. Thus, beginning with an assumption of seasonal rounds as noted among modern hunting and gathering groups, Southeastern archaeologists have used stone tool data, raw material distribution, animal behaviors, and demographic patterns to direct Late Paleoindian and Early Archaic peoples' seasonal movements.

FRAMING A MODEL FOR THE MIDDLE TENNESSEE RIVER VALLEY

This project extends the above trends in modeling the Late Paleoindian and Early Archaic periods. I add to the list of resources considered by these models of subsistence strategies and settlement patterns by incorporating plant resources. Although plant remains are largely absent from most early sites due to poor preservation, activities associated with the gathering of plant foods are key to understanding the lifeways of early peoples in the Southeast.

I approach the modeling of settlement and subsistence strategies from the perspective of evolutionary ecology. Use of this theoretical perspective is certainly not new to Southeastern archaeology; indeed, strands of evolutionary ecology appear in the models constructed by Meltzer and Smith (1986) and Cable (1996). However, I apply two approaches within evolutionary ecology – the division of labor and central place foraging theory – that have yet to be fully considered for Southeastern Paleoindian and Early Archaic peoples. Below I discuss the basic assumptions of evolutionary ecology, its value to archaeological research, and the manner in which I will employ theories regarding the division of labor and central place foraging in my study. Please note as well that in the following discussion, as well as the remainder of this study, I use "foraging" in the broadest sense of the term, rather than Binford's (1979, 1980) more narrow definition.

Evolutionary Ecology

Evolutionary ecology approaches the study of human behaviors from the standpoint of Neo-Darwinian theory, asserting that natural selection affects the occurrence of particular behaviors. Of the available behaviors from which individuals can choose, those that provide individuals with an advantage in survival and sexual reproduction are "selected," or passed on to subsequent generations at higher rates than other behaviors (Kelly 1995:52; Smith and Winterhalder 1992; Winterhalder 1981:16). While these behaviors must be passed from parent to offspring for natural selection to operate, the mode of transmission need not be genetic: children may learn these behaviors through enculturation (Bettinger 1991:154, Kelly 1995:52), whether consciously or subconsciously (Winterhalder 1981:16).

Stated succinctly, evolutionary ecologists assume (1) that individuals make decisions (2) that maximize their ability to survive and raise offspring (3) within particular contexts (Bettinger 1991; Kelly 1995; Smith and Winterhalder 1992; Winterhalder and Smith 1992). I discuss each of these points in further detail below.

First, individuals make decisions to exhibit particular behaviors. This reflects not only that an individual must decide between a number of possible behaviors, but also the fact that variation among behaviors is necessary for natural selection to take place. It also highlights the individual as the basic unit of analysis in evolutionary ecology. This is important in part because fitness, or survival and sexual reproduction, is measured at the level of the individual. Furthermore, the actions and goals of individuals are held to be key to understanding social and ecological processes, an assumption termed "methodological individualism" (Smith 1988:225). Because "properties of groups ... are a result of the actions of its individual members" (Smith and Winterhalder 1992:39), the individual should be prominent in analyses of these groups.

Second, individuals act as if they exercise rational choice in deciding which behavior(s) to adopt, such that they optimize their fitness, or ability to survive and produce viable offspring (Smith and Winterhalder 1992:45). Individuals must therefore evaluate various behaviors, and choose the one with the highest payoffs (Kelly 1995:52). Of course, fitness is difficult for researchers to measure, much less for individuals. Various proxy currencies are therefore used, which may either be maximized or minimized by individuals. For example, individuals may aim to maximize net energy returns from their food-getting pursuits, or maximize social capital from sharing foods. Conversely, they may strive to minimize the risk of being without food during lean times by storing or sharing foods, or minimize time spent foraging in order to have more time for other activities (Kelly 1995; Smith 1988; Smith and Winterhalder 1992:51). Individuals need not perform lengthy calculations to decide which behavior, among those available, provides the highest payoff. Instead, individuals probably learn rules of thumb that assist in such decision-making (Kaplan and Hill 1992; Mithen 1989).

Third, the context within which these decisions are made is key. Natural selection is context-specific: particular behaviors are adaptive only in particular contexts (Kelly 1995; Smith and Winterhalder 1992; Winterhalder and Smith 1992). Stockpiling meat for future use is adaptive in arctic climates, but not in tropical ones where the meat would spoil quickly. Context includes more than local climate and physical environment, however. The social environment also plays a prominent role, and may include interactions with neighbors, the perceived value of resources, and cultural prescriptions (Smith and Winterhalder 1992). Evolutionary ecologists also recognize that individuals impact and influence their physical surroundings, for example by affecting prey populations (Belovsky 1988; FitzGibbon 1998), encouraging growth of particular plant species (Winterhalder and Goland 1993, 1997), and adopting new technologies (Winterhalder 1981). These change the payoffs of various behaviors, particularly interactions with animals, plants, and the landscape.

In order to understand how individuals make these decisions, evolutionary ecologists employ models as heuristic devices, simplifying complex processes in order to better define the problem, understand the data, test that understanding, and make further predictions (Winterhalder 2002; Winterhalder and Smith 1992:13). Models of adaptive strategies typically take the form of cost-benefit analyses using microeconomic models and detailed studies of available resources (Hames and Vickers 1982, Hawkes et al. 1982). These are often presented as mathematical algorithms. Models may also employ game theory analysis to understand the dynamics of interactions between individuals and groups (Smith 1988; Smith and Winterhalder 1992). It should be stressed that models are considered heuristic: they are not presumed to include all possible behaviors or incorporate all possible social and physical constraints. Instead, they highlight a subset of these and suggest whether they are salient to the question at hand.

Among the behaviors, choices, and interactions modeled within evolutionary ecology, those associated with some economic choice or outcome are most commonly used within archaeology. These unquestionably have a social aspect as well, as economic choices are made within and shape social contexts. Some of the common topics addressed by these models include foraging strategies, such as the choice of food items as well as of resource patches (e.g. Belovsky 1988; Stiner et al. 2000); the placement of camp sites and decisions about the transport of goods to those sites (e.g. Gremillion 2006; Jones and Madsen 1989; Zeanah 2000), as well as decisions to move camp sites (e.g. Kelly 1997; Kelly and Todd 1988; Surovell 2000); the sharing of resources to reduce the risk of being without such resources at a later date (Winterhalder 1990); the division of labor by gender and age (e.g. Elston and Zeanah 2002); and the decision to tend gardens or animals rather than, or in addition to, hunting and gathering wild resources (e.g. Winterhalder and Goland 1993, 1997). This list is by no means exhaustive, but suggests the range of subjects tackled by evolutionary ecology that may be of use to archaeologists.

Models from evolutionary ecology are not always easily adapted to archaeological problems, however. Many of the algorithmic equations require detailed information, typically regarding the nature of resources, that is simply not available in most archaeological situations. This is particularly true of the Paleoindian and Early Archaic periods. Fine-grained reconstructions of local environments are not available for most regions. Even if organic remains are preserved, recovery biases are such that the full range of plant and animal resources used by a group cannot be known with certainty. Strict hypothesis testing thus is often not feasible.

While detailed modeling is not always possible, evolutionary ecology still provides valuable insights for archaeologists. Although the models may not be useful for directly evaluating and testing some types of archaeological data against expectations, they aid in interpretation of the data or recommend ways in which the data might be organized (Winterhalder 2002). They can provide an interpretive framework from which the data may be viewed. Perhaps the most significant manner in which these models facilitate interpretation is by encouraging researchers to perceive the archaeological record as the result of the decisions of individuals, who are gendered and have agency. This focus on the decisions of individuals further widens the application of ethnographic analogy within archaeology (O'Connell 1995). The salient points of comparison between ethnographic and archaeological peoples become the decisions they face rather than similar technologies, subsistence strategies, and environments.

In this project, I use models developed within evolutionary ecology both to test my data and to provide an interpretive framework. I directly apply a model of central place foraging to explore why people occupied the four rockshelter sites, how they may have organized their movements between these and other open-air sites through the seasons of a year, and how gathering may have influenced these movements and occupations. I also use models of the division of labor to shape my discussion of gathering, although I do not employ specific models for this purpose. I discuss the two in turn below, beginning with the division of labor.

The Division of Labor

Ethnographic and historic accounts of hunter-gatherer groups consistently note a gendered division of labor, which in its simplest form equates gathering with women and hunting with men. More nuanced discussions broaden these categories, observing that women primarily target resources that may have higher processing costs and lower energy return rates but are relatively stable and reliable. Examples include plant foods, shellfish, and smaller animals. Men, on the other hand, generally pursue larger prey with lower processing costs that yield higher energy return rates, but whose capture is much more unpredictable (Bird 1999; Hawkes 1996; Panter-Brick 2002). Just as important as the consistency with which it is observed is the considerable flexibility in the division of labor, within as well as between various foraging societies (Kelly 1995; Panter-Brick 2002). Among some groups, women join men on hunting forays or hunt large animals themselves, although with different tools (Panter-Brick 2002). Men may also hunt smaller animals, fish, collect honey, and gather plant foods (Hawkes 1993, 1996; Robert Walker et al. 2002). However, the general pattern of a sexual division of labor describes the majority of men's and women's activities both within and across groups.

The larger question is why this general pattern is so consistent across foraging societies. Evolutionary ecologists largely address this question from two different perspectives (Bird 1999): a conflict model, which stresses the differences in reproductive success of women and men; and a complementarity model, which highlights the interdependence of men and women due to their different life histories. I discuss the two approaches below, and note that while they provide distinctly different explanations, both position the development of the division of labor in the evolutionary history of human primates.

Conflict Model. The conflict model relates the division of labor to differences in the reproductive strategies of men and women. A woman's reproductive success is limited by the number of children she can bear and raise to reproductive age. In contrast, a man's reproductive success is limited by his mating opportunities: he can father many more children over his reproductive span than a woman can bear. Men and women thus face different incentives. It is in a woman's best interest to invest in the well-being of her children, and her children's offspring, while a man's best strategy is to foster relationships that improve his opportunities to mate (Hawkes 1993:350, 1996).

Women can promote the well-being of their children through attentive care-giving, to reduce children's exposure to danger, as well as by ensuring that they have adequate nutrition. Neither children nor pregnant or lactating mothers can go without food for long without incurring significant negative health effects. As such, we should expect mothers to target resources that are stable and predictable, such as plant foods and shellfish. Returns from hunting larger game, on the other hand, are generally much less reliable; even skilled hunters can go days or weeks without success (Bird 1999; Hawkes 1996).

Women face a tradeoff between childcare and foraging to feed children, and must weigh the benefits and costs of the two (Hawkes 1996). During seasons when foraging is more productive and/or danger to children from pests is lower (so that mothers need not be overly attentive), women spend more time foraging (Bird 1999:69; Hawkes 1996). Mothers may also decide to take children with them to pick berries or leave them at home to process nuts, depending on which option yields the higher return rate (Hawkes 1996:291). Importantly, women do not seem to choose between childcare and hunting. Not only do women in some societies hunt with nursing infants strapped to their backs (Kelly 1995:268), but post-reproductive women do not hunt more frequently than younger women (Bird 1999:70). In addition, women who can leave their children at camp with older siblings, relatives, or other caretakers do not necessarily hunt more often (Bird 1999:70; cf. Kelly 1995:268). Instead, hunting by women seems to be related to local resource structures: women are more likely to hunt in areas where it provides a relatively predictable food supply (Bird 1999; Panter-Brick 2002). Indeed, women primarily hunt opportunistically, when they encounter small game while out gathering (Kelly 1995:267). Agta women, who are renowned for the frequency at which they hunt, use additional strategies, such as training and employing hunting dogs, that significantly improve their success rates compared to men (31% versus 17%) (Kelly 1995:268). The factor that best explains women's hunting appears to be whether they can reliably feed their children by engaging in it.

Men, on the other hand, do not appear to be as concerned with predictable resources. Although they could feed their children more reliably by gathering and collecting food resources (Hawkes 1993:344), men instead generally choose to hunt larger animals. As noted above, returns from hunting larger game are highly variable. Even when hunters do return to camp with a successful kill, the carcass is often divided up among numerous families within the camp, so that the hunter's family does not gain any greater benefit from the meat itself. This community-wide sharing, which is observed in a number of modern hunter-gatherer groups (Kelly 1995), does not seem to reflect a direct investment by the hunter in the success of his children. Instead, hunters apparently gain social standing by felling and sharing larger prey (Bird 1999; Hawkes 1996). While increased social standing may garner better treatment for hunters' children from the community, this benefit may be incidental. Rather than provisioning their children, hunters appear to be strengthening social alliances through sharing meat; these social ties may lead to greater mating opportunities (Bird 1999; Hawkes 1993:349, 1996:297). This strategy promotes men's reproductive success, which is limited by mating opportunities.

Complementarity Model. The complementarity model approaches the division of labor from a different perspective, comparing the life histories of men and women rather than reproductive strategies. The main premise of the model is that hunting, particularly of larger animals, requires a significant learning investment in order for a hunter to be proficient. Observations of modern hunters support this: while adult humans reach their peak strength in their early twenties, hunters do not achieve their peak hunting returns until around the age of 35. This lag suggests that skill, gained only through frequent – if not daily – practice, is a significant component of hunting success (Kaplan et al. 2000, 2001).

Women simply may not have the time to invest in such practice. Assuming that women who are more than six months pregnant or nursing cannot go on hunting forays, a woman can only devote one-fourth of her reproductive life to hunting (Kaplan et al. 2001:306). Without the extended skill investment, hunting of larger game is not profitable for women, especially when compared to gathering. Men, on the other hand, unencumbered by pregnancy and lactation, are able to invest this time and eventually profitably hunt larger game at a high return rate. Presumably the decision to make such an investment is largely subconscious and highly enculturated. The nutritionally valuable meat they provide thus complements the plant foods that women gather. Furthermore, with these large packages of food provided by men, women in turn can spend more time caring for children. This cooperation between fathers and mothers leads to better outcomes for their children, and should therefore be favored by natural selection (Kaplan et al. 2001).

Comparing the Models. There are several important differences between the two models, beyond life histories and reproductive strategies. Perhaps most importantly, they differ as to which parent provides the bulk of food for children. The conflict model asserts that women provide the majority of food opportunities for their children, whether through their own efforts or by bringing children with them on gathering forays so that children can gather food for themselves as well (Hawkes 1996). Men provide meat less frequently, but their own children do not appear to consume any more meat than other families with whom the kill is shared (Hawkes 1993, 1996). This is in stark contrast with the complementarity model, in which fathers purportedly supply children with 97% of their caloric intake. Kaplan and colleagues (2001:308) arrive at this number by averaging the productivity of men and women in ten ethnographically-observed foraging societies (Kaplan et al. 2000: Table 2). The authors note that men provide an average of 68% of calories while women provide 32%. Assuming that women consume 31% of all calories, men 39%, and children 31%, they conclude that women only produce 1% more than they consume. Men, on the other hand, provide 29% more calories than they consume; these leftovers apparently comprise children's diets.

These calculations are problematic on several levels. First, they assume that children do not obtain any food for themselves. While it may be true that on average children forage at significantly lower rates than adults (Kaplan et al. 2000:160), they do acquire some food for themselves, of which Kaplan and colleagues (2000:168-169) provide several examples. Accordingly, a mother may choose gathering tasks that do not maximize her efforts alone, but those of her "team," which includes her children. For example, she may take her children with her to pick berries because they can do so at a relatively efficient rate, even though the berry patch is at some distance (Hawkes 1996). Perhaps more importantly, however, the calculations do not take into account the periodicity in returns of men's and women's food-getting efforts. While men may indeed on average provide more calories than women, these calories come in large packages (carcasses) that may be obtained only once a week or even once a month, and may not necessarily be storable. Of course periodicity may also be avoided by sharing, which Kaplan and colleagues (2000, 2001) assert does not significantly detract from the amount of meat available to a hunter's family. Instead, they suggest that hunters retain some control over the distribution of meat from their kills, and that they share only with those who will reciprocate. Reciprocal sharing would alleviate the periodicity of hunting and provide a more regular supply of meat to a group of families. Such a scenario is tenable as long as free-riding could be prevented, which is debatable (Bird 1999; Hawkes 1993).

Two additional points of difference follow from the first. Fathers are thought to invest significantly more energy in parenting, as suggested by the amount of food they provision to children, in the complementarity model (Kaplan et al. 2000, 2001). In contrast, men invest in parenting in the conflict model only if it coincides with strategies that increase their mating success (Bird 1999; Hawkes 1996). The roles of relatives other than fathers and mothers also differ between the two, beyond just the active foraging of children mentioned above. The availability of alternative care-takers, such as older siblings, other mothers, and grandmothers, significantly affects the foraging decisions of mothers in the conflict model. Grandmothers may also provision their grandchildren, thus furthering their own reproductive success (Hawkes 1996:292-3). In the complementarity model, however, it appears that only the families with whom hunters reciprocate play a significant role in food provisioning other than the father and mother (Kaplan et al. 2000:178-9).

Finally, the two models differ in their approach to hunting by women. The complementarity model persuasively argues that women do not hunt large game because they cannot invest the time to become efficient at it. But it does not address the fact that women do hunt with some regularity, sometimes alongside men (Bird 1999; Panter-Brick 2002:631). Women such as the Agta apparently should not be hunting with infants strapped to their backs, but instead should be home nursing. The conflict model does allow for hunting by women, particularly when the risk of being unsuccessful is relatively low (Kelly 1995; Panter-Brick 2002).

Despite the differences between the two models, both place the biological differences between women and men at the base of the division of labor. The conflict model ties the division of labor to differences in reproductive success of men and women, and the complementarity model to differences in their reproductive lives. As such, both models incorporate the division of labor in the evolutionary history of humans.[1] This explains why a sexual division of labor is widely observed among modern foraging societies: not only do they presumably share a common ancestor, but also the same reproductive strategies, as do all modern humans.

If this is the case, then it should be reasonable to assume that Paleoindian and Archaic foraging groups also practiced a sexual division of labor. However, we must also assume that this division of labor was highly flexible in the past, as it is today. Women likely targeted stable, predictable resources, including shellfish, fish, and smaller game in addition to plant foods. These resources may differ significantly in different ecological settings and different seasons (Panter-Brick 2002:633, 638). Men also probably gathered plant foods, not only for their own consumption while on forays, but also for their families. In general, however, women probably performed the majority of gathering activities, as well as activities associated with processing and preparing both plant and animal foods, while men likely performed the majority of hunting activities, as well as specialized tool production.

Because the archaeological record is an accumulation of patterned behavior (Yarnell 1982), and because the general pattern among human foraging societies is that women gather and men hunt, it is reasonable to assume that women are responsible for the majority of gathered resources recovered from the occupation sites of foraging groups. In particular, women likely performed the majority of tasks associated with gathered plant foods, including monitoring, harvesting, and processing them.

I do not directly apply either the conflict or complementarity model to the data I analyze in this project. Instead, I draw from the models' similarities, which pose different foraging decisions for

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[1] The division of labor may be a (perhaps relatively modern) social construct, in which men appropriate hunting and the value associated with it in order to secure higher stature within the group. This explains why women do not hunt and refer to hunting as men's work, even though they can and do hunt themselves (Brightman 1996). But it does not explain why men choose hunting rather than gathering; it is possible that plant foods could have been culturally defined as more valuable than meat. Neither does it explain the universality of the division of labor observed among hunter-gatherer societies.

women and men based upon their reproductive differences. As fully modern humans, Paleoindian and Archaic men and women faced similar decisions. I use this assumption to shape my interpretation of the plant remains from the four rockshelter sites examined in this project, suggesting that they derive primarily from the efforts of women, children, and the elderly.

Central Place Foraging Theory

Of the numerous working theories in evolutionary ecology, central place foraging (hereafter CPF) is the most applicable to concerns of mobility and settlement patterns. This theory assumes that foragers return to a central place with the food they capture or collect, and that they attempt to maximize the rate of delivery of energy to that central place (Orians and Pearson 1979). In other words, individuals attempt to bring back to camp as large a quantity of energy (food) as possible while expending as little energy as possible in travel and transport. From these assumptions, CPF theory attempts to derive and test predictions regarding how far foragers will travel from their base camps in order to pursue food items (Gremillion 2006; Jones and Madsen 1989), or where foragers should locate their camps relative to the distribution of available resources (Orians and Pearson 1979; Zeanah 2000).

The theoretical answer to the latter is that central places should be situated such that travel time *to* and transport costs *from* foraging patches is minimized, with the result that central places are located at the "center of gravity" of food distribution (Orians and Pearson 1979; Zeanah 2000). How far foragers travel from these central places depends on the resource being targeted, and whether the benefits gained from the resource are greater than the costs of obtaining it. As such, foragers will travel much farther distances to pursue resources with high return rates, such as large mammals. The benefits, whether measured in terms of calories or in the prestige associated with sharing the meat with one's neighbors, outweigh the costs of travel in search of and transport back to camp with the prey. Accordingly, the distance traveled to obtain items with lower return rates, such as plant foods, should be considerably less (Jones and Madsen 1989; Kelly 1995:141; Orians and Pearson 1979).

The net foraging return rate, or benefits minus the costs, of obtaining various resources and bringing them back to a central place can be calculated with the following equation (after Gremillion 2006):

$$r = \frac{e_{\mathrm{obt}} - e_{\mathrm{exp}}}{t}$$

where

r is return rate (kcal per hr)

e_{obt} is energy obtained per load (kcal)

e_{exp} is energy expended in procuring one load of the resource (kcal)

and t is time spent procuring one load (hr).

While the energy obtained per load can be readily determined from the caloric content of various foodstuffs, the energy expended in obtaining one load has several components. These include the energy used to walk to the patch where the resource can be found; energy used to harvest the resource (commonly referred to as handling costs); and energy used to carry the load back to camp. Similarly, time includes that spent traveling to and from camp, as well as spent harvesting (or handling) the resource. Including these components, the equation becomes (after Zeanah 2000: Table 1.4):

$$r = \frac{e_{\mathrm{obt}} - \left[H_t * H_c + \left(\sum_{s=1}^{n} D_s * W_s \right) + \left(\sum_{f=1}^{n} D_f * L * U_f \right) \right]}{H_t + \dfrac{\sum_{s=1}^{n} D_s}{V}}$$

where

H_t is handling time per load (hr)

H_c is handling costs per load (kcal/hr)

D_s is distance of slope s traveled to and from the nearest patch of the resource (km)

W_s is cost of walking across slope s (kcal/km)

D_f is distance of slope f from the nearest patch of the resource to camp (km)

L is weight of one load of the resource (kg)

U_f is cost of carrying one load across slope f (kcal/kg/km)

and V is walking speed (km/hr).

The equation can then be used to compare the return rates that various resources afford foraging groups, given the distribution of resource patches relative to campsites. Gremillion (2006) uses such an equation to compare the return rates of both wild and domesticate sumpweed and chenopod in floodplain and hillside settings, to explore the range of options available to occupants of rockshelters in Kentucky. Comparing the return rates of mountain sheep and tansy mustard seeds, Zeanah (2000) demonstrates that the seasonal availability of resources can significantly influence the placement of base camps in the Great Basin. When mountain sheep are readily available, base camps should be located in the uplands, but when these highly-ranked resources are scarce, foragers should shift camps to the lowlands to be nearer to resources like tansy mustard with lower return rates. The equation can also be employed to determine the distance of travel at which the energy spent procuring a particular resource is greater than that provided by the resource (Jones and Madsen 1989). Additionally, the benefits of processing items in the field can be weighed. While the energy obtained per load increases with the removal of low-utility parts (such as nutshells), the handling time and costs increase as well. Metcalfe and Barlow (1992) discuss the value of such an application in understanding field processing and transport of tool stone and carcass elements, as well as nuts. Bettinger and colleagues (1997) examine the payoffs of processing acorn, as well as mussels, in the field versus at camp.

In keeping with central place foraging theory, I contend that Late Paleoindian and Early Archaic foragers located their base camps near important resources. Because foragers are less likely to travel long distances to obtain items with lower return rates, I expect that camps should be located nearer to these resources, such as plants and mussels, as long as they are sufficiently abundant in the landscape and critical to foragers' diets. While gathered resources tend to provide less energy per load than larger mammal resources, they are more predictable in time and space.[2] This reduces search times, and therefore increases their relative return rate during seasons of availability. I suggest that site locations and mobility patterns are organized around the seasonal and spatial availability of plant foods and other gathered resources. More specifically, I hypothesize that early foragers chose their base camps so that they could exploit gathered foods residentially, while they exploited other resources, both animal and raw materials, logistically.

In this project, I use the equation defined above to explore the influence of various resources, particularly plant foods but also animal and tool stone resources, on the choice of campsites. Similar to Zeanah (2000), I evaluate how the distribution of resources in space and time affects the payoffs of using such resources. The caloric content of various foodstuffs can be obtained from US Department of Agriculture compilations (e.g. Kuhnlein and Turner 1991; US Department of Agriculture, Nutrient Data Laboratory [USDA NDL] 2004), and the handling time and costs of most resources can be estimated from a number of experimental studies (e.g. Munson 1984). With the aid of a geographic information system, I map not only the rockshelter sites, but also an approximation of resource patches. I develop a map of resource distribution, using field notes from the early-19th-century Government Land Office surveys of the project area that identify witness trees to tentatively reconstruct local habitats in the region. With slopes derived from a digital elevation model using geographic information system (GIS) software, I employ the above equation to model the costs of traversing the landscape, in search of and burdened by these various resources. By comparing these costs, I explore how these resources influence site choice in the region.

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[2] As noted in the previous section, the predictability of gathered foods is what makes them particularly attractive to women, who need reliable sources of food for themselves and their children.

SUMMARY

Models of Late Paleoindian and Early Archaic bands in the Southeast have grown increasingly sophisticated over the past 40 years, incorporating middle range theories, environmental reconstructions, and considerations of biological needs. Current models nevertheless center the mobility and subsistence strategies of these groups around hunting and stone-tool procurement. The impact of gathering – typically the work of women, children, and the elderly – on such strategies has yet to be carefully examined.

With this project, I expressly consider gathering in a model of early foraging in the Middle Tennessee Valley. I approach modeling from the perspective of evolutionary ecology. Namely, I employ central place foraging theory to structure mobility patterns to test the hypothesis that foraging groups situated their camps to be nearer to available plant foods than animal or stone tool resources. Furthermore, I assume that these early groups practiced a gendered division of labor, common to historic and ethnographic foraging societies, in which women, children, and the elderly generally performed tasks associated with gathering plant foods. Thus the subsistence activities of women, children, and the elderly may have been important factors shaping site location and movement across the landscape.

CHAPTER THREE:
THE LANDSCAPE OF THE MIDDLE TENNESSEE RIVER VALLEY

Encompassing a region where the Tennessee River receives tributaries that drain three distinct physiographic regions, the northwest corner of Alabama claims a rich and varied environment. This landscape supports a wide variety of aquatic and terrestrial animals, supplied by a range of plant communities. Combined with high-quality stone resources, the region had much to offer its early occupants. The regional landscape should not be seen as static, however, particularly not over the span between roughly 13,000 and 8,000 years ago with which I am concerned. First, dramatic changes associated with the transition from glacial to post-glacial climates affected not only the local climate but also the composition of local plant and animal communities. Second, the actions of early foraging groups also certainly shaped the landscape, as they hunted animal populations, gathered plant resources, and quarried stone in the region beginning over 13,000 years ago.

In this chapter, I describe the physical setting of the research area, including the local geology and recent flora and fauna of the physiographic districts that comprise it. I then discuss the climate of the region, particularly the conditions and changes associated with the Pleistocene-Holocene transition. I review reconstructions of Late Pleistocene plant and animal communities, and the subsequent impact of the shift in climate on these communities. Finally, I stress that human occupants of the region should also be viewed as active components of the landscape, whose movements and actions both shaped and were shaped by the local environment.

PHYSIOGRAPHY

The research area, which includes Lauderdale, Colbert, and Franklin counties, encompasses three major physiographic regions: the Highland Rim, Cumberland Plateau, and Fall Line Hills

(Figure 3.1). In general, the topography slopes gently westward, with the Tennessee River flowing to the west and turning to the northwest where Alabama meets with Mississippi and Tennessee. Major tributaries to the river include Shoal Creek and Cypress Creek in Lauderdale County; Cane Creek and Spring Creek in Colbert County; and Cedar Creek, Little Bear Creek, and Bear Creek in Franklin County, which drain through Colbert into the Tennessee River.

The waterways of the area have been significantly affected by the construction of dams by the U.S. Government and the Tennessee Valley Authority (TVA) during the 20th century. Wilson and Pickwick Landing Dams, completed in 1924 and 1938 respectively, not only powered hydroelectric generators, but also made the dangerous Muscle Shoals area navigable (TVA 2005). This stretch of shallow shoals and rapids, extending nearly 80 kilometers upriver from the present-day city of Florence, dropped the level of the river over 40 meters. The dams submerged the shoals and the surrounding area under some three to four meters of water. The Tennessee Valley Authority also constructed a series of dams along the Bear Creek drainage system to provide flood control as well as a water supply to the region. The first was Bear Creek Dam, finished in 1969, followed by Little Bear Creek in 1975, Upper Bear Creek in 1978, and finally Cedar Creek Dam in 1979 (TVA 2005).

Highland Rim

The Highland Rim includes all but the western and southeastern portion of the research area. This region can be further subdivided into the Tennessee Valley, Little Mountain, and Moulton Valley regions (Alabama Maps 2005; Harper 1942). The Tennessee Valley area is characterized by karstic uplands divided by the narrow floodplain of the river, which measures approximately 1.5 to 2.5 km in width. Bluffs of Mississippian-age Tuscumbia limestone flank the floodplain and rise some 20 m above it. These bluffs give way to gently rolling uplands that range between 150 and 200 m above sea level. In addition to streams, sinks and springs mark the uplands; groundwater has also dissolved the underlying limestone to create caves along the bluffs. Beneath the Tuscumbia formation lies Fort Payne chert, which outcrops along the river and its tributaries. The Fort Payne

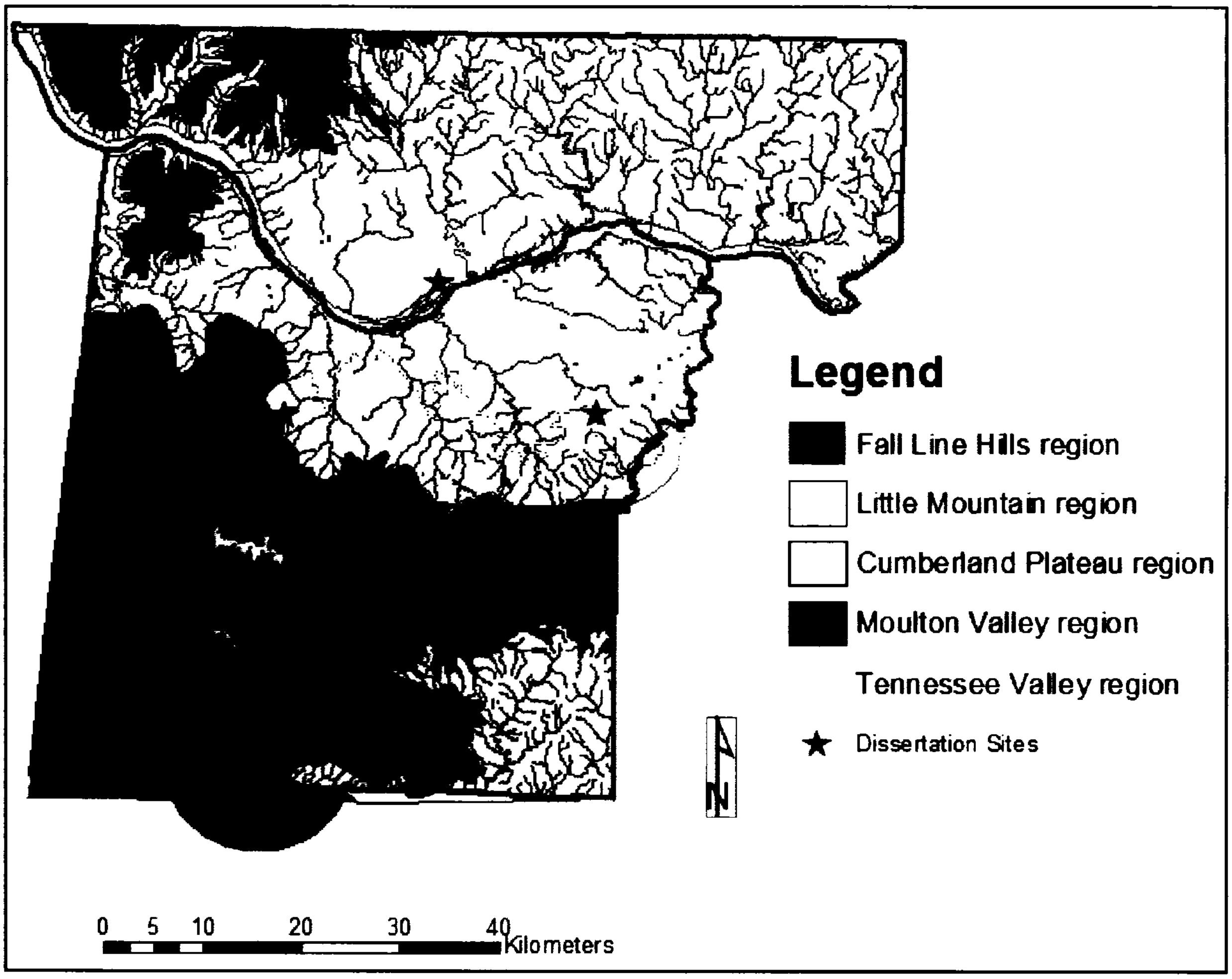

Figure 3.1. Map of the physiographic regions comprising the project area.

formation consists primarily of limestone bearing nodules and beds of blue-gray chert (Osborne et al. 1989). High-quality grades of this blue-gray Fort Payne chert served as raw material for stone tools throughout human occupation of the region. The tabular beds of the chert located in outcrops of Fort Payne limestone could have been quarried. However, secondary deposits in the form of cobbles, found in nearby rivers and streams, are more easily shaped into tools (Johnson and Meeks 1994).

Of note are the Muscle Shoals and the various islands associated with this stretch of the river, including Tick, Jackson, Patton, Seven Mile, Koger's, Colbert's, Brush Creek, Bee Tree and

Waterloo Islands. The shoals and many of the islands are now covered partially or completely by the waters of Wilson and Pickwick dams. Created by beds of chert and limestone resistant to the erosion of the river, the shoals once provided habitat for some 70 species of freshwater mussels, what has been described as the richest array in the world. Add to this the rich resources of the backwater sloughs, islands, and floodplains; the river and the shoals certainly attracted aquatic animals and people alike (Parmalee 1994:135).

The Little Mountain region lines the southern border of the Tennessee Valley area, in the central and eastern portion of Colbert County. This region corresponds with the Hartselle sandstone formation of Mississippian age (Harper 1942; Osborne et al. 1989). Its boundary with the Tennessee Valley region is sharply demarcated, forming an escarpment roughly 30 m in height. The Little Mountains generally range between 200 m above sea level at their base to nearly 300 m at their highest point. They are highly dissected by streams that cut deep and narrow valleys into the hills. Erosion of the sandstone has formed numerous rockshelters in the hills of the region.

The Moulton Valley region lies south of the Little Mountain region in the northeast corner of Franklin County and extends westward, following Cedar Creek Valley. This region, underlain by Mississippian-age Bangor limestone, has little relief. It is bounded by the hills of the Cumberland Plateau to the south in the eastern portion of Franklin County, and disappears beneath the Fall Line Hills of the Coastal Plain towards the west (Alabama Maps 2005; Harper 1942; Osborne et al. 1989). The lowest elevation of the Moulton Valley region is roughly 180 m above sea level in the northeastern corner of the county, increases to roughly 220 m in the upper reaches of Cedar Creek Valley, and falls again to around 140 m at the lower end of the valley.

In the early 1900s, the forests of the Highland Rim region were largely oak-hickory, with relatively low percentages of evergreens compared to other areas of the state. A majority of these evergreens were cedar. Cypress trees grew along the creeks west of the shoals, and a wide variety of hardwoods populated the limestone slopes (Harper 1913:43-45). Pine species were more prevalent in the Little Mountain region (Harper 1942:68). Along with oaks and hickories, chestnuts grew throughout the Highland Rim district, but were most frequent in the Little Mountain area (Harper 1942:70).

In addition to blue-gray Fort Payne chert, two other chert types can be found in the Highland Rim. These include other Fort Payne chert, of lower quality than the blue-gray variety, which outcrops along the Tennessee River. Other Fort Payne is also available both in primary outcrops and in secondary deposits, as cobbles in rivers and streams (Meeks 1998; Randall 2002). The other chert type is Tuscaloosa gravel, which is ubiquitous in the project area. As its name suggests, this chert is found in gravel form in river- and streambeds. Not only is Tuscaloosa gravel generally relatively poor in quality, its smaller size precludes the manufacture of larger tools (Meeks 1998; Randall 2002).

Fall Line Hills

The second major physiographic region in the project area is the Fall Line Hills of the Coastal Plain, which comprise the western portion of the three counties. These hills consist of Cretaceous deposits of sand and gravel, termed the Tuscaloosa formation. Bear Creek and its two major tributaries, Little Bear and Cedar Creeks, wind their way westward through the Fall Line Hills. These and other smaller-order streams deeply dissect the hills, exposing the underlying Bangor limestone and Pottsville formation of the Cumberland Plateau (Harper 1942; Osborne et al. 1989). The lowest elevation in this region is 126 m for the Pickwick Reservoir, but the hills rise up sharply from here and are generally over 200 m above sea level.

In the early 1900s, the forests of the Fall Line Hills could be characterized as a mix of the Coastal Plains' southern pines and the Highland Rim's oak-hickory forests. Pines comprised roughly 44% of forest trees. The slopes of the region supported more diverse woods, adding beech, sweet gum, and other hardwoods to the pines, oaks, and hickories that covered the uplands (Harper 1913:74-76).

In addition to the ubiquitous Tuscaloosa gravel, a fossiliferous chert derived from nodules in the limestone Bangor formation is available in the Bear Creek watershed area of the Fall Line Hills. Referred to as fossiliferous Bangor, this chert is of similar quality to Tuscaloosa gravel. Furthermore, it occurs in similarly small packages (Meeks 1998; Randall 2002).

Cumberland Plateau

The Cumberland Plateau, the third major physiographic region of the research area, reaches into the southeast corner of Franklin County and the upper portions of Bear Creek. This region is defined by the Pottsville formation, a Pennsylvanian-age sandstone. The plateau stands at the highest elevation in the research area at above 300 m, and is highly dissected by streams. Through erosion of the sandstone, rockshelters have formed in the sides of the hills. Similar to the Highland Rim, the Cumberland Plateau gives way to the Fall Line Hills in the western half of Franklin County (Alabama Maps 2005; Harper 1942; Osborne et al. 1989). This physiographic region is the highest in elevation of the three, ranging between 290 and 320 m above sea level. Within the portion of the Cumberland Plateau included in the project area, both Tuscaloosa gravel and fossiliferous Bangor chert serve as local stone resources (Meeks 1998; Randall 2002).

The uplands of the plateau supported forests dominated by short-leaf pines and oaks in the early 1900s, with evergreens comprising nearly 30% of forests. As with the other regions, wider varieties of hardwoods, including beech, poplar, and sweet gum, populated the slopes leading down to the creeks (Harper 1913:49-50). Harper (1913:50-51) further noted that the forests on the richest plateau soils were similar to those on the poorest soils in the Tennessee Valley region, as both included higher percentages of evergreens.

Summary

Although the various physiographic districts differ in a number of regards, the most salient distinguishing characteristic is the nature of the underlying geologic formations. Those that are underlain by sandstone are dominated by highly dissected uplands and poorer soils that support forests with higher percentages of coniferous trees. Areas where limestone serves as bedrock tend to be characterized by gently rolling topography and richer soils. The Tennessee Valley region is further distinguished by the availability of high-quality blue-gray Fort Payne chert, as well as access to Muscle Shoals and its rich aquatic resources.

CLIMATE

Around the turn of the 20th century, the average temperature for Florence, Alabama, was just under 16° C, and the growing season spanned some 215 days. Annual precipitation measured roughly 1250 mm, over half of which fell during the winter months (Harper 1913:188). However, these climatic descriptors are not particularly relevant for studies of the Late Paleoindian and Early Archaic periods. Global climatic conditions changed significantly over the last 15,000 years as the last glacial period waned and interglacial weather patterns were established (Figure 3.2).

By approximately 14,500 cal B.P., increases in summertime solar radiation and the resulting retreat of glacial ice sheets that covered most of Canada and the northern United States brought significant and relatively rapid shifts in the climate of North America. In general, the colder, drier conditions associated with the last glacial maximum ameliorated. However, the degree to which various regions experienced this trend in warming and shift in rainfall differs based on the varying influence of ice sheets, air masses, and ocean currents (COHMAP 1988; Delcourt and Delcourt 1987; Kutzbach et al. 1993; Shuman, Bartlein, Logar, Newby, and Webb 2002; Shuman, Webb, Bartlein, and Williams 2002). The jet stream no longer tracked both northward and southward of the continental ice sheet by this time, but flowed in a westerly direction just south of the ice, migrating northward as the glaciers retreated. Air masses over the ice sheet spun in an anticyclonic direction, causing winds to blow cold air from an easterly direction over regions just south of the glaciers but north of the jet stream. As a result, a steep temperature gradient likely existed between regions affected by these easterly arctic winds, such as the Great Lakes region, and those located below the jet

Calibrated Radiocarbon Years	**Global Climate Shifts**	**Cultural Periods**	**Plant Communities in the MidSouth // Deep South**
7,000	Temperatures similar to present		Oak-hickory-southern pine forest // southern pine forest
		Kirk Stemmed (8,900-7,800 cal B.P.)	
8,000	8.2ka Event (8,200-7,900 cal B.P.)		
	Continuing warming and increase in moisture as glaciers retreated	LeCroy/Kanawha Bifurcates (9,800-8,600 cal B.P.)	
9,000			Deciduous hardwoods // warm temperature broadleaf-evergreen forest
		Kirk Corner-Notched (10,500- 9,800 cal BP)	
10,000			Mixed hardwoods // oak-hickory-southern pine forest
		Early Side-Notched (11,200- 10,500 cal BP)	
11,000	Preboreal Oscillation (11,400-11,200 cal. BP)		
		Dalton (12,000- 11,200 cal BP)	
	Younger Dryas (12,900-11,600 cal.BP)		
12,000		Quad/Beaver Lake (12,900-12,000 cal BP)	Non-analog mixed conifers and northern hardwoods // mixed hardwoods
13,000	Continuing retreat of glacial sheets		
14,000			

Figure 3.2. Climatic, cultural, and vegetative changes in the Midsouth between 14,000 and 7,000 cal B.P.

stream, including the Southeast, where the Pacific and Maritime Tropical air masses prevailed (COHMAP 1988; Delcourt and Delcourt 1987; Kutzbach et al. 1993). In the southeastern United

States, January temperatures were probably between 4° and 8°C cooler than present, and July temperatures probably only 0° to 2°C cooler. Annual precipitation appears to have been approximately 200 mm less than present (Kutzbach et al. 1993; Webb et al. 1993).

This warming trend reversed briefly during the Younger Dryas event (12,900-11,600 cal B.P.). The sudden discharge of cold, freshwater glacial lakes to the north Atlantic Ocean disrupted the circulation of warmer ocean currents. The colder surface seawater brought significant dips in temperatures throughout the north Atlantic, dropping global temperatures by several degrees (Meeks 2001; Shuman, Webb, Bartlein, and Williams 2002; Teller et al. 2002; Yu and Eicher 1998). However, the Younger Dryas also produced varying conditions in different regions. In the southeastern United States, this event brought winter temperatures 4° to 5°C lower than present day, as well as summer temperatures roughly 2°C warmer than present (Shuman, Webb, Bartlein, and Williams 2002). The Younger Dryas ended abruptly, probably as ocean circulation again changed. Moisture levels increased and global temperatures rose an average of 7°C over just several decades (Meeks 2001; Shuman, Webb, Bartlein, and Williams 2002; Taylor et al. 1997; Yu and Eicher 1998).

A second, smaller oscillation, termed the Preboreal Oscillation, occurred roughly between 11,400 and 11,200 cal B.P., apparently triggered by an abrupt discharge of glacial meltwater into the Arctic Ocean (Fisher et al. 2002; Teller et al. 2002). Briefer than the Younger Dryas event, the Preboreal Oscillation brought a drop of approximately 2°C in global temperatures (Meeks 2001; Wagner et al. 1999; Wagner et al. 2004; Yu and Eicher 1998), although the effect may have been less severe in the Southeast. Warming continued as summer solar radiation increased and the ice sheet retreated (Yu and Eicher 1998). By approximately 10,000 cal B.P., the jet stream had moved further northward, although anticyclonic winds continued to blow across the remaining glaciers onto the Northeast. Winter temperatures in the southeastern United States were only 1° to 4°C cooler than present, while summer temperatures may have been as much as 2°C warmer than present. Annual precipitation appears to have been roughly similar to current values (Kutzbach et al. 1993; Webb et al. 1993), although lake levels indicate that the region was drier relative to the present (Shuman, Bartlein, Logar, Newby, and Webb 2002; Webb et al. 1993). Available moisture in the Southeast increased by 9000 cal B.P., however, as the ice sheet continued to wane and subtropical air masses dominated the region.

A final oscillation, lasting some 300 years, occurred at approximately 8200 cal. BP (Shuman, Bartlein, Logar, Newby, and Webb 2002; Wagner et al. 2004; Yu and Eicher 1998) as the vast glacial-meltwater lakes drained completely into the north Atlantic Ocean and the portion of the Laurentide Ice Sheet over the Hudson Bay collapsed (Shuman, Bartlein, Logar, Newby and Webb 2002; Teller et al. 2002). Again, the northeastern United States and eastern Canada, particularly those areas near the ice sheet, were most significantly affected by this "8.2ka Event." However, the disappearance of the anticyclonic air mass associated with the ice sheet gave greater influence to warm, moist, subtropical air masses, bringing even wetter conditions to the Southeast (Shuman, Bartlein, Logar, Newby, and Webb 2002). By roughly 7000 cal B.P., annual precipitation appears to have increased to around 200 mm greater than present, particularly in the Coastal Plain of the Carolinas, Georgia, and Florida. Winter temperatures may have been slightly cooler than present, but summer temperatures were apparently comparable with modern values (Webb et al. 1993).

Local Climatic Conditions

At the request of Lara Homsey (2004), Reid Bryson of the Center for Climate Research at the University of Wisconsin created a model of the climatic conditions for the area around Dust Cave, using the nearby city of Muscle Shoals, Alabama, as a proxy. The model includes variables such as solar radiation, the global extent of continental ice sheets, the absorption and reflection of heat by the earth's surface, and circulation of air masses (Homsey 2004:44). The outputs are graphs of mean annual temperature, as well as annual, winter, and summer precipitation (Figures 3.3 and 3.4).

Bryson's (1999a, 1999b in Homsey 2004:316) model indicates that annual mean temperatures around 14,000 cal B.P. for northwest Alabama were as low as 12°C, approximately 4°C

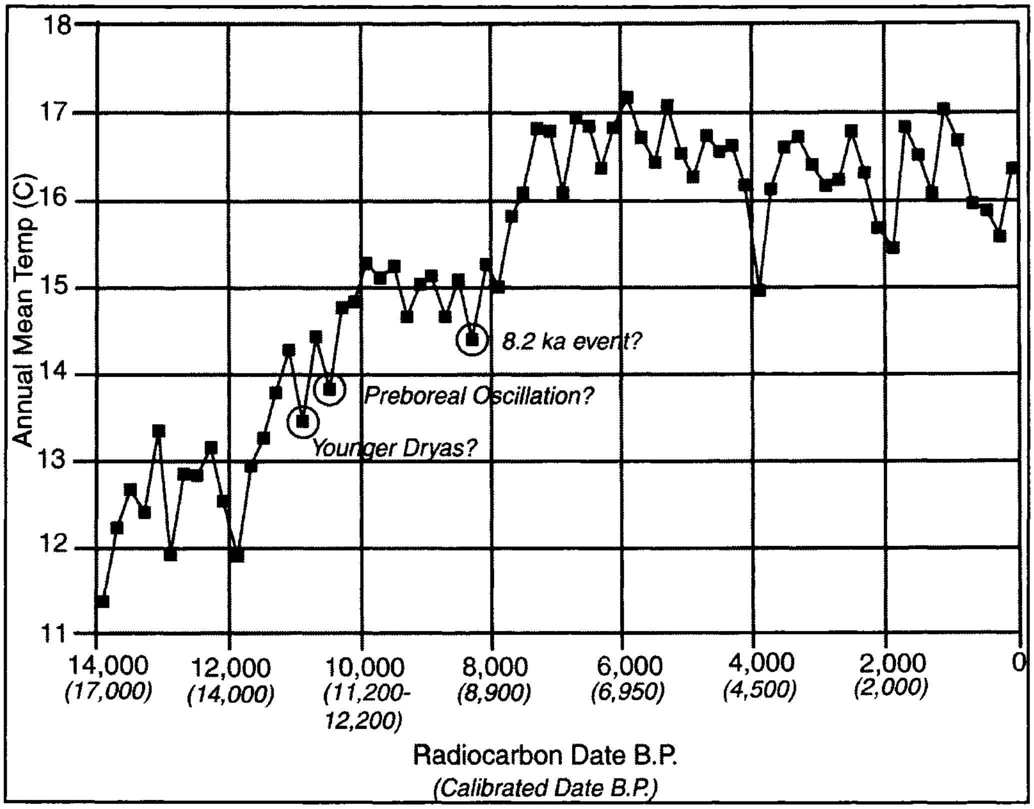

Figure 3.3. Bryson's (1999b) model of temperature history for Muscle Shoals, Alabama (adapted from Homsey [2004: Figure C1]).

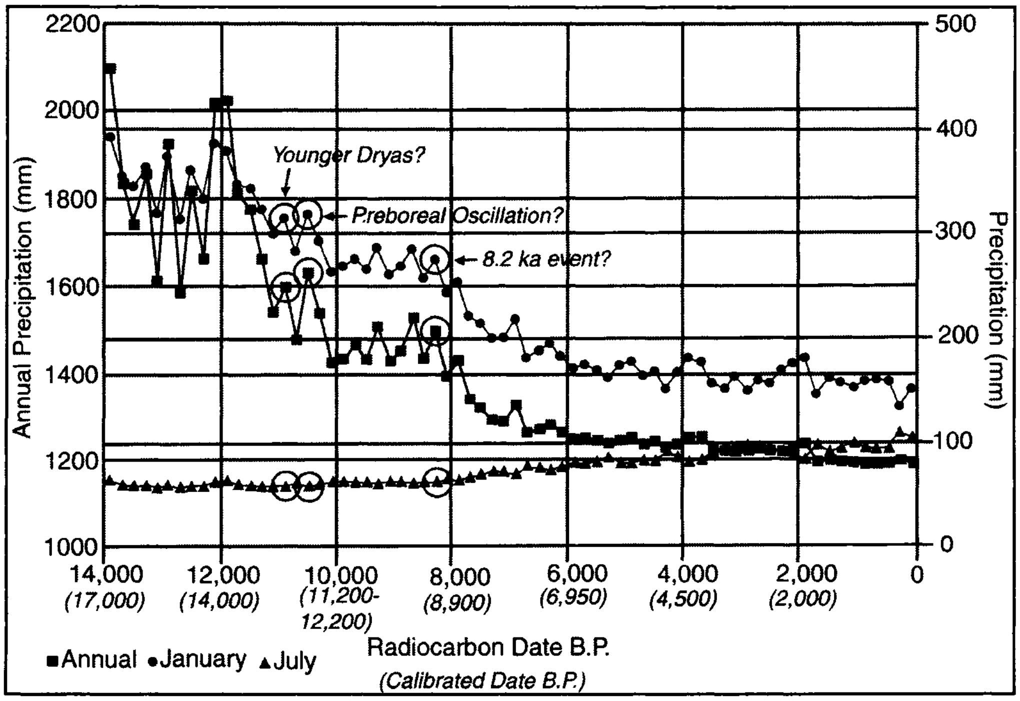

Figure 3.4. Bryson's (1999a) model of precipitation history for Muscle Shoals, Alabama (adapted from Homsey [2004: Figure C2]).

lower than present. Winter precipitation was considerably higher than present, by nearly 300 mm. In contrast, summer precipitation was slightly lower than modern values, and annual precipitation measured just above 2000 mm, significantly higher than the 1250 mm seen today. Temperature steadily increased through approximately 11,000 cal B.P. (or roughly 10,000 radiocarbon years before present), with the exception of two downward spikes that likely correspond to the Younger Dryas event and Preboreal Oscillation. Both events apparently dropped annual mean temperatures for the area by roughly 1°C. They are also associated with upward spikes in winter precipitation, which otherwise decreased steadily.

Annual mean temperature and precipitation were comparatively stable for the next 2000 years or so, hovering around 15°C and approximately 1500 mm annually in precipitation. There were several dips in temperature, with corresponding spikes in precipitation, within this span. These were significantly reversed, however, between 8,900 and 7,900 cal B.P. Annual mean temperature increased to nearly 17°C, while annual precipitation fell to roughly 1300 mm. The latter was impacted both by a drop in winter precipitation and a slight increase in summer rain. This final significant increase in temperature could well be related to the collapse of the Laurentide Ice Sheet and the "8.2 ka event," as glacial air masses no longer dominated circulation patterns over the northern United States. Although after 7,900 cal B.P. annual mean temperature continued to oscillate, winter precipitation fell further and summer rain rose slightly, these climatic conditions generally prevailed through the present (Bryson 1999a, 1999b in Homsey 2004:316).

While the annual mean temperature near Muscle Shoals only shifted slightly, particularly during the cooler oscillations during the overall warming trend that characterized the Pleistocene/Holocene transition, there may well have been more dramatic differences between winter and summer temperatures. This is suggested by regional climatic reconstructions (Kutzbach et al. 1993; Shuman, Bartlein, Logar, Newby, and Webb 2002; Webb et al. 1993). Such differences between winter and summer conditions are further suggested by fluctuations in winter precipitation associated with dips in temperature in Bryson's (1999a, 1999b) models: it appears that winter conditions were affected more than summer conditions by various climatic changes and oscillations. Interestingly, Bryson's (1999a, 1999b) reconstructions differ significantly in terms of available moisture from the larger regional models (e.g. Kutzbach et al. 1993; Shuman, Bartlein, Logar, Newby and Webb 2002; Webb et al. 1993). The latter suggest drier conditions than present for the Southeast during the Pleistocene/Holocene transition, with a trend towards increasing moisture. In contrast, Bryson's (1999a, 1999b) local model for Muscle Shoals suggests significantly wetter conditions during the last ice age than at present.

ECOLOGICAL COMMUNITIES

An understanding of local climatic conditions and changes are important because they directly affect the local vegetation and the wildlife that it supports. Plants are sensitive not only to moisture balance and nutrients in the soil, but also to length of growing seasons and temperature extremes. Animals, in turn, may depend on particular vegetation structures, but also may respond to temperature shifts. For example, some species of mollusks, mice, and voles, among others, are quite sensitive to climatic conditions. Possible shifts in local habitat structures are important to understand because they shape the resources available to hunter-gatherers and the strategies these groups employ to exploit those resources.

Plant Communities

Reconstructions of paleoenvironments are based upon pollen studies of lake cores. Relatively few cores have been analyzed from the Southeast, making such reconstructions broad in nature. Several cores are located relatively near my research area in northwest Alabama. These include Anderson Pond in eastern Tennessee; B.L. Bigbee Oxbow in eastern Mississippi; Cahaba Pond in eastern Alabama; and Pigeon Marsh and Quicksand, both in northwest Georgia (Figure 3.5; Delcourt and Delcourt 1987; Webb et al. 1993). Spanning the last 20,000 years, the cores from these sites indicate changes in vegetation in the region during the Pleistocene/Holocene transition. Extrapolating

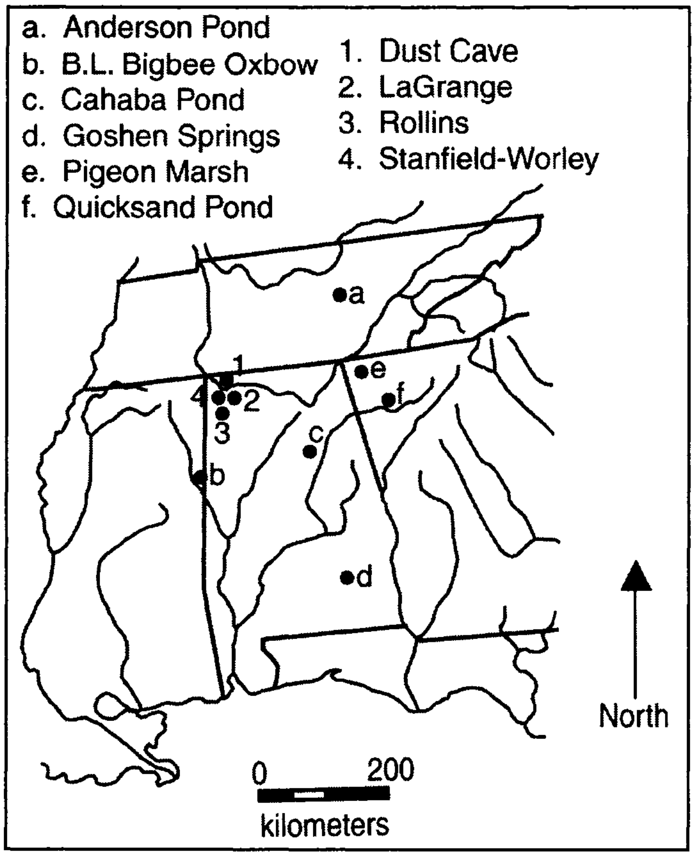

Figure 3.5. Map of pollen cores nearest to the project area (H. Delcourt and Delcourt 1985: Figure 1; Delcourt and Delcourt 1987).

from these reconstructions for my research area can be difficult, largely because it includes three major physiographic regions. The Highland Rim, Fall Line Hills and Cumberland Plateau comprise distinct communities today, and likely did in the past as well.

Researchers approach paleoenvironment reconstructions from different angles. One is to map vegetative communities, based on similarities between fossil and modern pollen assemblages. The drawback to this method is that modern analogs do not always exist: paleocommunities may have included species that do not co-occur today (Delcourt and Delcourt 1987; Overpeck et al. 1992). Instead, researchers may map distributions of individual taxa, thus suggesting the species mix in particular regions.

Paleovegetation reconstructions suggest that northwest Alabama may have been near the confluence of three vegetation communities around 14,000 cal B.P. Deciduous forests appear to have covered the Coastal Plain and Fall Line Hills, while mixed forests comprised the Ridge and Valley province to the east. Non-analog communities, comprised primarily of spruce woodlands, apparently characterized the Highland Rim (Delcourt and Delcourt 1981; Overpeck et al. 1992). Shortly after the close of the Younger Dryas event, around 11,200 cal B.P., mixed hardwoods typical of cold temperate forests dominated the local vegetation (Adams 2002; Delcourt and Delcourt 1981). These deciduous forests apparently persisted in the research area through 7,000 cal B.P. (Adams 2002; Adams and Faure 1997; Overpeck et al. 1992), although forests dominated by oak, hickory, and southern pines increasingly encroached on the area from the south (Adams 2002; Delcourt and Delcourt 1981). Indeed, by 10,000 cal B.P. the boundary between the two biomes was close to the research area (Adams 2002; Adams and Faure 2002; Delcourt and Delcourt 1981). This may be related to the physiographic regions encompassed in the research area: the Highland Rim north of the Tennessee River may well have supported different vegetation than the Fall Line Hills and Cumberland Plateau to the south.

Data derived from maps of individual pollen taxa follow these general shifts in vegetation communities (Table 3.1). Around 14,000 cal B.P., forests in the research area were comprised primarily of oak (20-40%) (see Table 3.1 for scientific names). Pines, likely a mix of northern and southern species, were also a significant forest component (5-20%). Most notable among other taxa associated with colder climates is spruce (1-20%). Birch, fir, hemlock, and alder may also have been present in low numbers (less than 5%). Sedges represent up to 10% of available pollen, also suggesting cooler conditions. Hickory likely comprised between 5% and 20% of these transitional forests. Additional hardwoods present in low quantities include maple, hackberry, beech, ash, walnut, aspen/cottonwood, tupelo, and willow (Delcourt and Delcourt 1987; Shuman, Webb, Bartlein, and Williams 2002; Webb et al. 1993). Based upon these compositions, the forests of the region were significantly different from those seen today (Shuman, Webb, Bartlein, and Williams 2002).

Table 3.1. Proportional Representation of Various Taxa in Regional Pollen Assemblages during the Pleistocene-Holocene Transition.*

Category: Taxon	14,000 cal B.P. (%)	13,000 cal B.P. (%)	11,000 cal B.P. (%)	10,000 cal B.P. (%)	9,000 cal B.P. (%)	7,000 cal B.P. (%)
Major constituents:						
Oak (*Quercus* spp.)	20-40		40-60	40-60	40-60	60
Hickory (*Carya* spp.)	5-20		10-20	>5	10	10-20
Pine (*Pinus* spp.)	5-20	<20	0-20	5	0-20	0-20
Northern species:						
Spruce (*Picea* spp.)	1-20	<20	0-20	1-5	0	0-5
Fir (*Abies* spp.)	<0.5-1			<0.5		<0.5
Hemlock (*Tsuga* spp.)	<0.5		<1-10	<0.5-1	0	<0.5
Alder (*Alnus* spp.)	<1-5			<1-5		<1-5
Birch (*Betula* spp.)	1-5		0-10	1	0	0-5
Minor constituents:						
Ash (*Fraxinus* spp.)	0-10	>5	0-10		0-10	0-10
Aspen/cottonwood (*Populus* spp.)	0-20		<1		<1	
Basswood (*Tilia* spp.)	0		<1-5		0	
Beech (*Fagus* spp.)	0-5		0-5	1-5	0-5	0-5
Cedar/Cypress (Cupressaceae)	0-10		0		0	0
Elm (*Ulmus* spp.)	1-5		10-15	1-5	5-10	0-5
Hackberry (*Celtis* spp.)	0-5		5		0-5	0-5
Maple (*Acer* spp.)	0-10		10			10-20
Tupelo (*Nyssa* spp.)	0		<1		0-10	0-20
Walnut (*Juglans* sp.)	1		0-1		0	1
Willow (*Salix* spp.)	0-5		0		0-5	0-5
Other:						
Sedges (Cyperaceae)	1-10	>5		1-5		5-10

* Data derived from pollen maps developed by Delcourt and Delcourt (1987), Shuman, Bartlein, Logar, Newby, and Webb (2002), Shuman, Webb, Bartlein, and Williams (2002), and Webb and colleagues (1993).

Spruce, sedge, ash, and other taxa associated with colder temperatures migrated slightly northward by 13,000 cal B.P., as pines expanded in the mid-South (likely southern pines). This trend was reversed to some degree during the Younger Dryas episode. However, summers remained warmer than previously during this cooler oscillation, allowing a different mix of trees to prevail (Shuman, Webb, Bartlein, and Williams 2002). Larger populations of ash (greater than 5%) were re-established in the research area during this time, along with sedge (greater than 5%), while pine populations diminished to below 20% (Shuman, Webb, Bartlein, and Williams 2002). Spruce still appears to have been present at less than 20% of forest populations (Delcourt and Delcourt 1987).

Forest compositions shifted rapidly again at the close of the Younger Dryas, as Holocene climatic conditions were established around 11,200 cal B.P. (Shuman, Webb, Bartlein, and Williams 2002). Oaks increased to 40-60% of forest species. Also increasing were elm (10-15%) and maple (roughly 10%), while ash populations declined to less than 5%. Pines remained at less than 20% of forest trees, but included primarily southern pines at this point. The presence of several taxa suggests that temperatures remained somewhat cooler than present, including spruce (0-20%), birch (0-10%), and possibly basswood and hemlock. The percentages of hickory, beech, walnut, hackberry and tupelo changed little (Delcourt and Delcourt 1987; Shuman, Webb, Bartlein, and Williams 2002).

Cooler conditions than present remain evident around 10,000 cal B.P., as forests included spruce (1-5%), alder (1-5%), birch (roughly 1%), and hemlock (less than 1%) (Webb et al. 1993). By approximately 9,000 cal. BP, these taxa were no longer present in forests near the research area. Oak remained at 40-60% of forest trees, while maple and tupelo both increased. In contrast, elm dropped to around 5%, and hickory may have decreased slightly to around 10%. Southern pines remained below 20%; ash, hackberry, and walnut also showed little change (Delcourt and Delcourt 1987; Shuman, Webb, Bartlein, and Williams 2002).

By 7,000 cal B.P., oak expanded to 60% and hickories rebounded to 10-20% of forest trees. Sedges and forbs increased to around 5% of the pollen assemblage, suggesting drier conditions (Webb et al. 1993). Elm decreased further to 0-5% of forest trees. Percentages of other taxa, including southern pines, ash, beech, hackberry, tupelo, and walnut again changed little (Delcourt and Delcourt 1987; Shuman, Bartlein, Logar, Newby, and Webb 2002; Webb et al. 1993).

Similar species, although in different proportions, cover the research area today and did in the recent past (Harper 1942). These modern communities generally map onto physiographic regions. Oak-hickory forests populate the Tennessee Valley and Moulton Valley areas of the Highland Rim (Bryant et al. 1993). Oak-hickory-pine forests predominate in areas underlain by sandstone, including the Little Mountain, Fall Line Hills, and Cumberland Plateau regions (Skeen et al. 1993).

Glade communities cover limestone outcrops in eastern Lauderdale and southeastern Franklin counties (Quarterman et al. 1993). Species associated with these communities are listed in Table 3.2.

Field notes taken by surveyors of the US General Land Office (GLO) in the early 1800s provide additional information about local forests prior to extensive logging and clearing in the recent past by Euroamericans. Caddell (1983:336-337) and Johnson (1985) reviewed GLO field notes for areas within Franklin and Colbert counties to reconstruct early forests. Caddell consulted notes for two townships in Franklin County. The first is in the vicinity of the Cedar Creek reservoir, and may be considered in either the Fall Line Hills or the Moulton Valley. The second is in the upper reaches of Bear Creek in southeastern Franklin County and is part of the Cumberland Plateau. These notes indicated that in the area near Cedar Creek, eight species of oak accounted for 53% of the trees recorded, hickories for another 14%, and pines 11%. Other species comprised less than 5%. Examining species distribution by elevation, Caddell (1983:336) notes that trees associated with slopes include pine, black oak (*Q. velutina*), post oak (*Q. stellata)*, white oak (*Q. alba*), black gum (*Nyssa sylvatica*), hickory, ash, elm, dogwood (*Cornus florida*), poplar (likely yellow poplar, *Liriodendron tulipifera*), and persimmon (*Diospyros virginiana*). Trees found only at higher elevations include chestnut oak (*Quercus prinus*), chestnut (*Castanea dentata*), Spanish oak (*Q. falcate*), sassafras (*Sassafras albidum*), red oak (*Quercus rubra* or *Q. shumardii*), and locust (*Gleditsia triacanthos* or *Robinia pseudo-acacia*). Those associated with lower slopes and riverbanks include holly (*Ilex opaca*), redbud (*Cercis canadensis*), sugartree (probably sugar maple, *Acer saccharum*), ironwood (*Ostrya virginiana*), cedar (*Juniperus virginiana*), and chinquapin oak (*Q. muehlenbergii*). Surveyors also noted the presence of vines, cane, and bushes (Caddell 1983:336). Similar trees appear in the notes for southeastern Franklin County, where oak, hickory, sassafras, sourwood, dogwood, maple, and grape (*Vitis* spp.) vines were common on the rocky hillsides, while bottomland trees included poplar and beech (Caddell 1983:337).

Johnson's (1985:50-52) study focused on three townships in the northwest corner of Colbert County, at the boundary between the Highland Rim and the Fall Line Hills. Johnson examined the

Table 3.2. Plant Taxa Associated with the Various Plant Communities Located in the Project Area.

Oak-Hickory[a]	Oak-Hickory-Pine[b]	Limestone Outcrops[c]
Dominants:	**Canopy:**	**Trees:**
White oak (*Quercus alba*)	White oak (*Quercus alba*)	Red cedar (*Juniperus virginiana*)
Northern red oak (*Q. rubra*)	Post oak (*Q. stellata*)	Sugar hackberry (*Celtis laevigata*)
Black oak (*Q. velutina*)	Northern red oak (*Q. rubra*)	Winged elm (*Ulmus alata*)
Shagbark hickory (*Carya ovata*)	Hickories (*Carya* spp.)	Blue ash (*Fraxinus quadrangulata*)
Bitternut hickory (*C. cordiformus*)	Shortleaf pine (*Pinus echinata*)	Post oak (*Quercus stellata*)
Subdominants:	Loblolly pine (*P. taeda*)	**Shrubs:**
Pignut hickory (*C. glabra*)	Virginia pine (*P. virginiana*)	Aromatic sumac (*Rhus aromatica*)
Black hickory (*C. texana*)	Persimmon (*Diospyros virginiana*)	Coralberry (*Symphoricarpus orbiculatus*)
Mockernut hickory (*C. tomentosa*)	Red cedar (*Juniperus virginiana*)	**Grasses/Forbs:**
Scarlet oak (*Q. coccinea*)	Yellow poplar (*Liriodendron tulipifera*)	Gladecress (*Leavenworthia* spp.)
Southern red oak (*Q. falcata*)	**Understory:**	Slim-spike three-awn (*Aristida longespica*)
Overcup oak (*Q. lyrata*)	Red maple (*Acer rubrum*)	Tennessee milk-vetch (*Astragalus tennesseensis*)
Blackjack oak (*Q. marilandica*)	Shadbush (*Amelanchier canadensis*)	Flatsedge (*Cyperus aristatus*)
Chinquapin oak (*Q. muehlengergii*)	Redbud (*Cercis canadensis*)	Gattinger's prairie-clover (*Dalea gattingeri*)
Chestnut oak (*Q. prinus*)	Flowering dogwood (*Cornus florida*)	Shooting star (*Dodecatheon meadia*)
Shumard oak (*Q. shumardii*)	American holly (*Ilex opaca*)	Fleabane (*Erigeron strigosus*)
Post oak (*Q. stellata*)	Sweet gum (*Liquidambar styraciflua*)	False aloe (*Manfreda virginica*)
Sugar maple (*Acer saccharum*)	Black gum (*Nyssa sylvatica*)	Sandwort (*Minuartia patula*)
Chestnut (*Castanea dentata*)	Sourwood (*Oxydendrum arboretum*)	Prickly-pear cactus (*Opuntia humifusa*)
Beech (*Fagus grandifolia*)	**Shrubs:**	Common witchgrass (*Panicum capillare*)
White ash (*Fraxinus americana*)	Sumac (*Rhus copallina, R. glabra*)	Scurf-pea (*Psoralea subacaulis*)
Black walnut (*Juglans nigra*)	Blackberry (*Rubus* spp.)	Little blue-stem (*Schizachyrium scoparium*)
Red cedar (*Juniperus virginiana*)	Viburnum (*Viburnum* spp.)	Texas stonecrop (*Sedum pulchellum*)
Yellow poplar (*Liriodendron tulipifera*)	**Vines:**	Dropseed (*Sporobolus vaginiflorus*)
Black cherry (*Prunus serotina*)	Poison ivy (*Rhus radicans*)	Fame-flower (*Talinum calcaricum*)
Sassafras (*Sassafras albldum*)	Catbriars (*Smilax* spp.)	**Algae/Lichens/Moss:**
American basswood (*Tilia americana*)	Grapes (*Vitis* spp.)	Blue-green alga (*Nostoc commune*)
American elm (*Ulmus americana*)	**Grasses/Forbs:**	Earth lichen (*Dermatocarpon lachneum*)
Slippery elm (*Ulmus rubra*)	Annual ragweed (*Ambrosia artemisiifolia*)	Skin lichen (*Leptogium* spp.)
Lowland communities:	Bluestem (*Andropogon* spp.)	Reindeer moss (*Cladonia furcata, C. subcariosa*)
Silver maple (*A. saccharinum*)	Aster (*Aster* spp.)	Pleurochaete moss (*Pleurochaete* spp.)
River birch (*Betula nigra*)	Queen Anne's lace (*Daucus carota*)	
Shellbark hickory (*C. laciniosa*)	Lovegrass (*Eragrostis* spp.)	
Sweet gum (*Liquidambar styraciflua*)	Fleabane (*Erigeron* spp.)	
Black willow (*Salix nigra*)	Dogfennel (*Eupatorium capilifollium*)	
Swamp chestnut oak (*Q. michauxii*)		
Cherrybark oak (*Q. pagoda*)		
Pin oak (*Q. palustris*)		
Cypress (*Taxodium* spp.)		
Shrubs:		
Sumac (*Rhus* spp.)		
Blackberry (*Rubus* spp.)		
Coralberry (*Symphoricarpus orbiculatus*)		
Vines:		
Catbriars (*Smilax* spp.)		

Table 3.2 (continued). Plant taxa associated with the various plant communities located in the project area.

Oak-Hickory[a]	Oak-Hickory-Pine[b]	Limestone Outcrops[c]
Grasses/Forbs:		
Ragweed (*Ambrosia* spp.)		
Bluestem (*Andropogon* spp.)		
Three-awn (*Aristida* spp.)		
Aster (*Aster* spp.)		
Crabgrass (*Digitaria* spp.)		
Fleabane (*Erigeron* spp.)		
Panicgrass (*Panicum* spp.)		
Bristlegrass (*Setaria* spp.)		
Goldenrod (*Solidago* spp.)		

[a] Bryant et al. 1993.
[b] Skeen et al. 1993.
[c] Quarterman et al. 1993.

distribution of recorded trees within three zones: the Tennessee River bottoms, limestone uplands, and sand hills. Fewer trees were recorded in the river bottoms, but these include birch, hornbeam (*Carpinus caroliniana*), elm, maple, ash, white oak, hickory, and black oak. Oaks comprised only 13% of these trees, and hickories 8%. In contrast, seven oak species accounted for 60% of trees in the limestone uplands, and hickories for 24%. All of the river bottom trees also occurred in the limestone uplands, as well as black gum, chestnut, poplar, dogwood, sourwood (*Oxydendrum arboreum*), and pines, which represented 3% of the total trees recorded. Pines comprised 21% of trees in the sand hills, however. Oaks were only slightly lower than in the limestone uplands, at 57%. Hickories are considerably lower, however, at 13%. The trees from the river bottom – birch, hornbeam, elm, maple, and ash – were absent from the sand hills. Other species present included chestnut, black gum, poplar, dogwood, and sourwood (Johnson 1985:51).

Animal Communities

Animal communities in the Southeast also changed substantially between 14,500 and 7000 cal B.P. Perhaps the most significant change was the extinction of 35 genera of Pleistocene fauna and megafauna, which had fully occurred in North America by approximately 12,200 cal B.P. (Beck

1996; Grayson and Meltzer 2003). The relatively abrupt disappearance of animals such as mammoths and mastodons, which greatly influenced local ecosystems through trampling, grazing and browsing, may well have been an important factor in changing plant and animal communities, in addition to climate change (Haynes 2002). Because of these extinctions and their ripple effects on ecological communities, as well as the fact that different species responded at different rates and in different manners to changing climates and habitats, Late Pleistocene animal communities often do not have modern analogs (FAUNMAP Working Group 1996). This is not surprising, given the lack of modern analogs for Late Pleistocene plant communities.

Using a hierarchical clustering technique to analyze possible associations among faunal assemblages from nearly 3000 sites, the FAUNMAP Working Group (1996) mapped distinct animal communities in the Late Pleistocene (approximately 17,000 – 11,200 cal B.P.). The results suggest that the indicator species for northwest Alabama include white-tailed deer (*Odocoileus virginianus*), short-tailed shrew (*Blarina* spp.), masked shrew (*Sorex cinereus*), pygmy shrew (*Sorex hoyi*), arctic shrew (*Sorex arcticus*), water shrew (*Sorex palustris*), southern bog lemming (*Synaptomys cooperi*), northern bog lemming (*Mictomys borealis*), eastern chipmunk (*Tamias striatus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), yellow-cheeked vole (*Microtus xanthognathus*), and meadow jumping mouse (*Zapus hudsonius*) (FAUNMAP 1996: Figure 3). Of these, southern bog lemming and thirteen-lined ground squirrel are today associated with prairie habitats (FAUNMAP 1996); the masked shrew (Lee 2001), arctic shrew (Rose 1999), and water shrew (Carmen 2001) are found in Canada and the northern United States; and the northern bog lemming (Nicholas 2001) and yellow-cheeked vole (Kroenig 2004) are specifically associated with boreal forests. These suggest cooler and drier conditions at the close of the Pleistocene, and different availabilities of animal species, than at present.

Southeastern Pleistocene fauna also included extinct species, such as mammoth (*Mammuthus primigenius*), mastodon (*Mammut americanum*), giant armadillo (*Glyptodon* sp.), sloth (*Eremotherium* sp.), dire wolf (*Canis dirus*), saber-tooth cat (*Smilodon fatalis*), tapir (*Tapirus* *veroensis*), flat-headed (*Platygonus* sp.) and long-nosed peccary (*Mylohyus* sp.), jaguar (*Panthera* sp.), fugitive deer (*Sangamona* sp.), giant tortoise (*Geochelone* sp.) and giant beaver (*Casotoroides* sp.) (Clausen et al. 1979; Walker 1998). The extent to which they were exploited by early inhabitants of the region is a topic of debate (Anderson 1995; Grayson and Meltzer 2003). However, remains of dire wolf and giant beaver recovered from Dust Cave and of tapir from neighboring Basket Cave (Paul Parmalee, personal communication 1998) are associated with deposits that predate the Late Paleoindian (Quad) occupation at Dust Cave. Possible human use of extinct megafauna are thus beyond the scope of this project.

By the late Holocene (approximately 4500 cal B.P.), indicator species of the research area derived by FAUNMAP include more familiar southeastern animals, such as the eastern gray squirrel (*Sciurus carolinensis*), common opossum (*Didelphis marsupialis*), marsh rice rat (*Oryzomys palustris*), swamp rabbit (*Sylvilagus aquaticus*), and eastern woodrat (*Neotoma floridana*) (FAUNMAP 1996: Figure 2). These animal communities are generally similar to those observed in the region today, although historic land clearing has certainly shaped the landscape and therefore the distribution and frequency of animal populations (Bryant et al. 1993; Skeen et al. 1993).

Modern animal communities can be further distinguished by physiographic region and forest type. Three general types are defined for northwest Alabama. These include oak-hickory forests, associated with the Tennessee and Moulton valleys; limestone outcrops, located in eastern Lauderdale and southeastern Franklin counties; and oak-hickory-pine forests, found in the Little Mountain, Fall Line Hills, and Cumberland Plateau regions.

The oak-hickory and oak-hickory-pine forests are quite similar in regards to the animal species they support. Local animal communities within these regions tend to differ by animals' preference for edge areas or dense forests. Animals associated with edges between forests and clearings include white-tailed deer, cotton rat (*Sigmadon hispidus*), pine vole (*Microtus pinetorum*), golden mouse (*Permyscus nuttalli*), cotton mouse (*P. gossypinus*), white-footed mouse (*P. leucopus*), eastern cottontail (*Sylvilagus floridanus*), and wild turkey (*Meleagris gallapavo*). These species take advantage of the cover and hard mast provided by the forest, the soft mast borne by shrubs and vines along the edges, and the seeds of herbaceous plants in clearings. Carnivores such as red (*Vulpes vulpes*) and gray foxes (*Urocyon cinereoargenteus*) also frequent these edges, because of the availability of prey. Gray squirrels and flying squirrels (*Glaucomys volans*) prefer densely wooded habitats, for mast as well as ease of movement between trees. In contrast, bobwhite quail (*Colins virginiana*) favors openings intermixed with woods (Skeen et al. 1993).

These forest communities can be further divided into upland and lowland habitats. The latter have higher net productivity, due to greater available moisture (Bryant et al. 1993:179). As such, the richest diversity of wildlife, particularly bird species, is found in these lowland habitats. Not surprisingly, aquatic species such as wood duck (*Aix sponsa*), snapping turtle (*Chelydra serpentina*), slider (*Trachemys scripta*), painted turtle (*Chrysemy picta*), and herons (Ardeidae) are exclusively associated with the lowlands. Additional species include barred owl (*Strix varia*), screech owl (*Otus asio*), osprey (*Pandion haliaetus*), egrets (Ardeidae), red-shouldered hawk (*Buteo lineatus*), swamp rabbit, cottontail rabbit, fox squirrel, gray squirrel, flying squirrel, raccoon (*Procyon lotor*), opossum, gray fox, striped skunk (*Mephitis mephitis*), and deer (Bryant et al. 1993; Skeen et al. 1993).

Upland areas do not support aquatic species, but offer significant mast resources. As such, they are frequented by a wide range of animals that consume acorns and other nuts, including blue jays (*Cyanocitta cristata*), wild turkeys, gray and flying squirrels, white-tailed deer and various mice (Bryant et al. 1993; Skeen et al. 1993). Additional animals associated with the uplands include box turtles (*Terrapene carolina*), gray fox, raccoon, opossum, and striped skunk (Bryant et al. 1993).

The major distinction between oak-hickory and oak-hickory-pine forests is the quantity of wildlife that they support. Because pines comprise a significant portion of the forest, oak-hickory-pine communities generally do not yield the quantity or density of mast resources that oak-hickory forests do. Furthermore, pine forests tend to be associated with lower quality soils (Harper 1942), suggesting lower productivity in general. Thus although widespread, wildlife in the oak-hickory-pine region is “not necessarily abundant” (Skeen et al. 1993:16).

Limestone outcrops occur primarily in oak-hickory forests, creating glade openings. The thin soil in these areas support grasses and other perennial herbaceous taxa that are intolerant of shade. Cedar, hackberry and shrubs such as sumac (*Rhus* spp.) and black haw (*Viburnum rufidulum*) grow where soil depth permits. The outcrop glades are frequented by cardinals (*Cardinalis cardinalis*), field sparrows (Emberizidae), blue jays, crows (*Corvus brachyrhyncohs*), and other birds. Small mammals such as mice and chipmunks will also visit glades but only when food and cover are available (Quarterman et al. 1993).

In general, the research area supports a wide variety of wildlife. The Tennessee River and its tributaries provide habitat for waterfowl, aquatic mammals, amphibians, reptiles, fishes, and at one time a remarkably diverse community of fresh-water mollusks. Over 250 species of birds populate the canopy and understory of the oak-hickory-pine and oak-hickory forests of the region. Mast from these trees feed various animals, including squirrels, mice, deer, turkeys, blue jays and woodpeckers (Picidae); seeds of herbaceous plants also provide food for a remarkable range of birds and small animals (Bryant et al. 1993; Skeen et al. 1993). Although the animal communities found within the oak-hickory and oak-hickory pine forests are similar in the species they include, the density of animals, particularly small mammals, is somewhat lower in the latter, primarily due to differences in the availability of food resources between the two (Skeen et al. 1993:22).

SUMMARY

Plant and animal communities in the Southeast have changed dramatically over the last 15,000 years, particularly as climate changed at the close of the last ice age. Oak-hickory and oak-hickory-southern pine forests replaced boreal species, while Pleistocene fauna became extinct and animals that prefer cooler conditions moved northward. Different species of both plants and animals migrated at different rates and in different directions, resulting in communities that do not have analogs in the present. However, these communities were likely shaped largely by local physiography in the past as they are today. Thus lowland communities along the rivers were likely more productive than the uplands, and the karstic uplands of the Highland Rim richer than the sandstone uplands of the Fall Line Hills and Cumberland Plateau.

It is also important to note the interactions between plant and animal communities, and also between these and human populations. Just as animals affect the range of particular plants through seed dispersal and encourage growth of other species by browsing and foraging, humans also actively shape plant and, by extension, animal communities. People may manage forests and clearings through pruning, coppicing, and burning undergrowth (Delcourt et al. 1998; Fowler 1996; Munson 1986). As such, hunter-gatherers enhance the productivity of plant resources, not just for themselves but also for animals, including prey species. They can thus maintain stands and clearings that provide plant foods and at the same time attract game.

Whether Late Paleoindian and Early Archaic hunter-gatherers were actively managing ecological communities through use of fire and other methods may be debatable, although I suspect they were. Regardless, these groups were agents on the landscape, affecting the animal populations which they hunted, fished, and collected; competing for nuts, berries and seeds with birds, deer, and small mammals; and disturbing plant communities with their trails and base camps. The landscape cannot be viewed simply as a backdrop on which early foragers went about their daily lives, but instead early foragers must be seen as active components within an ever-changing and meaningful landscape.

CHAPTER FOUR:
ARCHAEOLOGICAL RESEARCH IN THE MIDDLE TENNESSEE RIVER VALLEY

Northwest Alabama claims one of the richest archaeological records of early hunter-gatherers in the United States; more fluted Paleoindian points have been found in each of Lauderdale and Colbert counties than in most states (Futato 1982). This is in part due to the abundance of resources available within the area to these groups, but also is related to the extent of archaeological research performed there. In this chapter I present an overview of research performed in Lauderdale, Colbert, and Franklin counties over the past 70 years. I highlight several important sites within the area, as well as several in close proximity that have significantly shaped our understanding of early occupations in the area. I also discuss several studies of site patterning within the region. Finally, I detail the excavations and research performed at the four rockshelter sites that comprise this study.

PREVIOUS ARCHAEOLOGICAL RESEARCH

The Middle Tennessee River Valley has received much attention over the last century from people interested in Native American artifacts. Many are not professional archaeologists, which can be problematic. Collecting is apparently a favorite pastime of many of the locals, and looting of sites is rampant (Futato 1996; Goldman-Finn 1995a; Oakley and Futato 1975; personal observation[1]). However, the interest of non-archaeologists has also been positive. Avocational archaeologists such as Frank Soday, Jack Cambron, and David Hulse have added significantly to the body of knowledge regarding prehistoric occupation of Alabama through the discovery, recording, and sometimes

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[1] The number of people who approached our vehicles marked with "University of Alabama Division of Archaeology" to tell us about the fields they recently walked, or used to walk with their dads and granddads, is striking and sometimes disheartening.

excavation of sites, as well as cataloging and describing artifacts. Numerous sites have been documented and reported by collectors and members of archaeological societies that might otherwise have gone unnoticed (Cobb et al. 1995; Hubbert 2004; Walthall 1980). Local chapters of the Alabama Archaeology Society have provided venues for archaeologists to present their work to interested people, and also have supplied funding and invaluable volunteer labor for surveys and excavation projects, including Stanfield-Worley and Dust Cave (DeJarnette et al. 1962; Driskell 1996; Goldman-Finn 1995a; Walthall 1980).

Perhaps the first avocational archaeologists to do research in the Middle Tennessee Valley were Squier and Davis, who mapped the Florence mound in their studies in the 1840s (Figure 4.1). Not until the late 1800s were the first archaeological excavations performed in the area, when Cyrus Thomas and his crew recorded and dug two mound sites in Lauderdale County. Mounds also interested Clarence B. Moore, who traveled down the Tennessee River in the early 1900s in his houseboat, the *Gopher*. He documented some eleven sites and site complexes in Colbert and Lauderdale counties, including mounds and "dwelling sites" (Goldman-Finn 1995b:17-20).

Walter B. Jones and David L. DeJarnette of the Alabama Museum of Natural History initiated a more comprehensive survey of archaeological sites in the Tennessee River Valley in 1932 (Walthall 1980:2). The Museum also excavated Reeder Mound, at the mouth of Mulberry Creek in Colbert County, and a cave site on Little Bear Creek in the early 1930s (Goldman-Finn 1995b:21). Intensive investigation of the valley began in 1934, as salvage archaeological work commenced in light of the impending construction of Pickwick Landing and Wheeler Dams by the Tennessee Valley Authority and resulting inundation of a considerable portion of the floodplain in Colbert and Lauderdale counties.[2] These efforts were directed by William S. Webb, while DeJarnette supervised fieldwork. With extensive labor provided by the Civil Works Administration and later the Works Progress Administration, the crews surveyed, mapped, and described some 323 sites in the Pickwick

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[2] Wilson Dam also significantly impacted the floodplain in these counties; it was completed in 1924, prior to significant archaeological investigation.

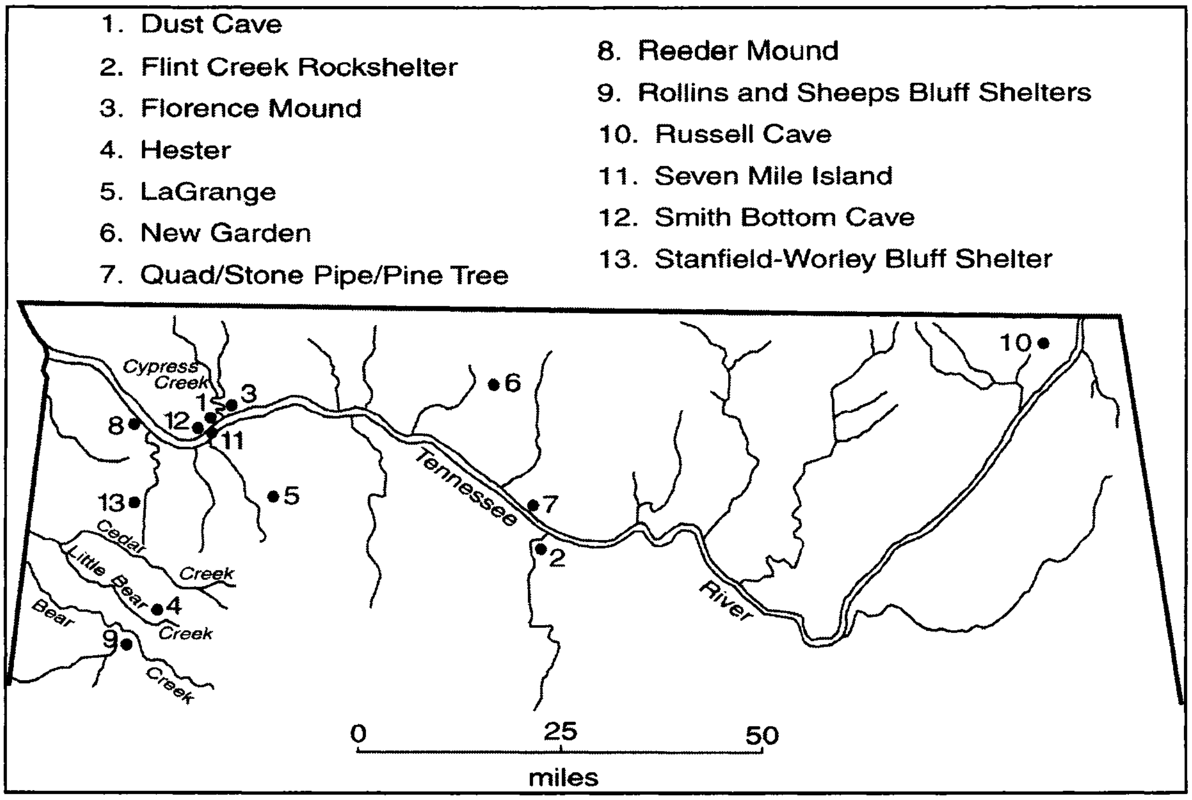

Figure 4.1. Map of Late Paleoindian and Early Archaic sites in north Alabama discussed in text.

Basin. Excavation began in 1936 and focused on the largest sites, namely mounds and shell mounds. With little time and water rising, nineteen sites were hurriedly, but systematically, excavated and documented (Goldman-Finn 1995b; Walthall 1980:3; Webb and DeJarnette 1942).

Little archaeology was performed in the Pickwick Basin during the 1940s and 1950s, although further upstream, avocational and professional archaeologists surface collected and excavated a number of sites, searching for evidence of Paleoindian occupations. These include the Quad site (Cambron and Hulse 1960; Soday 1954), Stone Pipe (Cambron 1955), Pine Tree (Cambron 1956), Flint Creek Rockshelter (Cambron and Waters 1959), and Russell Cave (Miller 1956), among others (Goldman-Finn 1995b:25; Futato 1996:299). With the aim of developing a chronology of these earliest occupations, the Archaeological Research Association of Alabama and the University of Alabama, under the direction of DeJarnette, began a program in the 1960s to test rockshelters in

Colbert and Franklin counties for stratified cultural deposits (Futato 1996:299). Stanfield-Worley Bluff Shelter in Colbert County (DeJarnette et al. 1962) was the first of these sites to yield significant evidence of early occupations, associated with Dalton and Early Side-Notched points. Additional sites excavated under this program include Rollins and Sheeps Bluff Shelters in Franklin County (Hollingsworth 1989; Stowe 1970), and LaGrange in Colbert County (DeJarnette and Knight 1976).

In the latter part of the 1960s and in the 1970s, archaeology throughout the state reorganized around cultural resource management. Large-scale surveys and more limited testing programs provided valuable information for areas that had previously received little attention (Futato 1996:302). A series of surveys and limited excavations were conducted in the Bear Creek drainage from 1967 through 1977, prior to the construction of dams on the Little Bear Creek (completed 1975), Upper Bear Creek (completed 1978), and Cedar Creek (completed 1979) (Futato 1983; Oakley and Futato 1975; TVA 2005). These surveys and excavations were conducted by the University of Alabama Department of Anthropology and Office of Archaeological Research, and funded primarily by the TVA and partially by the National Park Service. Additional survey projects in Lauderdale County included one focusing on Cypress Creek conducted by the University of Alabama in the early 1970s (O'Hear and DeJarnette 1974), and a survey of Seven Mile Island performed by Auburn University in the early 1980s (Waselkov and Morgan 1983). Waselkov returned to Lauderdale County in 1986 to survey areas surrounding the upland sinks (Waselkov and Hite 1987). Beginning in the late 1980s, the University of Alabama Division of Archaeology conducted a survey of TVA property in the Pickwick Basin, which included over 800 archaeological sites in Alabama, Mississippi, and Tennessee (Meyer 1995). Goldman-Finn (1995a) also directed a smaller survey project in 1994, crosscutting the Tennessee River floodplain and upland hills in Colbert and Lauderdale counties.

Interest in cave and rockshelter sites resumed in the early 1980s, when Richard Cobb, a local spelunker, brought several cave sites in the Pickwick Basin to the attention of University of Alabama archaeologists (Cobb et al. 1995). Excavation of Smith Bottom Cave began in 1984, and in 1988 the

Division of Archaeology began a survey and testing program of twenty caves, thirteen of which are listed as archaeological sites. One of these sites, Dust Cave, yielded significant cultural deposits and was further excavated from 1989 through 2002 (Driskell 1996, 2001; Sherwood and Driskell 2003); these efforts and the information gleaned from them will be discussed further below.

Archaeological investigations continue in the area today, primarily under the auspices of cultural resource management. Through the numerous survey and excavation projects conducted over the years, some 668 sites have been recorded in Lauderdale County, 536 in Colbert County, and 695 in Franklin County. Of these, 117 sites in Lauderdale, 62 in Colbert, and 32 in Franklin County have been identified as containing a Late Paleoindian and/or Early Archaic component (Alabama State Site File 2005) (Table 4.1).

KEY LATE PALEOINDIAN AND EARLY ARCHAIC SITES

The vast majority of Late Paleoindian and Early Archaic sites recorded by surveys in northwest Alabama are represented by lithic scatters and few diagnostic artifacts. However, several of the sites include much larger concentrations of artifacts, sometimes within the context of stratified deposits. These provide valuable information regarding early occupation of the region. I briefly discuss several of these sites that have substantially shaped our understanding of early peoples' occupation of the region below.

Quad Site

The Quad site is located on the north bank of the Tennessee River in Limestone County. Consisting of clusters of chipped stone artifacts, debris, and fire-cracked rock, the site may actually be thought of as a complex of sites stretching some three miles along the riverbank (Futato 1996:309; Hubbert 1989). Hubbert (1989:148) considers the Pine Tree site (Cambron 1956) and Stone Pipe site (Cambron 1955) to be within this complex. The Quad site is presently under the waters of Wheeler Lake, but while Wheeler Dam was being serviced in the early 1950s and the water level was

Table 4.1. Archeaeological Sites Recorded to Date in Lauderdale, Colbert, and Franklin Counties.

	Lauderdale County	Colbert County	Franklin County
Early Archaic sites	106	60	28
Late Paleoindian sites	48	20	11
Late Paleoindian and Early Archaic sites	117	62	32
Total sites	668	536	695

lowered, the site received much attention from local amateur archaeologists. Frank Soday (1954) discovered the site in 1951 and performed extensive surface collections. In 1959, Cambron and Hulse (1960) excavated 21 5-x-5-ft units between 9 and 12 inches in depth. Unfortunately, the site has now largely eroded away, is apparently deflated, and has been intensively collected, leaving little promise for future systematic excavation (Futato 1996:309; Hubbert 1989).

The materials recovered indicate that the locale includes multiple components. Paleoindian diagnostic artifacts include Clovis, Cumberland, Quad, Beaver Lake, and Dalton points; Early Archaic points include Early Side-Notched, Kirk Corner-Notched, and bifurcate forms (Cambron 1956; Cambron and Hulse 1960; Soday 1954). The Early Archaic occupation appears to be more extensive (Walthall 1980:51): while over 200 fluted points have been found at the site (Futato 1996:309), Early Side-Notched points from the Quad locale number near 3,100 (Randall 2002:60). A wide range of tools other than hafted bifaces were also recovered, including numerous scrapers, unifacial and bifacial knives, gravers, drills, hammerstones, and at least one mortar and one greenstone bead (Cambron and Hulse 1960). The majority of tools appear to have been made on locally available Bangor chert, although blue-gray Fort Payne chert also comprised "a considerable amount" of the stone artifacts (Cambron and Hulse 1960:26). Cambron and Hulse (1960:24) also encountered one feature, which contained fragments of raccoon bone (Cambron and Hulse 1960:24).

The diversity of the toolkit suggests use of the site as a base camp. Some have further suggested that the spatial clustering of artifacts represents repeated use of the Quad locale by small groups, due to its favorable location along the river (Soday 1954; Walthall 1980:33-34). However, Hubbert (1989:157) and Futato (1996:309) envision the Quad site as a locus of seasonal aggregation. Each cluster can then be thought of as representing the base camp of a single band, and the entire complex of clusters as the co-occupation of several related bands – or a macroband – that have coordinated their seasonal rounds to live along this section of the river at the same time.

New Garden

Located in the uplands of Limestone County, north of the Quad locale, the New Garden site is the only single component Early Side-Notched site recognized in the Middle Tennessee Valley to date (Randall 2002:58). Also collected by an avid amateur, Gene Lenser, the site's artifact assemblage includes a wide variety of tool forms, including uniface endscrapers and blades, stage bifaces, drills, and flake tools, apparently made from chert available as cobbles in a nearby stream. Some 42 Early Side-Notched points were also collected (Randall 2002:58; Walthall 1980:51). Based upon the site's proximity to a chert source, the various stages of tool manufacture and use present, and "a high percentage of workshop debris," Walthall (1980:51) suggests that the site served primarily as a stone-tool workshop and is therefore an example of a "limited activity work camp." Randall (2002:58-59) disagrees, however, arguing that the range of tool types from the site indicates that various activities were performed at the site.

Hester Site (1Fr311)

Located at the confluence of Lost Creek and Cedar Creek in the Fall Line Hills of Franklin County, the Hester site is now under the waters of Cedar Creek Reservoir. Investigations of the site by archaeologists in the 1970s recovered several Dalton and 26 Early Side-Notched points (Randall 2002:61), although previous efforts by local collectors apparently produced over 200 Dalton points (Futato 1996:312). The Early Side-Notched points are made primarily from locally available Tuscaloosa gravel and fossiliferous Bangor, although some 30% are made from blue-gray Fort Payne chert (Randall 2002:78). Randall (2002:87-88) also notes that the majority of these hafted bifaces (over 85%) are in the early stages of reduction, and suggests that tool production and replacement was more important to the site's occupants than tool conservation (Randall 2002:104).

Because of extensive collecting, cultivation, and construction of a Middle Woodland burial mound, no intact early deposits remain at the Hester site, but Futato (1996:312) suggests that it was intensively occupied during the Early Archaic. The wide range of bifacial and unifacial tools, as well as expedient flake tools, recovered from the site supports a base camp interpretation (Randall 2002:61-62).

Seven Mile Island Archaeological District

An area encompassing Seven Mile Island and Coffee Slough has been designated as an archaeological district on the National Register of Historic Places. This complex of islands and riverbank floodplains immediately downstream from the Muscle Shoals has been surveyed by Waselkov and Morgan (1983), as well as the University of Alabama's Office of Archaeological Services (Meyer 1995). The boundaries of the district are somewhat arbitrary, such that 159 sites are located within the immediate area, although only 122 are technically within the district's bounds. Of these 159 sites, 29 have Paleoindian and/or Early Archaic components (Meyer 1995:117-125). Two are cave sites: Smith Bottom Cave, which will be discussed further below; and Dust Cave, which I use in my analysis. Most of the sites have only been surface collected (Alabama Online Cultural Resources Database 2005), although test excavations have been conducted at several. Among these is the Refuge Site (1Lu356), a stratified open-air site at the mouth of Cypress Creek. This site contains a Kirk Corner-Notched component, which Meeks (1997:75) interprets a residential base camp that may have been occupied in fall or winter. A deeper stratum, from which a uniface blade was recovered, may represent a Late Paleoindian component (Meeks 1997:75).

With numerous sites lining the rises of the islands and creek banks, the Seven Mile Island Archaeological District is reminiscent of the Quad locale. Located in a similarly rich environment, or perhaps more so given the proximity of the shoals, Seven Mile Island also may well have served as a seasonal aggregation site for early macrobands (Randall 2002). Unfortunately, similar to the Quad locale, many of the sites are under water and/or significantly eroded by both the river and cultivation.

Smith Bottom Cave

Smith Bottom Cave was first brought to the attention of archaeologists at the University of Alabama in 1984 by Dr. Richard Cobb, a local teacher and avid speleologist. Cobb mapped a series of caves in the Pickwick Basin for the Alabama Cave Survey, and submitted an archaeological site form to the Alabama State Site File for this and other caves in which he found cultural materials (Cobb et al. 1995:220). Subsequent excavations at the site by field schools from the University of Alabama and University of North Alabama in 1984 and 1987 through 1989 (Cobb et al. 1995). This work revealed cultural deposits over 3 m in depth, both within the cave as well as the adjoining shelter area and talus slope. These deposits include a Late Paleoindian component represented by Quad and Dalton points, as well as uniface tools. Both an Early Side-Notched and Kirk Corner-Notched component are also present (Cobb et al. 1995:252-255).

Few interpretations about the nature of occupation at Smith Bottom Cave were made in the preliminary site report. Cobb and colleagues (1995:260) describe it as a habitation site, but do not venture further about the character of this habitation. Analyses of the extensive, well-preserved faunal remains found within the cave (Parmalee 1994; Snyder and Parmalee 1992) suggest that the site's early occupants exploited a variety of habitats, collecting mussels, fishing, and hunting waterfowl along the river and its tributaries; hunting and/or trapping small mammals, turkeys and deer in wooded and ecotone areas; and hunting birds in grassland areas that likely spotted the level uplands above the bluff line. The presence of waterfowl in the deposits indicates that Smith Bottom was occupied at least during the spring and/or autumn, although use of the site during other seasons is not precluded. These faunal analyses provide valuable insight to hunting and fishing pursuits of early occupants of the region, as faunal remains are poorly preserved at open-air sites.[3]

SITE PATTERNS IN THE MIDDLE TENNESSEE VALLEY

The various surveys, testing programs, and excavations performed over the last 70 years in the Middle Tennessee Valley provide a significant body of information for the nearly 1900 sites recorded in the three counties considered here. Several researchers have explored the site file data for patterning in site use through time. These patterns may then be used to suggest changes in mobility and settlement systems over time.

Focusing on sites in the Pickwick Basin of the Tennessee River, Futato (1995:273) notes that Paleoindian sites tend to be located on older levees or at the rear of the floodplain, where it meets the upland slopes. Sites are also not as strongly associated with the river as they are in later periods, but instead cluster 100 to 200 meters from first- or second-order streams. Early Archaic sites demonstrate slightly greater ties with the river, although still not as great as those seen during later periods (Futato 1995:272-273). Futato (1995) makes few interpretations from the data, simply noting that Paleoindian sites are more frequently found on older levees largely because modern levees post-date, and therefore obscure, these occupations.

Goldman-Finn (1994:222-223) compares the distribution of Early and Middle Archaic sites in five counties in northwest Alabama (Colbert, Franklin, Lauderdale, Lawrence, and Limestone), although she apparently lumps Dalton sites into the Early Archaic period. Similar to Futato, she notes that Early Archaic sites are much less likely to be found in the lower elevations of the floodplain than Middle Archaic sites, and instead are located in the uplands. Perhaps not surprisingly, Dalton/Early Archaic sites are highly associated with sinks, which are common in the karstic uplands of the region. In contrast, Middle Archaic sites show a greater association with the Tennessee River and first-order

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[3] Unfortunately, I could not locate floatation samples unequivocally associated with the Early Archaic and Late Paleoindian components at Smith Bottom Cave.

streams than do Early Archaic sites. Goldman-Finn (1994:223) suggests that these patterns represent coping mechanisms as peoples adjusted to drier and warmer environmental conditions during the Holocene.

Meeks (2001) compares Clovis through Bifurcate sites in the Highland Rim region of Alabama. His use of finer time intervals (Clovis, Cumberland, Quad, Dalton, Early Side-Notched, Kirk Corner-Notched and Bifurcate) produces slightly different patterns. While sites for all time periods tend to be associated with higher elevations, Dalton, Early Side-Notched, and Kirk Corner-Notched sites are more frequently found in riverine settings. Notably, less than 15% of Quad sites are located near the river. As seen in the other studies, Paleoindian sites are primarily associated with upland sinks, but Bifurcate sites show a similar correlation. Quad, Dalton, and to a lesser extent Kirk Corner-Notched sites were most frequently reoccupied in subsequent cultural phases. Meeks suggests that the larger size of Quad sites may be related to frequent reoccupation by Quad peoples. Taking the span of years encompassed by each cultural phase into account, he notes that Quad sites are relatively infrequent, but more significantly, the frequency of sites drops dramatically during the Bifurcate phase.

Like Goldman-Finn, Meeks draws upon changing climatic conditions to explain these differences. He links the Quad phase with the Younger Dryas event (12,900-11,600 cal B.P.), associated with a sudden drop in temperatures, particularly winter temperatures, and likely with a drop in resource availability as well. Meeks suggests that Quad groups reoccupied these sites frequently during this time of resource stress because they were advantageously located. The orientation of these sites away from the river was probably related to instability of waterways during this climatic oscillation. Dalton and later peoples reoccupied them because of their favorable locations. Interestingly, Dalton and Early Side Notched sites displayed similar patterns, suggesting little difference in settlement strategies for these time periods. Finally, Meeks hypothesizes that the decline in Bifurcate sites, and perhaps in population, may be related to the "8.2 ka" cooling event.

Of note is the fact that each of these researchers ties site distributions to the stability of the river, and often to changes in environmental conditions. The recurrence of this theme begs the question whether changes in river morphology have simply washed away evidence of occupation along banks and levees that are now inundated, silted over by new banks, or eroded by changing stream positions. Instability of rivers may have been less of a factor for relatively mobile groups with little investment in shelter or preparation of land, unlike more sedentary horticultural groups. The possibility that early sites are no longer visible because of fluvial activities must be kept in mind while reviewing such patterns.

ROCKSHELTER SITES

The geology of the research area is conducive to the formation of rockshelters and caves. The underlying limestone dissolves along joints and seams, creating passages and chambers in the bedrock that form caves. Cliff faces of either sandstone or limestone become weathered and erode to form rockshelters. The fundamental difference between the two is that ambient light, weather, moisture, and open-air plants and animals characterize rockshelters; true caves, on the other hand, are not penetrated by light, have nearly constant temperature and moisture, and are populated by specialized plants and animals (Collins 1995:353).

Numerous caves and rockshelters located in the limestone and sandstone bluffs of Lauderdale, Colbert, and Franklin counties have been recorded in the Alabama State Site File (2005). Fourteen caves and/or rockshelters are listed in Lauderdale County, two of which (Smith Bottom Cave and Dust Cave) contain deposits of early human occupation. In Colbert County, 40 caves and/or rockshelters are included in the site file; Stanfield-Worley and LaGrange are the only two known to contain Late Paleoindian or Early Archaic deposits. Fifty-six rockshelters and one cave with an associated rockshelter were recorded in Franklin County, in which sandstone dominates the surface geology. Of these, only Rollins Bluff Shelter is known to possess Late Paleoindian and Early Archaic deposits; two additional sites [1Fr323 (Sheeps Bluff Shelter) and 1Fr593] contain Early

Archaic components (Alabama State Site File 2005). Note that other rockshelter and cave sites may also hold evidence of early occupation in the region; many have yet to be systematically tested.

These four cave and rockshelter sites with Late Paleoindian and Early Archaic deposits form the backbone of this study. Their protected deposits not only contain stone artifacts but also well-preserved plant and animal remains, bone tools, and intact features. In addition, the sites were systematically excavated and plant materials were collected, albeit using different methods over the last four decades. The history of these excavations, performed largely by the University of Alabama archaeologists, is presented below.

Stanfield-Worley Bluff Shelter

In search of early occupation of Alabama, David DeJarnette began an excavation program targeting the deep deposits of the numerous rockshelters located in the northern hills of the state. The first site to provide such evidence was Stanfield-Worley Bluff Shelter (1Ct125), excavated between 1960 and 1963 (Futato 1996). Located approximately seven miles south of the Tennessee River, the shelter is situated in one of the many coves carved out of the Hartselle sandstone formation that caps the underlying Tuscumbia limestone. Eroded from the 100-ft-high bluff that lines the cove, Stanfield-Worley Shelter measures roughly 200 feet in length and between 20 and 60 feet in depth (DeJarnette et al. 1962).

During the first season in 1960, DeJarnette and his crew, comprised of University of Alabama students and volunteers from local chapters of the Alabama Archaeological Society, dug two 5-x-45-ft perpendicular test trenches in 4-in arbitrary levels at the site (Figure 4.2). The T-shaped trenches exposed the site's stratigraphy, which was divided into four zones (DeJarnette et al. 1962; Figure 4.3). Zone A was "loosely consolidated" (DeJarnette et al. 1962:2), measured between two and four and one-half feet deep, and included pits and animal burrows as well as charcoal and lenses of burnt clay. Cultural materials from this zone suggest Late Archaic through Mississippian occupations. The

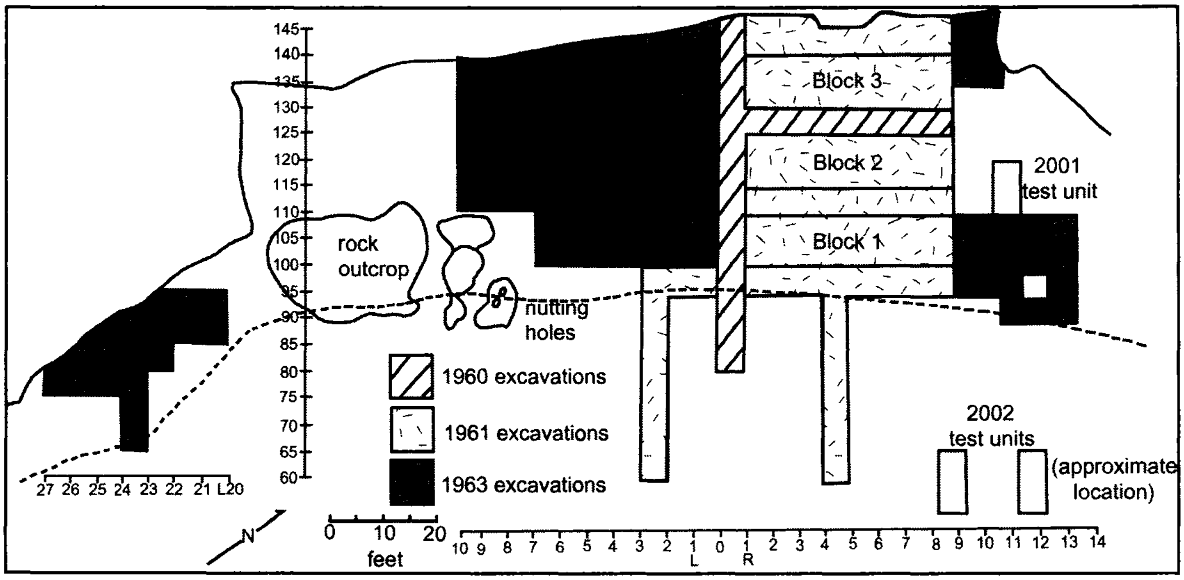

Figure 4.2. Map of excavations at Stanfield-Worley Bluff Shelter (1Ct125) (adapted from DeJarnette et al. 1962: Figure 9, Goldman-Finn 1997: Figure 2).

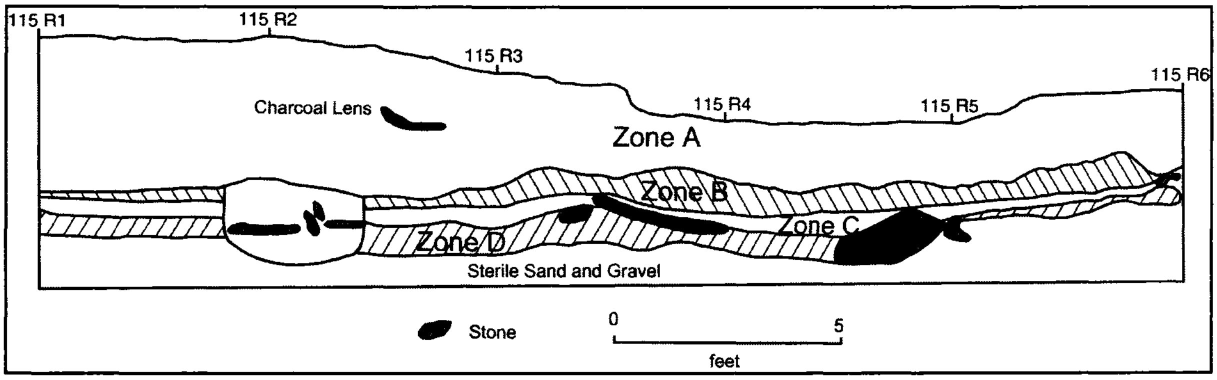

Figure 4.3. Stratigraphy shown in the 115 profile at Stanfield-Worley, excavated in 1961 (adapted from DeJarnette et al. 1962: Figure 9).

surface of Zone B was marked by "a very obvious occupational floor" (DeJarnette et al. 1962:2) of fire-hardened clay. This zone was roughly one-half foot in depth and includes a number of pit features as well as artifacts dating it to the Middle Archaic period, particularly the Morrow Mountain phase. Zone C was described as a sterile sandy layer, roughly 0.3 to 0.8 feet thick, fortuitously sealing off the underlying Zone D, or "Dalton Zone." This "dark-brown, midden stratum" (DeJarnette et al. 1962:2), only a few inches to 18 inches thick and flecked with charcoal, contained the evidence DeJarnette was looking for: Dalton points, as well as side-notched forms. Radiocarbon samples from this zone provided uncalibrated dates between roughly 9,000 and 10,000 years before present (Table 4.2). Zone D was underlain by a sterile zone of sand and gravel that terminated at an "indeterminately large rock" (DeJarnette et al. 1962:4).

DeJarnette and his crew returned to Stanfield-Warley in the 1961 season, excavating two additional trenches parallel to the back wall of the shelter with the added help of a local Girl Scout troop (Figure 4.2). These trenches isolated three large blocks with exposed profiles, which were then excavated by zone in 5-x-5-ft units. Excavators paid particular attention to the Dalton Zone, which was excavated in 1-inch arbitrary levels. Materials were screened through ¼-inch mesh, using mechanical agitation when the motors were working (1961 field notes).

The crew spent one final season at the site in 1963, mainly concentrating their efforts on the left half of the shelter (Figure 4.2). While they were able to discern several zones, they had difficulty matching these with the four zones described in the previous seasons in all but Block 7. Perhaps because of these difficulties, the report for the 1963 season was never completed (Graham and Pearson 1964).

Today the site remains much as it had since the close of the 1963 season. The excavations were not backfilled, although dirt was added to the profiles to create a slope so that the cattle that subsequently occupied the shelter would not be harmed (Bobby Stanfield, personal communication 2001). The bedrock of the shelter is exposed in a number of places. This includes a large, flat boulder into which numerous small, circular depressions had been ground. The similarities between these golf-ball-size cups and nutting stones are striking, so much that I would confidently describe it as the latter. Three "hominy holes" are also located in the bedrock around the perimeter of the shelter. Unfortunately, the site has been significantly impacted by looters; they have dug a number of pits along the back wall of the shelter, where local legends suggest Native American burials are likely to be located. These areas are also strewn with milk crates, gloves, and other refuse.

Table 4.2. Radiocarbon Dates from Zone D at Stanfield-Worley Bluff Shelter.

Sample	Radiocarbon date (uncalibrated)	Context within Zone D	Reference
M-1152	9,640 ± 450	Unit 130R3, collected at "vertical random"	DeJarnette et al. 1962:85, 87
M-1153	8,920 ± 400	R7 profile, collected at "vertical random"	DeJarnette et al. 1962:87
M-1348	9,040 ± 400	Block 2, Level 1, 1 inch below top	Josselyn 1964[a]
M-1347	9,340 ± 400	Block 2, Level 4, 4 inches below top	Josselyn 1965[a]
M-1346	9,440 ± 400	Block 2, Level 10, 10 inches below top	Josselyn 1966[a]
[b]Beta-205458	6,750 ± 40 (7,570-7,670 cal B.P.)	Unit 120R6, Level 2 (hickory nutshell; δ^{13}C = -26.2‰)	
[b]Beta-205459	10,010 ± 50 (11,250-11,670 cal B.P.)	Unit 125R3, Level 14 (hickory nutshell; δ^{13}C = -25.4‰)	

[a] Josselyn's dates are found in Goldman-Finn (1997: Table 3).

[b] AMS dates obtained with NSF Dissertation Improvement Grant #0332275.

In the hopes of finding intact deposits from which floatation samples could be taken, Asa Randall (University of Florida) and I excavated two test pits, measuring 1-x-2-m, in the unexcavated area in the right half of the shelter during the summer of 2001 (Figure 4.2). We fortunately clipped part of the 1963 excavations with one of our test pits. While we dug through zones similar to DeJarnette and colleagues' (1962) descriptions of Zones A, B, and C, we did not encounter Zone D, nor any diagnostic artifacts. In our test pits, Zone C appeared to grade into DeJarnette's underlying sterile zone of sand and gravel (Randall and Detwiler 2002). Instead, the Dalton Zone seems to have been located primarily in the central area of the site, pinching out towards the sides of the shelter. This corresponds to field drawings of profiles made by DeJarnette's crews, as well as Goldman-Finn's (1997) analysis of vertical distributions of artifacts at the site, which both illustrate a thinning of Zone D towards the edge of the shelter. We returned to the shelter in the summer of 2002 and similarly dug two test pits in the talus slope in front of the shelter with the assistance of students from Middle Tennessee State University (Figure 4.2). Unfortunately, we found more backfill, gravel, and poison ivy than anything else.

Artifacts. The original analysis of artifacts from Stanfield-Worley concentrated primarily on descriptions and tabulations of various stone and bone tools and ceramic sherds. Diagnostic points recovered from the Dalton Zone include Beaver Lake, several variations of Dalton, and Big Sandy or Side-Notched points. Depth distributions of these diagnostic tools suggested that they were coeval (DeJarnette et al. 1962), but in the original analysis, all levels greater than 36 inches in depth were lumped together. Goldman-Finn (1997) reanalyzed the vertical distribution of diagnostic points by unit along several of the gridlines, demonstrating that in some areas Side-Notched and Dalton tools can be separated by depth below datum. However, mixing of components was evident in other areas, not only by Dalton and Side-Notched points but also the inclusion of at least one Late Archaic form (Goldman-Finn 1997:8, 10).

Goldman-Finn (1997) analyzed an additional sample of the stone tools by artifact type, raw material, and use-wear. Artifact types include bifaces, uniface blades, scrapers, and flake tools, as well as bone awls and at least one hammerstone and pecked sandstone slab (DeJarnette et al. 1962:83-85; Goldman-Finn 1997). Microwear analysis of several of the bifaces, scrapers and flake tools suggest working of hide and wood at the site (Goldman-Finn 1997:29). In contrast, biface production seems to be limited. Few early-stage preforms are present, and many of the hafted bifaces show evidence of resharpening and/or have been reworked into drills, scrapers, awls and chisels (Goldman-Finn 1997:15). In addition, the majority of tools are made from blue-gray Fort Payne chert, which outcrops along the Tennessee River, rather than materials available near the site. This differs from later occupations of the site, when local raw materials were used more extensively (Goldman-Finn 1997:15).

Randall (2002:100) also notes the preferred use of blue-gray Fort Payne chert for Early Side-Notched hafted bifaces at Stanfield-Worley, as well as the significant quantity of late-stage bifaces (2002:103). He contrasts this high degree of "tool consumption" with the much more expedient toolkits used during the Early Side-Notched occupations at Dust Cave and 1Fr311, also within the Tennessee River Valley (2002:105). Randall (2002:103-104) suggests that the occupants of

Stanfield-Worley were not replacing their worn out tools while they were residing at the shelter because it was not convenient for them to do so; instead, they were busy with other activities, such as hunting deer and collecting and processing nuts.

Faunal analysis. Faunal remains were collected from the ¼-inch mesh used to screen the deposits. Paul Parmalee (1962) analyzed specimens from the 1960 and 1961 excavations, including materials from the Dalton Zone. Of the latter, some 94% could not be identified due to its fragmentary nature. Parmalee (1962:112) suggests that the occupants purposefully broke many of these, particularly the nearly 5000 large mammal bones that appear to be primarily deer, to extract the marrow. Of the 297 specimens identified to species, 162 are white-tailed deer, further indicating its importance to the diets of the site's occupants (Parmalee 1962:112, Table 32). However, Parmalee (1962:112) suggests that squirrel may have been selectively hunted as well, given the 57 identified squirrel remains and numerous unidentified small mammal elements that are likely squirrel. Similarly, turkey (n = 7, plus unidentified bird remains that are likely turkey) and turtles (n = 31) may have been relatively important (Parmalee 1962:112-113, Table 32).

Features. Few Dalton features were noted during the 1960-1961 excavations. DeJarnette and colleagues (1962:Figure 17) assigned eight features to Zone D, two of which were described as animal burrows. The remaining six are termed "midden-filled depressions," interpreted as "midden accumulation in natural depressions" (DeJarnette et al. 1962:25). In her analysis of rockshelter features, Homsey (2004:269) suggests that these features may be thought of as refuse deposits.

Homsey (2004:269-270, Figure 8.7) further examined features excavated during the unreported 1963 excavation, based on field forms. These include at least two additional midden-filled depressions, eight circular refuse pits, two centrally-located hearths, two patches of "fire-hardened clay," and three instances of bedrock mortars. The latter two feature types bear special mention. Fire-hardened clay masses at sites such as Dust Cave have been termed "prepared surfaces" by Sherwood (2001; Sherwood and Chapman 2003). These surfaces were intentionally constructed, through transport, smoothing, and firing of clay, and appear to have been multipurpose in function, whether providing a surface for activities, cooking, or heating (Homsey 2004:145-146; Sherwood 2001; Sherwood and Chapman 2003). At Stanfield-Worley, these prepared surfaces are located near bedrock mortars in Zone D (Homsey 2004:269). These mortars likely served as nutting stones; they include numerous small, circular depressions pecked into the large exposed sandstone boulders or bedrock encountered at the base of excavations and associated with Zone D.

Previous Site Interpretations. Using these various datasets, researchers have developed several interpretations regarding the early occupation of Stanfield-Worley. DeJarnette and colleagues' (1962:85-88) concluded that, based on the recovery of tools associated with hunting and hide preparation, the high proportion of deer remains and lack of implements for processing plant foods, the occupants who deposited Zone D relied heavily on hunting for their subsistence, at least during their time at the shelter. Goldman-Finn (1997:28) observes that the artifacts at the site are relatively dispersed through space, suggesting that the site was used sporadically for short stays. Occupation of the site may have become more intense by the Early Archaic period, as Early Side-Notched points are more prevalent than Dalton forms. While hunting and hide working are among the activities performed by site occupants, woodworking is evident as well from use-wear analyses (1997:29). Based on the heavy use of blue-gray Fort Payne chert, Goldman-Finn (1997:29) postulates that groups headed toward Stanfield-Worley and the uplands after visiting the Tennessee River in their seasonal rounds.

Randall (2002:103-105) reaches similar conclusions based on the large number of late-stage bifaces, noting that the occupants of Stanfield-Worley prepared their toolkits elsewhere, when it was more convenient. While at the site, likely during autumn, they focused their activities on food procurement and processing, notably hunting deer and gathering various nuts. These resources do present time constraints. Deer rut during the fall, and as such are more active and less nocturnal than other times of the year. In addition, they carry extra fat. Nuts begin to drop from trees in autumn, and are only available for several weeks before they are eaten or spoiled by squirrels, mold, and other competitors. Randall (2002:103-104) suggests, then, that the occupants of Stanfield-Worley had little time to make tools, busy as they were with hunting, preparing hides, and collecting and processing nuts. He cautions, however, that increases in Early Side-Notched bifaces are not necessarily equated with increases in population or intensity of site use (Randall 2002:106). He demonstrates that these bifaces have shorter use-lives than highly curated Dalton forms, and links their inexpensiveness to the fact that Early Side-Notched bifaces are more likely to be made with local materials than Dalton bifaces. The higher quantity of Early Side-Notched versus Dalton points at Stanfield-Worley should be viewed in light of this.

Rollins Bluff Shelter

Rollins Bluff Shelter (1Fr323) is another of the shelter sites excavated by DeJarnette, a crew of University of Alabama field school students, and volunteers from the Alabama Archaeological Society. Noel Read Stowe served as field supervisor and compiled the site report (Stowe 1970) for the 1968 season as part of his master's thesis. A second field season was apparently conducted at the site in 1969 but never reported (Futato 1983:6). The neighboring Sheeps Bluff Shelter (1Fr324) was excavated concurrently, but did not contain evidence of a Dalton occupation (Hollingsworth 1989).

Similar to Stanfield-Worley, Rollins Bluff Shelter eroded from the Pottsville sandstone formation, creating a semi-circular shelter some 85 feet wide and 30 feet deep (Stowe 1970:81). It had been used in the recent past as a sheep barn and to house a liquor still operation (Stowe 1970:83). At present, a small, intermittent stream flows over the roof in the northern half of the shelter, making this area damp and relatively unsuitable for habitation. Excavations were thus concentrated in the southern half of the shelter and talus slope (Figure 4.4; Stowe 1970:81-82, Plate 11).

The crew excavated a 5-x-25-ft trench in 4-inch arbitrary levels through the shelter and down the talus slope to obtain an extensive profile of the deposits. From these, the crew delineated seven

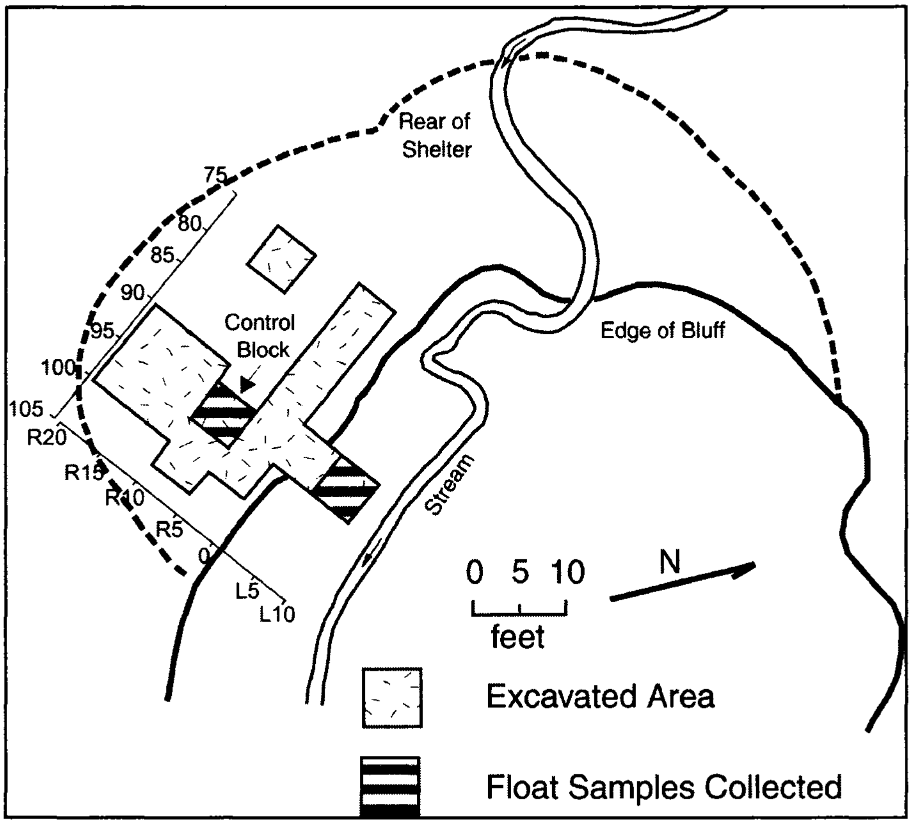

Figure 4.4. Map of excavations at Rollins Bluff Shelter (adapted from Stowe 1970: Plates 11 and 13).

zones of stratigraphy, the upper five of which contained diagnostic cultural materials (Figure 4.5). These cultural deposits thinned toward the rear of the shelter, as well as on the northern side, and indicated significant disturbance in these areas (Stowe 1970:84). The uppermost Zone A, a light-tan "sandy midden," was roughly 0.4 feet in depth and included both historic and Woodland period artifacts. Beneath this, the more "loosely packed" Zone B measured approximately 1.5 feet in thickness and contained Woodland and Archaic materials.

Zone C, a "chocolate-brown" midden, was encountered at about 2 feet below the surface and averaged 2 feet in thickness. It was limited horizontally to the area beneath the drip line and just inside the shelter. Artifacts recovered from the upper levels were diagnostic of the Middle Archaic period, while Early Archaic materials were found in the lower levels of the zone. Hickory nutshell from Level 5 of Zone C gave an AMS date of 8160-8360 cal B.P. (Table 4.3).

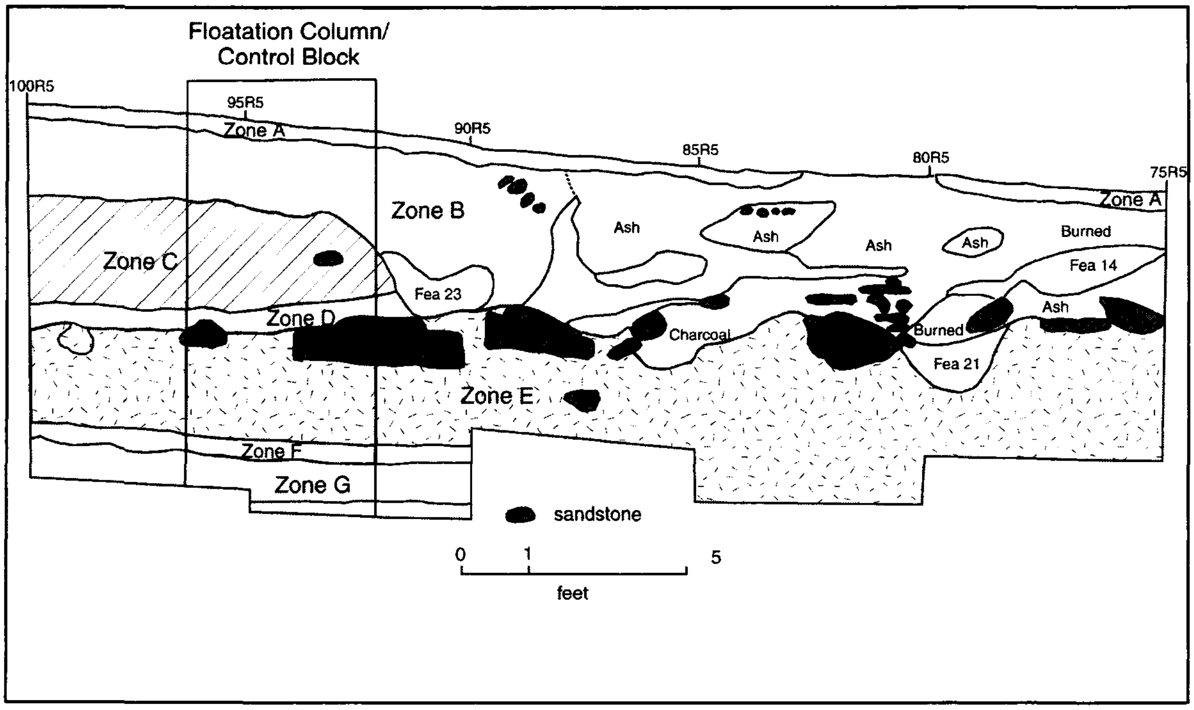

Figure 4.5. Stratigraphy shown in the R5 profile at Rollins Bluff Shelter (adapted from Stowe 1970: Plate 12).

Table 4.3. AMS Dates Obtained from Rollins Bluff Shelter (NSF Dissertation Improvement Grant #0332275).

Sample	Radiocarbon date (uncalibrated)	Calibrated Date (2 sigma)	Context
Beta 207215	7,430 ± 50 B.P.	8,160-8,360 cal B.P.	Control Block 1, Zone C, Level 5; hickory nutshell; δ^{13}C = -25.2‰
Beta 205462	8,910 ± 50 B.P.	9,890-10,200 cal B.P.	Control Block 1, Zone D, Level 2; hickory nutshell; δ^{13}C = -25.8‰
Beta 205463	10,000 ± 50 B.P.	11,250-11,650 cal B.P.	Control Block 1, Zone E, Level 3; hickory nutshell; δ^{13}C = -26.3‰

Zone D, found only in the vicinity of the drip line at about 4.2 feet below surface, measured roughly 0.5 feet in thickness. This “black, sandy midden” contained primarily Early Archaic artifacts. Stowe (1970:101) notes that some “Transitional Paleoindian” materials were recovered from the lower levels of Zone D, but he also includes Big Sandy or Early Side-Notched bifaces in this Transitional Paleoindian category. It is possible, then, that Zone D indeed primarily represents an

Early Archaic occupation.[4] An AMS date of 9,890-10,200 cal B.P. was obtained from hickory nutshell in Level 2 of Zone D (Table 4.3).

At 4.7 feet below surface, Zone E measured approximately 2.3 feet in thickness and consisted of sand and gravel eroded from the sandstone. Dalton artifacts were recovered from this zone only in units near the front of the shelter, although it extended across the site. Other than a few small chert flakes, few artifacts were found in Zone F, a dark brown layer with gravel and clay lenses encountered some seven feet below surface. Excavators delineated two additional sterile sandy zones, G and H, beneath Zone F. These lower levels appear to be alluvial in origin (Stowe 1970:125). Excavation concluded when the crew encountered the water table at 8.3 feet below surface (Stowe 1970:87-90). Hickory nutshell from Level 3 of Zone E gave an AMS date of 11,250-11,650 cal B.P. (Table 4.3).

Subsequent excavation in the remaining units proceeded in arbitrary 4-inch levels, with the exception of a central control block, which was dug by natural stratigraphy in 0.2-ft levels (Stowe 1970:84). All deposits from these units were screened through ¼-inch mesh. Sediment from the control block, features, and lower levels of several units were processed in the field using floatation to collect plant remains, after previously being screened through ¼-inch mesh to remove larger artifacts. Water from the stream flowing over the shelter roof was diverted into a coal scuttle using a gutter fitted with a screen to remove contaminants. Floating materials were collected from the scuttle using a "fine-mesh screen," dried, and stored (Stowe 1970:85).

Artifacts. Analysis of stone tools recovered from the site consists primarily of identification and tabulation of various types by level. In addition to hafted bifaces, Dalton toolkits included a variety of uniface and biface scrapers – end, side, ovate, core, and blade scrapers – as well as blades,

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[4] Based on Stowe's (1970) tabulation of artifacts by level rather than by zone, it is difficult to determine the association between levels, zones, and artifacts. While such analysis is beyond the scope of the present study, these tabulations should be revisited in future studies to clarify these associations, similar to Goldman-Finn's (1997) reassessment of the Stanfield-Worley artifacts.

utilized flakes, cores, pebble tools, and ground stone implements (Stowe 1970: Tables 14-16). Pebble tools include ovate and side scrapers, "split side and end" tools, and spokeshaves, and are fashioned from locally available yellow jasper, or Tuscaloosa gravel, in keeping with other pebble tools in the region (Futato 1996:301; Walthall 1980:23-25). Among the pecked and ground tools are hammerstones made from quartz and sandstone mortars and nutting stones. Mortars include stones with large circular depressions, while nutting stones claim one or more small circular depressions (Stowe 1970:119). Dalton artifacts cluster spatially in the area near the dripline (Stowe 1970:101). The reason for this is unclear, although fluvial activities may be to blame. Wet conditions may have made habitation of other areas of the shelter unpleasant. Alternatively, fluvial agents may have swept evidence of occupation from these other areas.

Early Archaic toolkits are broadly similar to Dalton artifacts, including unifacial and bifacial scrapers and knives, mortars, mullers, anvil stones and nutting stones, utilized flakes and cores. Two differences stand out between the Dalton and Early Archaic deposits. The first is an increase in number of artifacts recovered from Early Archaic levels (Stowe 1970: Tables 14-16). This trend is reflected as well by a substantial increase in the quantity of waste flakes greater than ¼ inch in size (Stowe 1970: Table 17), suggesting increasing intensity of site use or significant changes in the activities conducted at the site.

The second difference between the two components is the prevalence of raw materials used for tool manufacture. While locally available materials occur in significant quantities, Dalton points made from blue-gray Fort Payne chert slightly outnumber those manufactured from red jasper, or heat-treated Tuscaloosa gravel. During the Early Archaic, red jasper bifaces slightly outnumber blue-gray Fort Payne chert forms (Stowe 1970:109). Patterns among waste flakes greater than ¼ inch are strikingly different, however. Red jasper flakes significantly outnumber blue-gray Fort Payne chert flakes during both periods of occupation (Stowe 1970: Table 17). In fact, the ratio of Fort Payne to red jasper flakes is roughly similar for the two, averaging about 0.10 for the Dalton and 0.12 for the Early Archaic period (Table 4.4). This pattern suggests that blue-gray Fort Payne hafted bifaces

Table 4.4. Comparison of Waste Flakes of Red Jasper and Blue-Gray Fort Payne Chert from Rollins Bluff Shelter by Time Period (Stowe 1970: Table 17).

Period	Level	Red Jasper* (count)	Blue-Gray Fort Payne (count)	Ratio of Blue-Gray Fort Payne to Red Jasper (count/count)
Early Archaic	7	414	47	0.11
	8	297	23	0.08
	9	420	41	0.10
	10	348	53	0.15
	11	298	49	0.16
	12	403	35	0.09
	13	391	59	0.15
Dalton	14	175	28	0.16
	15	261	36	0.14
	16	195	1	0.01
	17	20	4	0.20
	18	32	2	0.06
	19	34	1	0.03
	20	3	0	0.00
	21	6	2	0.33
Total		726	74	0.10

* Heat-treated Tuscaloosa gravel.

were manufactured elsewhere, while occupants of the site made and maintained red jasper bifaces during their stay. Indeed, the cores recovered from these levels are of red and yellow jasper. The only other tool types consistently made from blue-gray Fort Payne chert are uniface tools and utilized flakes (Stowe 1970: Tables 14-16).

Faunal analysis. Animal remains were scarce at Rollins Bluff Shelter. Stowe (1970:124) postulates that conditions for bone preservation at the site are poor for two reasons. First, the presence of a stream flowing over the roof of the shelter, as well as moisture dripping from the ceiling onto the deposits, likely subjected the deposits to wet and dry periods not conducive to preservation. In addition, the deposits are acidic, which leads to decomposition of organic materials. Of the small amount of bone present, Stowe (1970:124) states that many appear to be white-tailed deer.

Features. Few features were recorded from the early deposits at Rollins. None are associated with the Dalton period. Among the Early Archaic features are five pits and a "sandstone arrangement" 2.0 feet across that Stowe (1970:127, Tables 9 and 10) interprets as a hearth. Stowe does not postulate about the function of the pits, but simply describes their contents, which consist primarily of waste flakes, chipped stone tools, and in some instances charcoal and ash (Stowe 1970: Table 9).

Previous Site Interpretation. Because little analysis was available other than that of the stone tools, Stowe (1970) relied heavily upon this artifact class for his interpretations regarding the occupation of Rollins Bluff Shelter. He highlighted the presence of ground stone tools in the Dalton component of the site, including mortars, mullers and nutting stones, and noted the contrast these presented with contemporary views of early groups as primarily relying on hunting. Based upon these, as well as the burned nutshell that had been cursorily examined from the floatation samples, Stowe (1970:126) argued that Dalton occupants were likely gathering seeds and nuts on a seasonal basis as well as hunting. The recovery of similar artifacts from the Early Archaic levels at the site suggests that the site's occupants continued to both gather and hunt various resources (Stowe 1970:127-128). Stowe also (1970:127) notes that blue-gray Fort Payne chert, or at least tools manufactured from it, was imported to the site from the Tennessee Valley. Early Archiac peoples living at Rollins may have used less of this higher quality chert, but they evidently continued to travel to or trade with peoples in the floodplain to some degree.

LaGrange Bluff Shelter

LaGrange was the last of the bluff shelters excavated by DeJarnette and his crew from the University of Alabama (Futato 1996:299). While similar to the previous two shelters in that it was created through the erosion of Hartselle sandstone, LaGrange differs in that it is located on the escarpment between the upland hills and the floodplain of the Tennessee River. Situated at the base of LaGrange Mountain, the shelter measures roughly 15 feet deep by 40 feet long (DeJarnette and Knight 1976:3).

Charles Hubbert of Florence State University (now known as the University of North Alabama) and a crew of volunteers conducted initial testing at the site in 1972, revealing evidence of a Dalton and a likely pre-Dalton occupation at the site. DeJarnette and his crew returned to the shelter in the summer of 1975 to excavate two 5-x-5-ft units which Hubbert had left as a control block, as well as two 1-x-5-ft units (Figure 4.6; DeJarnette and Knight 1976:4-5). With three profiles exposed, the crew delineated six strata at the site (Figure 4.7).

Zone A, a light tan, loosely consolidated sandy soil and averaging some 18 inches thick, contained artifacts from the Woodland and Mississippian periods. This uppermost zone had been disturbed toward the front of the shelter by looters' pits. Zone B, a darker brown clayey sand roughly 12 inches thick, supplied cultural materials dating to the Early, Middle, and Late Archaic periods. Zone C occurs in the rear of the shelter, but pinches out towards the front. The few artifacts recovered from this dark tan sandy layer date it to the Early Archaic period (DeJarnette and Knight 1976:7-9). However, hickory nutshell from Level 15 in Zone C yielded an AMS date of 8340-8410 cal B.P., placing it at the start of the Middle Archaic (Table 4.5).

Zone D, a "clayey chocolate brown sand," contained materials from the "Transitional Paleoindian" or Dalton period. However, these materials include Big Sandy, or Early Side-Notched, and St. Albans points (DeJarnette and Knight 1976:38), suggesting that the upper levels of Zone D should be classed as Early Archaic. In the southern portion of the control block, excavators could not distinguish between Zone D and the overlying Zone B, so they arbitrarily separated the two at 39 inches below datum (DeJarnette and Knight 1976:9). Zone E consisted of "a mottled brown sand." While it contained few artifacts other than chert flakes, its position beneath Zone D suggests that it is associated with a Dalton occupation. This is corroborated by an AMS date of 11,200-11,340 cal B.P. obtained from hickory nutshell in Level 19 of Zone E (Table 4.5). DeJarnette and Knight (1976:9)

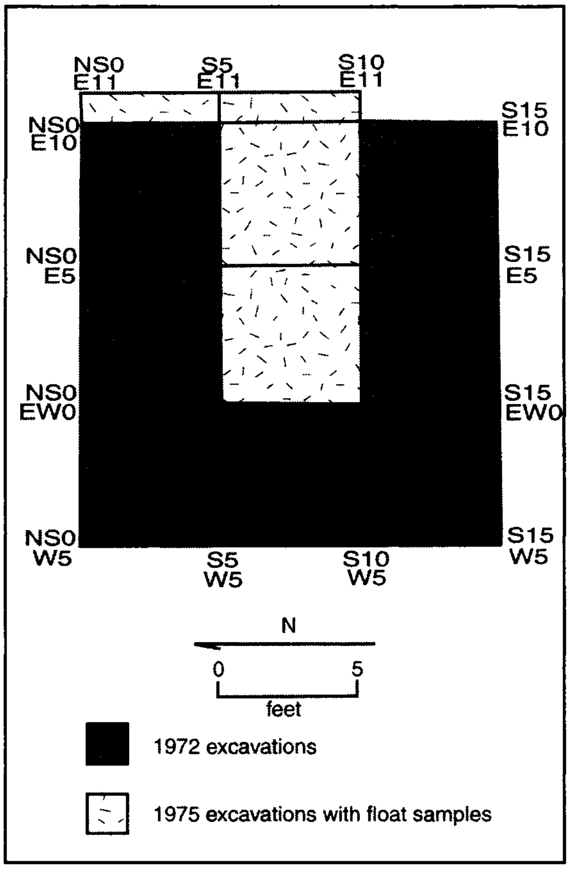

Figure 4.6. Map of excavations at LaGrange Bluff Shelter (adapted from DeJarnette and Knight: Figure 2).

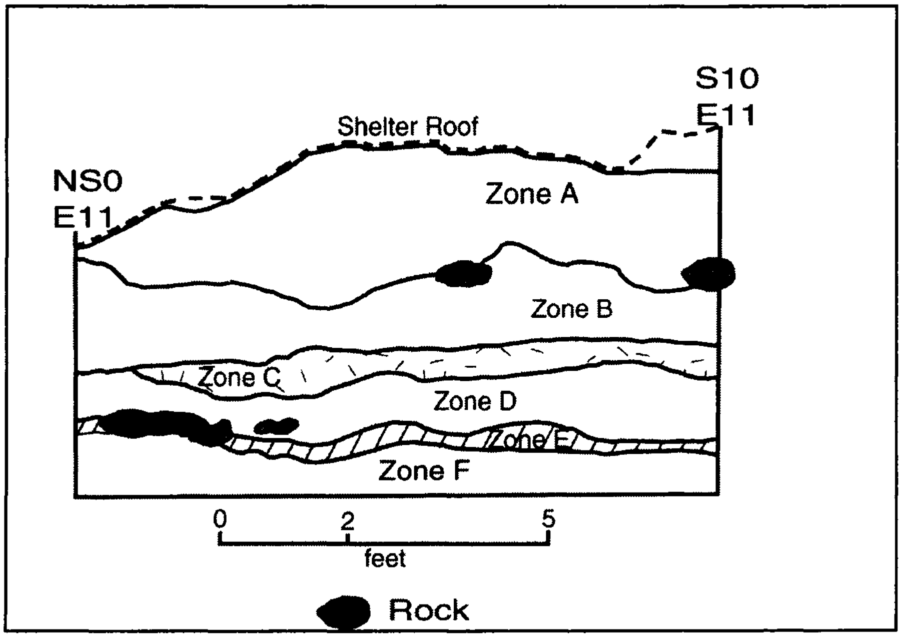

Figure 4.7. Stratigraphy shown in the E11 profile at LaGrange Bluff Shelter (adapted from DeJarnette and Knight: Figure 3).

Table 4.5. AMS Dates Obtained from LaGrange Bluff Shelter (NSF Dissertation Improvement Grant #0332275).

Sample	Radiocarbon date (uncalibrated)	Calibrated Date (2 sigma)	Context
Beta 205456	7,570 ± 40 B.P.	8,340-8,410 cal B.P.	Unit S10E10, Zone C, Level 15; hickory nutshell; $\delta^{13}C = -25.4‰$
Beta 205457	9,910 ± 50 B.P.	11,200-11,340 cal B.P.; 11,520-11,530 cal B.P.	Unit S10E10, Zone E, Level 19; hickory nutshell; $\delta^{13}C = -25.7‰$

presume that materials recovered from Zone F, a white sandy layer of decomposed sandstone bedrock, migrated down through the deposits from the overlying zones D and E.

Excavation of the control block proceeded in 3-inch arbitrary levels and all deposits were screened through ¼-inch mesh. Soil samples, weighing roughly 40 lbs, were also collected from each zone and processed through a three-column water screen. Plant materials, as well as small animal bones and chert flakes, were recovered from the smallest screen, with 0.59 mm openings. The plant remains were further removed through floatation using carbon tetrachloride (DeJarnette and Knight 1976:5).

Artifacts. Analysis of artifacts consisted primarily of tabulations and descriptions of various chipped stone tools by level. Dalton toolkits, in addition to hafted bifaces, included cores, biface blades and backed knives, and a variety of uniface tools, such as knives, end scrapers, and utilized flakes (DeJarnette and Knight 1976: 45-47, Tables 5 and 6). Five small fragments of abraded red ochre were also recovered from Dalton levels. DeJarnette and Knight (1976:47) speculate that these may have had ritual uses. The majority of the flakes from these lower levels are less than 10 mm in size, suggesting that site occupants regularly retouched the edges of their tools (DeJarnette and Knight 1976:48-49, Table 10). However, the five Dalton points recovered from the site showed no evidence of significant resharpening, nor were preforms found. This suggests that while hafted bifaces may not have been regularly manufactured at the site, at least within the area of excavation, Dalton bifaces were relatively disposable. This may be related to the availability of blue-gray Fort Payne chert in the nearby Tennessee River floodplain.

The upper levels of Zone D, which are associated with the Early Archaic period, yielded Big Sandy and St. Albans points, as well as numerous cores, a backed bifacial knife, retouched flakes, abraded red and yellow ochre, and a bone awl (DeJarnette and Knight 1975: Table 5). In addition, a large, tabular fragment of sandstone with a single "nutting depression" was recovered from one of the upper levels, and was associated with burned hickory nutshell (DeJarnette and Knight 1975:47).

Zone C, associated with the Early Archaic period, contained few artifacts. Several corner notched points were recovered, as well as a bifacial knife and three flake tools. In addition, a concentration of flakes was encountered toward the rear of the shelter, accompanied by nine cores (DeJarnette and Knight 1976:32). These cores are likely of blue-gray Fort Payne chert, which dominated the lithic assemblage at the site (DeJarnette and Knight 1976:49).

Similar artifacts were recovered from the lower levels of Zone B. These include Big Sandy, Decatur, and Kirk Corner-Notched points, bifacial blades, cores, and abraded red and yellow ochre (DeJarnette and Knight 1976: Table 3). In addition, specialized uniface tools clustered in the lower levels of this zone, including a knife and side and end scrapers, which DeJarnette and Knight (1976:29) associate with wood-, bone-, and hide-working.

Chert flakes recovered from the water screen were sorted by size and grouped according to zone. The greatest quantities of flakes were recovered from zones D and B, and the vast majority of flakes – at least 65% from each zone – are less than 10 mm in size. DeJarnette and Knight (1976:49) conclude that occupants retouched tool edges while using the site.

Although no quantitative data are given, the researchers remark that blue-gray Fort Payne chert dominates the lithic assemblage, practically to the exclusion of other chert types. They note the presence of Tuscaloosa gravel, but the relatively local availability of high quality Fort Payne chert apparently precludes significant use of other cherts (DeJarnette and Knight 1976:49).

Faunal analysis. Faunal remains were recovered in relatively low quantities from the site, and include no fish or bird species, and very few mollusks or snails (Curren 1976:56). Species recovered from the Dalton levels include deer, snake, opossum, raccoon, and turtle. Skunk, rabbit, deer, snake, and ground squirrel were identified among the upper, presumably Early Archaic levels of Zone D. All bone fragments recovered from Zone C were unidentifiable, and the only species evident among the lower levels of Zone B was fox (Curren 1976: Table 3).

Features. Few early features were encountered within the excavation block. One small, shallow, basin-shaped pit was excavated in Zone D. The fill of the pit, which intruded into Zone E, was similar to the matrix of Zone D but contained no artifacts. In addition, excavators noted an "occupational floor" in Zone D, described as "a large, irregular area showing signs of fire, with grey to black consolidated clayey soil" that covered the front half of the control block. The nutting stone and a Big Sandy point, as well as charcoal and animal bone, are associated with the floor (DeJarnette and Knight 1976:48, Figure 4).

The most significant feature excavated was a secondary burial located toward the rear of the shelter in Zone C. DeJarnette and Knight (1976:32) are confident of its association with Zone C rather than B because of the stark difference in color between the lighter sand of Zone C and the darker, more consolidated Zone B. The burial, a middle-aged adult of indeterminate sex, was covered by four sandstone boulders and interred with four flakes, one core, and one limestone fragment. A similar secondary burial, capped by sandstone, was encountered during the 1972 excavation of LaGrange, apparently near the base of Zone B. This individual was also a middle-aged adult of indeterminate sex, buried with a large, thick biface (DeJarnette and Knight 1976:32-34).

While several pits and hearths were encountered during excavation of Zone B, it is difficult to determine whether they are associated with the Early Archaic or subsequent Archaic occupations at the site. One small, circular pit containing charcoal and chert flakes was excavated near the base of Zone B, which DeJarnette and Knight (1976:31) suggest may have been used briefly as a fire basin.

Previous Site Interpretation. DeJarnette and Knight (1976:49-50) made few interpretations about the nature of the various occupations at LaGrange. They highlight the presence of plant processing tools, namely nutting stones, in the early levels of this site. Noting that similar artifacts were recovered at sites like Rollins Bluff Shelter, they suggest that previous understandings of Dalton peoples as relying heavily upon hunting should be re-examined. DeJarnette and Knight (1976:50) also postulate that the variety of diagnostic points recovered from the site is the result of many visits at the site by many different groups. In other words, the six point styles found in the Dalton level (Big Sandy, St. Albans, Dalton, Hardaway, Browns Valley-like and Beaver Lake) were deposited by six different social groups. They further relate this to relatively flexible territorial boundaries that shift frequently so as to accommodate these various groups within a single site over a relatively short period of time. Today, archaeologists likely agree that these point styles were used by different social groups, but consider few of them to be strictly contemporaneous (Anderson et al. 1996).

Dust Cave

Similar to Smith Bottom Cave, Dust Cave was originally noted in 1984 by Richard Cobb and slated for testing as part of the investigation of caves along the Tennessee River funded by TVA and directed by Boyce Driskell (Cobb 1987; Cobb et al. 1995; Goldman-Finn and Driskell 1994). The present-day entrance of the cave was only about 50 centimeters high and 2 meters across, leading to an entrance chamber measuring roughly 40 square meters in size. Passageways adjoin this chamber and extend another 20 meters or so into the bedrock before becoming too tight for exploration (Goldman-Finn and Driskell 1994:1-4). The cave opens to the southeast and overlooks Coffee Slough, a slow-moving backwater of the Tennessee River. Prior to damming of the river by the TVA, the slough would have been a stream fed by a permanent spring roughly 100 meters up the bluffline from Dust Cave.

In the summer of 1989, a small crew of University of Alabama field school students and volunteers dug five 30-x-30-cm test units at the site, two in the entrance chamber and three in the back passages of the site (Figure 4.8). The crew had decided to abandon the test pits and the site, as no artifacts had been recovered and the bottom of the pits were at arm's length, when excavators found several chert flakes and noticed a change in sediment color in Test Units A and D. Test Unit A was expanded to 2-x-2 meters in size and excavated to a depth of 160 cm, revealing Benton (Middle Archaic) artifacts, a human burial and a dog burial, and complex stratigraphy (Goldman-Finn and Driskell 1994:5-6).

Driskell returned with another field school in 1990 and expanded test efforts. Students increased the size of Test Unit E to one by one meter, and excavated both this and Test Unit A to bedrock. They also sank two additional 2-x-2-m test units, F and G, in the center of the entrance chamber and in the talus slope, respectively. No cultural deposits were encountered in G, and excavation was abandoned there at 3.5 m below surface.

In 1991, excavation proceeded in Test Unit F and Test Unit H, which spans the dripline. H began as a 2-x-2-m unit, but at 2 m below the surface was reduced to 1-x-2 meters in size; excavation of the east half of the unit continued down to bedrock at nearly 5 meters below surface. Test Units B and C were also excavated to bedrock.

During 1992, efforts turned to digging a 2-x-12-m trench through the talus and entrance chamber of the site, intersecting with Test Unit F. This trench, continued in 1993 and completed in 1994, provided an extensive profile of the site, revealing almost five meters of cultural deposits, represented by over 200 zones (Goldman-Finn and Driskell 1994:6-7; Figure 4.9). Forty-three radiocarbon samples provide dates that span from the Late Paleoindian (Quad) through late Middle Archaic (Benton) periods (Sherwood et al. 2004).

Geoarchaeological and micromorphological investigations of the site's deposits as well as of nearby Basket Cave, only 30 meters down the bluff and 6 meters higher than Dust Cave, suggest that during the Pleistocene Dust Cave was choked with alluvium from the Tennessee River. Around 18,700 cal B.P., the Tennessee River and local water table lowered, turning Dust and other caves into

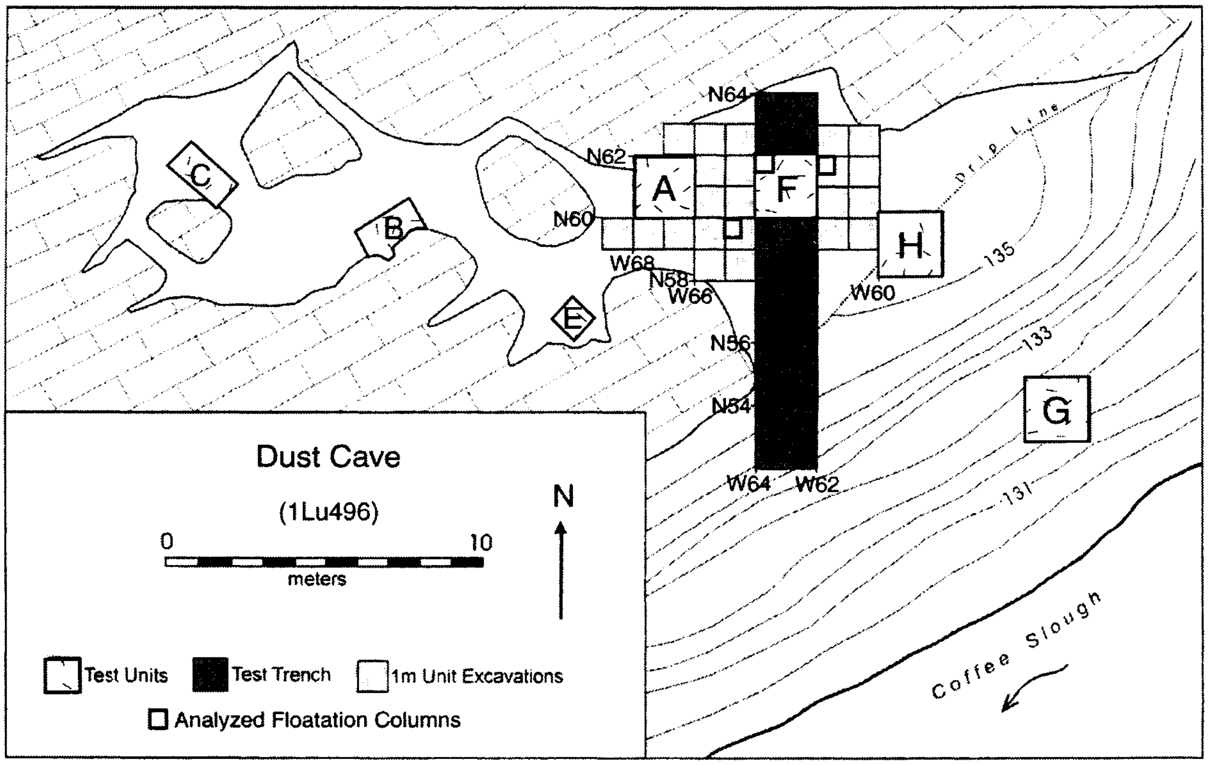

Figure 4.8. Map of excavations at Dust Cave (adapted from Sherwood et al. 2004: Figure 2).

conduits for draining springs. These springs flushed sediments from the cave, particularly the entrance chamber (Collins et al. 1994; Sherwood 2001). The lowest deposits at Dust Cave, Zone Y, represent both endogeneous cave sediments and Tennessee River alluvium that collected in drainage channels in the bedrock. Zone Y is culturally sterile, although faunal remains of extinct Pleistocene fauna including giant beaver (*Castoroides ohioensis*) and dire wolf (*Canis dirus*) were recovered (Parmalee, personal communication 1999; Sherwood 2001; Sherwood et al. 2004:540-542).

These sterile deposits are overlain by Zones U and T, associated with Quad and Beaver Lake points. Zone T also appears to include a Dalton component, suggested by four Dalton and Hardaway Side-Notched points. These deposits date between 12,650 and 11,200 cal B.P., and primarily formed as talus materials washed into the cave, and as periodic floodwaters brought in alluvial deposits. Occupants of the cave apparently focused their use towards the center and front of the entrance

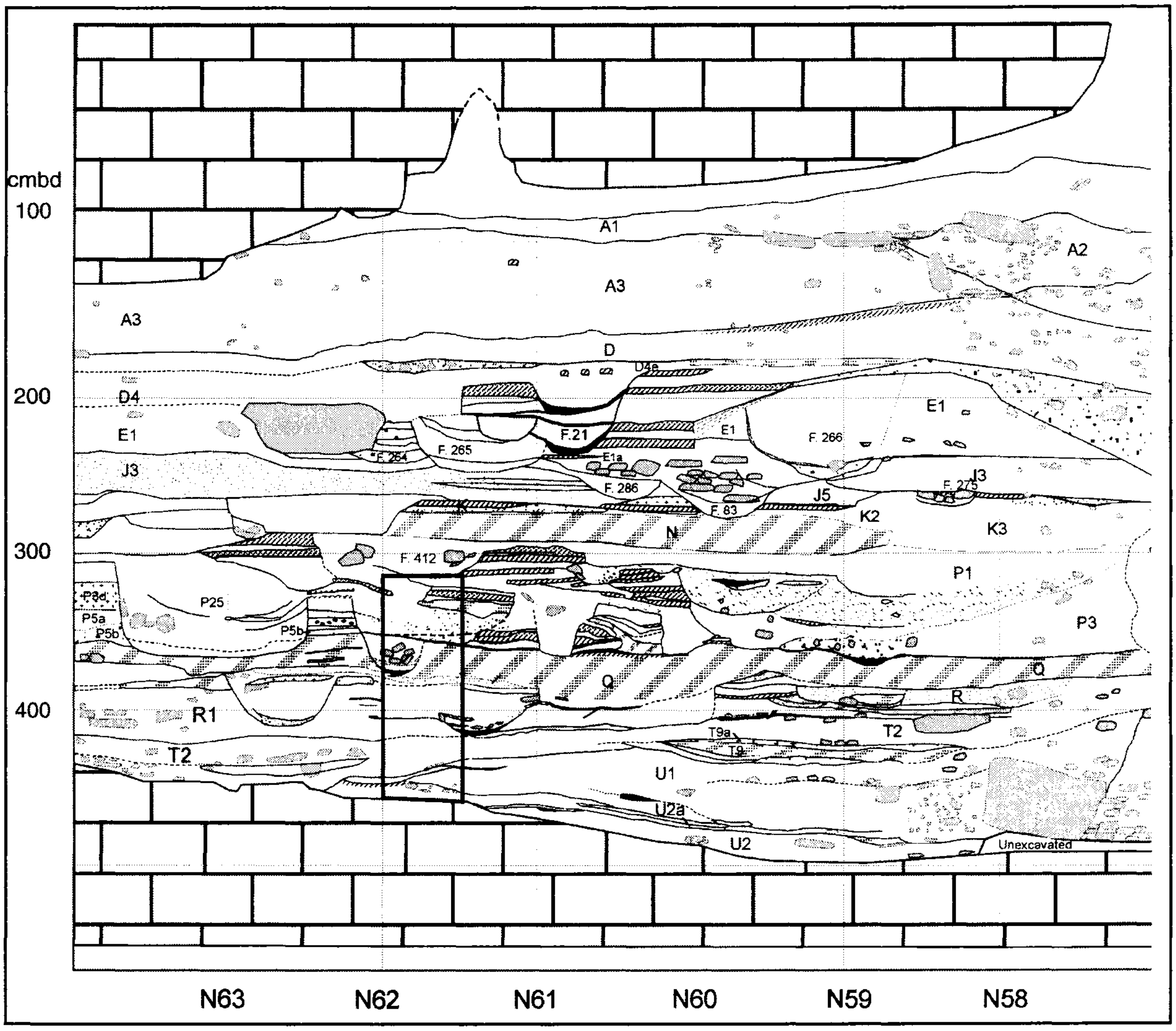

Figure 4.9. Stratigraphy shown in the W62 profile at Dust Cave (adapted from Sherwood et al. 2004: Figure 3). Rectangle denotes approximate location of floatation column in the N62W62 unit.

chamber, as the rear of the chamber was often damp (Homsey 2004; Sherwood 2001; Sherwood et al. 2004:544).

While intact anthropogenic features, such as charcoal pits and prepared surfaces (see below) first appear in Zone T, Zone R represents the first extensive and one of the most intensive occupations of the site. People appear to have used all areas of the entrance chamber during this Early Side-Notched component, dating between 11,200 and 10,500 cal B.P., and artifact density in this zone is notably high. In addition to Early Side-Notched points, several Kirk Corner-Notched bifaces were also recovered from the upper levels of this zone (Sherwood 2001; Sherwood et al. 2004:546).

The top of Zone R is marked by a disconformity with overlying Zone Q, a massive deposit that may represent several significant erosional events and slope washes. These events appear to have mixed Early Side-Notched materials from Zone R with what limited human occupation occurred during the deposition of Zone Q. These occupations are evidenced not only by features, although fewer than seen in Zone R, but also several Kirk Corner-Notched and Kirk Stemmed points among other stone tool artifacts and organic remains. Kirk Corner-Notched diagnostic bifaces (n = 10) are relatively rare at Dust Cave, leading Sherwood and colleagues (2004:548) to speculate that deposits associated with a Kirk Corner-Notched occupation may have been largely removed by the erosional events associated with Zone Q. A radiocarbon sample from the top of Zone Q yielded a date of 9,570 cal B.P. (Sherwood et al. 2004:548).

Zone P is associated with Kirk Stemmed and Serrated points, placing it at the transition between the Early and Middle Archaic periods. Two Kanawha bifurcate diagnostic bifaces were also recovered from this zone, which yielded dates between 10,200 and 7,800 cal B.P., although bifurcates usually date between 9,800 and 8,600 cal B.P. and Kirk Stemmed bifaces between 8,900 and 8,300 cal B.P. in the Middle Tennessee Valley (Sherwood et al. 2004:548). Zone P includes significant quantities of ash, as well as numerous charcoal pits, superimposed prepared surfaces, and possible storage pits (Homsey 2004). The sediments are largely anthropogenic and indicate intensive use of the site (Sherwood 2001; Sherwood et al. 2004:549).

An Eva/Morrow Mountain component corresponds with zones N, K, J and E, dating between 8,400 and 6,000 cal B.P. Zone N is associated with a number of burials that intrude into Zone P and more limited occupation of the entrance chamber, and includes both slope wash and anthropogenic deposits. Zones K, J, and E provide evidence of more intense use of the cave, with notably high levels of ash as well as numerous charcoal pits and stacked prepared surfaces, and are primarily anthropogenic (Sherwood 2001; Sherwood et al. 2004:549).

Zone D is associated primarily with Benton points, but also includes Sykes/White Springs and Crawford Creek diagnostic bifaces, as well as several Morrow Mountain bifaces (Meeks 1998). Use of the cave decreased during this component, evidenced by fewer features and deposits dominated by slope wash rather than anthropogenic materials. This drop in use is apparently related to the fact that by this point in time, between 6,400 and 5,600 cal B.P., sediments in the cave had accumulated within a meter of the ceiling: occupants simply had little room in which to perform daily tasks (Sherwood 2001; Sherwood et al. 2004:549-550).

People abandoned the cave altogether after roughly 5,600 cal B.P., without enough headroom to comfortably use the space. Zone A, composed of slope wash colluvium and sediments washing down through the cave itself, caps the cultural deposits. Measuring roughly 75 cm in depth, this sterile cap protected the deposits by discouraging would-be looters, but also nearly prevented discovery of cultural materials during the initial testing of the site (Sherwood 2001; Sherwood et al. 2004:550).

The excavations thus revealed extensive use of the entrance chamber of the site over the span of some 7,000 years. While bioturbation has disturbed some areas within the deposits, the sequence of radiocarbon dates and evident microstratigraphy indicate that the site's deposits are primarily intact (Driskell 1996; Sherwood et al. 2004). Little cultural material was recovered from the back passages of the cave, as cultural deposits thin towards the rear of the entrance chamber. In addition, few artifacts were recovered from the talus slope, although cultural debris that would have suggested use of the talus may have washed down the slope or decayed (Driskell 1994; Sherwood 2001; Sherwood et al. 2004).

With this stratigraphic and chronological information derived from the entrance trench, Driskell returned to Dust Cave with field schools in the summers of 1996 through 2000 and 2002 to excavate another two meters on either side of the entrance trench. These efforts aimed to gain more information about the use of the cave not only for the sake of research itself, but also because the site is threatened by the seasonal flooding of the Tennessee River each spring as the water level in

Pickwick Reservoir is raised and lowered by TVA. Subsequently, up to a meter of the lower deposits are saturated and then dried each year. During particularly wet seasons (such as the summer of 1997), up to two meters of deposits have been impacted by standing water. This wet-dry cycle has serious implications for the future preservation of organic remains at the site, as well as the complex microstratigraphy (Driskell 1996).

Major digging at the site concluded in 2002, as the crew encountered several burials in the units targeted for excavation. At the request of the Eastern Band of Cherokees, these burials were not further disturbed. Without disturbing these burials, few additional units could feasibly be excavated, bringing the field school to a close. A final season is planned to collect an additional set of micromorphological samples, stabilize the remaining deposits, and re-inter burials that had been excavated during previous seasons (Driskell, personal communication 2004; Sherwood et al. 2004).

Methods of excavation shifted over the eleven seasons spent at Dust Cave. The entrance trench was originally excavated in 2-x-2-m units, but the crew quickly shifted to 1-x-1-m units for more horizontal control. Similarly, the units were originally dug in arbitrary 10-cm levels, but as different zones were recognized and the need for finer vertical control became evident, levels were dug by zone in 5 cm increments. In 1992, the crew began excavating a 50-x-50-cm floatation column from every 2-x-2-m unit in the entrance trench, and then from just over half of the 1-x-1-m units excavated from 1996 through 2002. In order to obtain a larger sample of small animal remains from the Late Paleoindian deposits, floatation columns were excavated from Zone T and lower in all units. All features were excavated separately and floated in their entirety. Floatation samples were processed in the field using a modified SMAP machine fitted with either window screen mesh (1/16-inch or 1.6 mm openings) or 1 mm mesh to catch the heavy fraction and 0.3-0.5 mm fine mesh to capture the light fraction. A bubbler system was added to the setup in 1998 to aid the floatation of light materials. On occasions when time did not permit field processing, the Office of Archaeological Services at the University of Alabama processed the remaining floatation samples using a similar apparatus. All other deposits were water screened through ¼-inch mesh using water pumped from Coffee Slough, just outside the mouth of the cave (Goldman-Finn and Driskell 1994).

From the outset, Driskell employed a variety of specialists at the site, to better understand the various aspects of the cave's complex deposits (Driskell 1996:317). These include geoarchaeologists (Collins et al. 1994; Goldberg and Sherwood 1994; Gose 2000; Sherwood 2001; Homsey 2003, 2004), lithic specialists (Johnson and Meeks 1994; Meeks 1994, 1998; Randall 2001, 2002, 2003), zooarchaeologists (Goldman-Finn and Walker 1994; Grover 1994; Morey 1994; Parmalee 1994; Walker 1998, 2000, 2001, 2003; Walker and Parmalee 2004; Walker and Richardson 1999; Walker et al. 2005), archaeobotanists (Detwiler 2000, 2001; Detwiler-Hollenbach 2003; P. Gardner 1994; Pike 2003), bioarchaeologists (Hogue 1994, 2003), and a researcher interested in fibers (Freeman 2003). The close work of many of these specialists has led to the integration of various avenues of research (Pike et al. 2005; Sherwood et al. 2004; Walker et al. 2001). Below I briefly discuss what is currently known about the Late Paleoindian and Early Archaic occupations at the site.

Artifacts. Stone tools and the debris (debitage) associated with making and using them comprise the majority of artifacts recovered from Dust Cave. The most striking characteristic of this artifact assemblage is that the overwhelming majority of the stone tools are made from blue-gray Fort Payne chert. This high-quality stone resource, which outcrops in the immediate surroundings of the site, accounts for some 97% of all analyzed debitage and tools (Meeks 1994; Randall 2001).

The local availability of a high-quality tool stone significantly shapes the lithic assemblage at Dust Cave. First, occupants of the site appear to have made new tools and maintained their old ones. This is evidenced by the presence of middle- and late-stage bifacial preforms in all components, further suggesting that initial shaping of preforms occurred elsewhere (Meeks 1994:93, 96). In addition, the majority of the debitage falls into smaller size grades, also indicative of final shaping of tools and resharpening (Meeks 1994; Randall 2001, 2002:102). However, resharpening appears to be related to maintenance of tools and not conservation of materials (Randall 2002:101-2). This is suggested by the discard of used tools at the cave. Randall (2001) notes that more than 30% of Late Paleoindian points at the site were discarded due to breakage during use, and a significant number of the blades associated with the Late Paleoindian are highly fractured or have been retouched. In addition, Early Side-Notched points appear to have been discarded prior to being significantly reworked (Randall 2002). Based on this evidence, Randall (2001, 2002) suggests that the site's occupants did not feel a need to heavily conserve their stone tools in light of the ready availability of a high-quality local resource: the tools could be easily replaced. Occupants did not necessarily manufacture these tools for use at the cave, however, but more likely for subsequent use beyond the site. Similarly, all of the discarded tools were not necessarily used at the site, but may have been tossed out of toolkits as people retooled and geared up for future forays (Randall 2001, 2002; Walker et al. 2001:189).

In addition to making and maintaining tools, people were actively using them as well. Non-diagnostic tools present at the site include bifaces, end and side scrapers, gravers, and drills, as well as expedient flakes (Meeks 1994; Randall 2001, 2003). Formal uniface tools, including blades, scrapers, and gravers, are associated with the early occupations at the site; over 70% of these tools derive from the Late Paleoindian component (Meeks 1994:88; Randall 2001). Meeks (in Walker et al. 2001) performed a microwear analysis of a sample of 33 Late Paleoindian bifacial and unifacial tools, which indicated that a majority were used in tasks associated with butchering and hide-working. These include cutting meat and bone, scraping hide and bone, and perforating hides. Woodworking, such as adzing and whittling, was also evidenced by polish on several tools, as was the production of bone tools (Walker et al. 2001:184-187).

While the stone tool assemblage demonstrates a considerable degree of continuity through time, there are several trends. First, the use of blue-gray Fort Payne may increase through time. Of the 35 Late Paleoindian non-hafted bifaces examined by Randall (2001), only 29 (82%) were made on blue-gray Fort Payne (Table 4.6). The remaining were made primarily on other locally available cherts, although one was made from Bangor chert, which outcrops in north-central Alabama and is

Table 4.6. Comparison of Raw Material Use for Manufacturing Bifaces by Component at Dust Cave.

	Hafted Bifaces			Bifaces		
Raw Material Type	Late Paleoindian	Early Side-Notched	Kirk Stemmed	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Bangor	0	0	0	1	3	4
Blue-gray Fort Payne	13	30	21	29	87	78
Camden	0	1	0	0	1	0
Fossiliferous Bangor	0	0	0	0	2	1
Fossiliferous Fort Payne	0	0	0	0	5	0
Other Fort Payne	2	0	0	3	0	6
Pickwick	1	0	0	2	0	0
Tuscaloosa Gravel	0	0	0	0	0	1
Total	16	31	21	35	98	90

considered non-local (Meeks 1998; Randall 2001). The percent of non-hafted bifaces made from blue-gray Fort Payne increases slightly to 89% (87 of 98 total) in the Early Side-Notched; similar values are obtained for the Kirk Stemmed component (Randall 2001, 2003, personal communication 2005). In addition, slightly higher percentages of Early Side-Notched and Kirk Stemmed bifaces are made from Bangor chert, as well as locally available fossiliferous Bangor (Meeks 1998; Randall 2001, 2003).

Hafted bifaces demonstrate a more pronounced trend, although the sample size is relatively small (Table 4.6). Twelve of 14 (83%) Late Paleoindian hafted bifaces are made from blue-gray Fort Payne chert (Randall 2001, personal communication 2005). In contrast, blue-gray Fort Payne chert accounts for 38 of 40 (95%) Early Side-Notched hafted bifaces (Randall 2002), and 100% of 21 hafted bifaces associated with the Kirk Stemmed component (Randall 2003). This trend may suggest a decrease in mobility or in range of settlement patterns through time (Randall 2001), or more frequent returns to areas in which blue-gray Fort Payne is readily available. This trend toward increasing use of blue-gray Fort Payne chert is interesting because archaeologists usually associate the more technically-demanding Late Paleoindian hafted bifaces with high quality chert. Instead, a greater association with blue-gray Fort Payne chert is suggested with Early Archaic artifacts. Raw material choice may certainly have had as much of a social as a techno-functional component (Meeks 1998; Randall 2003).

Comparing the hafted and non-hafted bifaces, it is also of interest that greater percentages of non-hafted bifaces were made from other cherts. This likely does reflect a preference for high quality blue-gray Fort Payne for hafted bifaces. Occupants of Dust Cave seem more willing to use other cherts to make scrapers and other bifacial tools, and more willing to dispose of them at the site, perhaps as they retooled their kits.

As mentioned above, formal uniface technology is highly associated with the Late Paleoindian component. This holds true not only at Dust Cave, but also at other Late Paleoindian (including Dalton) sites throughout the Southeast (Meeks 1994:88). No blade cores have been recovered from Dust Cave, although several have been found at other sites in Coffee Slough near Dust Cave (Meeks 1994:101). Notably, all but one of the 156 unifaces studied by Randall (2001) were made from blue-gray Fort Payne chert.

Cores for producing expedient flakes are present at the site, all but one of which are blue-gray Fort Payne (Randall 2001, 2003). Of the 31 cores examined by Randall (2001), there are three times as many from the Early Side-Notched component as from the Late Paleoindian. Similarly, lithic debitage is notably higher in the Early Side-Notched than any other component at Dust Cave (Meeks 1994:91; Randall 2001). Indeed, a box plot of lithic material (weight divided by volume of sample) from the floatation samples I have analyzed with this project further demonstrates this trend (Figure 4.10). This may indicate more intensive use of the cave, a different focus of activities by the people who occupied the site (Meeks 1994:91; Randall 2001), and/or different technological constraints (Randall 2002:104).

In addition to chipped stone tools, ground stone and bone tools have been recovered from Dust Cave. Only five nutting stones have been recovered from the early components at the site, all from the Kirk Stemmed component (Randall 2003). This is not to say, however, that processing of nuts and use of nutting stones did not occur prior to this time at Dust Cave. The lack of nutting stones

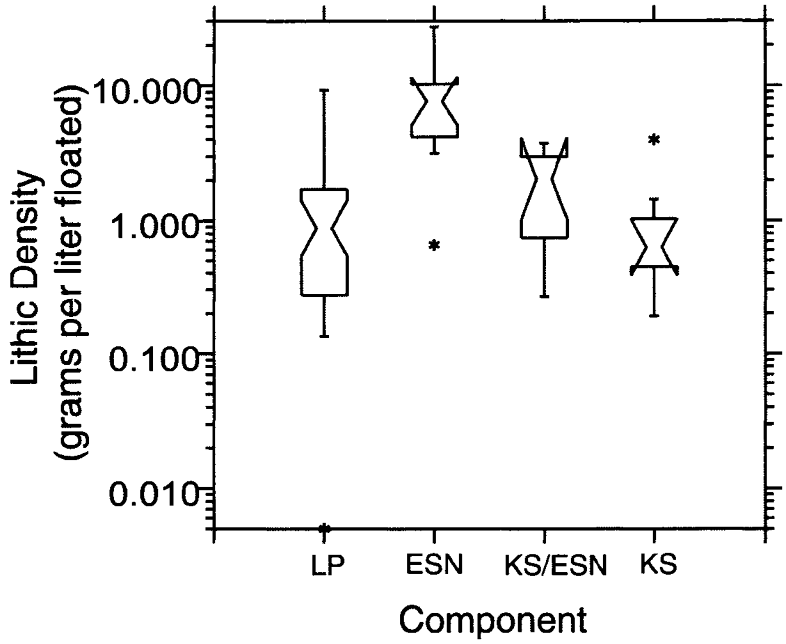

Figure 4.10. Boxplot comparing density of lithic debitage in floatation samples by component at Dust Cave. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

from earlier components is more likely related to the fact that excavators had difficulty recognizing nutting stones as such. Fashioned from limestone, the nutting stones initially appear to be spall from the ceiling of the cave; only when viewed from a different perspective are the depressions evident. Having narrowly rescued one from being tossed by a student, I wonder how many nutting stones have gone unrecognized and now lie in the slough beneath the water screen.

Bone tools are more numerous, however. Four awls, one perforated raccoon tooth, and one worked bone object were recovered from the Late Paleoindian component. Early Side-Notched bone tools include three awls, one bead or tube, one needle, a bone point, and an antler tine. In addition to eight awls and two needles, the Kirk Stemmed bone tool assemblage includes one fishhook, a perforated raccoon tooth, three fragments of polished turtle shell, and one worked object (Goldman-Finn and Walker 1994:110; Walker 1998:163). Most of the bone awls were made from the long bones of mammals, but several were fashioned from bird bones (Goldman-Finn and Walker

1994:110). Also of interest is a cache of 23 goose humeri excavated from the Late Paleoindian component at the cave, 13 of which had cutmarks. Walker and Parmalee (2004:30) suggest that these humeri may have been cached for the purpose of making tools and/or decorative objects, and note that caches of bird bones are extremely rare for such early deposits.

Faunal analysis. Walker (1998; Walker et al. 2001) analyzed faunal remains from randomly sampled proveniences within the entrance trench. Her samples include 46 floatation samples and 161 water screen samples. These samples yielded over 2,400 specimens from Late Paleoindian contexts, over 3,900 from the Early Side-Notched, and nearly 1,500 from the Kirk Stemmed component (Walker 1998). Of these, a smaller subset could be identified to class, family, genus, or species (Table 4.7).

Before comparing the faunal assemblages of the various components, it is important to note that bone preservation at the site is remarkable for all components. Comparisons of ratios of more durable fish vertebrae to more delicate fish ribs through time actually suggests that bone preservation is better in the Late Paleoindian and Early Side-Notched deposits than any of the subsequent components (Richardson 1998; Walker and Richardson 1999). Indeed, I frequently found fish scales in the floatation samples from these lower zones. It is possible that bone preservation appears better in the earlier occupations because of the intensive nature of subsequent occupations: increases in the intensity of daily activities, including trampling, sweeping, and cleaning, may have had negative consequences for the preservation and later recovery of fragile bone. Regardless, preservation of bone is remarkable throughout the cave, and as such does not introduce significant bias to the recovery of particular animal classes.

Walker's (1998; Walker et al. 2001; Table 4.8) results suggest several significant changes through time. Birds, particularly waterfowl, represent nearly 70% of the identifiable specimens in the Late Paleoindian faunal assemblage. Prairie chicken, bobwhite, and passenger pigeon are also present, as well as one specimen identified as turkey. Mammals constitute less than 20% of the

Table 4.7. Faunal Remains from the Late Paleoindian and Early Archaic Components at Dust Cave (Walker 1998: Table 7.1).

Taxon	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Opossum (*Didelphis marsupialis*)	1	7	7
Shrews (*Sorex* spp.)	2		
Shorttail shrew (*Blarina brevidauda*)	1		
Moles (Talpidae)	1		
Eastern mole (*Scalopus aquaticus*)	1		
Bats (Vespertiliondiae)	5	1	2
Raccoon (*Procyon lotor*)	15	9	8
Weasels/skunks/mink (Mustelidae)	1	2	
Weasel/mink (*Mustela* sp.)		1	
Mink (*Mustela vison*)	1		
Striped skunk (*Mephitis mephitis*)			1
Dogs/wolves/coyotes/foxes (Canidae)		1	1
Dogs/wolves/coyotes (*Canis* sp.)	12		2
Red fox cf. (*Vulpes fulva* cf.)	1	2	
Gray fox (*Urocyon cinereoargenteus*)	2		
Eastern chipmunk (*Tamias striatus*)	2		
Woodchuck (*Marmota monax*)		1	
Squirrels (*Sciurius* sp.)		3	
Gray squirrel (*Sciurius carolinensis*)	9	70	51
Eastern fox squirrel (*Sciurius niger*)	1	4	3
Beaver (*Castor canadensis*)		1	
Mice, rats, voles (Cricetidae)	4	3	
White-footed/deer mice (*Peromyscus* sp.)	1	3	
Eastern woodrat (*Neotoma floridana*)	2	1	1
Voles (*Microtus* sp.)	14	1	
Muskrat (*Ondatra zibethica*)	11	10	1
Rabbits (*Sylvilagus* sp.)			6
Eastern cottontail (*Sylvilagus floridanus*)	14	13	8
Swamp rabbit (*Sylvilagus aquaticus*)	5		2
White-tailed deer (*Odocoileus virginianus*)	7	35	9
Indeterminate Mammal	177	168	120
Small Mammal/Bird	1		3
Waterfowl (Anatidae)	8	7	2
Geese (Anserinae)	3	2	
Diving ducks (Aythyinae)		1	
Snow goose (*Chen caerulescens*)	1		
Canada goose (*Branta canadensis*)	2	3	
Marsh ducks (*Anas* sp.)	10	10	2
Mallard (*Anas platyrhynchos*)	2	2	
Turkey (*Meleagris gallopavo*)	1	5	1
Pheasant/prairie chicken (Phasianidae)			1
Prairie chicken (*Tympanuchus cupido*)	7	3	
Common bobwhite (*Colinus virginianus*)	9	4	1
Hawks/eagles (Accipitridae)	2		

Table 4.7 (continued). Faunal Remains from the Late Paleoindian and Early Archaic Components at Dust Cave (Walker 1998: Table 7.1).

Taxon	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Barred owl (*Strix varia*)			1
Passenger pigeon (*Ectopistes migratorius*)	8	4	1
Blackbirds/orioles (Icteridae)	1		
Common grackle (*Quiscalus quiscula*)	1		
Indeterminate Bird	988	499	197
Frog/toad (Anura)	4	1	
Frogs (*Rana* sp.)	6	1	
Bullfrog (*Rana catesbeiana*)	2		
Turtles (Testudines)	18	27	18
Stinkpot (*Sternotherus odoratus*)		5	4
Pond, Marsh, Box Turtles (Emydidae)	1	18	6
Eastern box turtle (*Terrapene carolina*)	9	13	2
Painted turtle (*Chrysemys picta*)			1
Snakes (Serpentes)	1	2	
Non-venomous Snakes (Colubridae)	13	5	2
Venomous Snakes (Crotalinae)		6	1
Sturgeons (Acipenseridae)	1		
Gars (*Lepisosteus* sp.)		2	1
Pikes/pickerels (Esocidae)		1	1
Suckers (Catostomidae)	20	43	10
Redhorse (*Moxostoma* sp.)	1	4	4
River redhorse (*Moxostoma carinatum*)		5	
Golden redhorse (*Moxostoma erythrurum*)	5	3	1
Bullhead catfish (Ictaluridae)	2	3	3
Channel catfish (*Ictalurus punctatus*)	2		
Bass/sunfish (Centrarchidae)	1	11	4
Bass (*Micropterus* sp.)		1	1
Largemouth bass (*Micropterus slamoides*)		5	2
Walleye/sauger (*Stizostedion* sp.)	1		
Freshwater drum (*Aplodinotus grunniens*)	7	10	
Indeterminate Fish	88	378	140
Unidentifiable	897	2487	847
Total	2413	3907	1479

sample, and are better represented by moles, shrews, mice, rats and voles than larger mammals. Other mammals include raccoon, squirrels, eastern cottontail, swamp rabbit, gray fox, opossum, mink, and muskrat. Only seven white-tailed deer specimens were identified. Fish, primarily suckers, redhorse, catfish, and drum, comprise 8% of the Late Paleoindian assemblage. Reptiles and

Table 4.8. Distribution of Animal Classes by Component at Dust Cave (Walker 1998).

Class	Late Paleoindian (%)	Early Side-Notched (%)	Kirk Stemmed (%)
Mammals	19	24	35
Birds	69	38	33
Amphibians	1	0.1	0
Reptiles	3	5	5
Fish	8	33	27

amphibians are present in low numbers, which changes little through time. Amphibians are represented primarily by frogs, and reptiles by eastern box turtles and non-venomous snakes (Walker 1998).

By the Early Side-Notched, birds drop significantly to only 38% of the assemblage, but are still heavily represented by waterfowl. Mammals increase to 24%, bolstered by an increase in gray squirrel and white-tailed deer (NISP = 35). Shrews and moles are notably absent from this and later components, and voles decrease significantly. Also of note is the significant increase in fish to 33% of the assemblage, most of which are suckers, bass/sunfish, and drum (Walker 1998).

The Kirk Stemmed assemblage was the smallest analyzed, with only 43% of the 1479 specimens identifiable. Of these, mammals comprised 35%, a considerable increase over earlier deposits. The mammals are represented primarily by gray squirrel, as well as opossum, raccoon, rabbits, and white-tailed deer. Birds decrease further to 33%, and are more evenly represented by terrestrial birds such as turkey, bobwhite, prairie chicken, and owls, as they are by waterfowl. Fishes, dominated by suckers, drop slightly to 27% (Walker 1998).

Walker (1998) also examined use of various habitats by the site's occupants through time. Not surprisingly due to its close proximity to both a stream and the Tennessee River and its backwaters, aquatic species (waterfowl, muskrat, swamp rabbit, pond turtles) significantly outnumber terrestrial species (white-tailed deer, turkey, squirrels, box turtle) in all three components (Walker 1998:139; Table 4.9). Greater differences through time are apparent when the fauna are divided among open, ecotone, and closed habitats. Species representative of open habitats significantly decrease from the Late Paleoindian and Early Side-Notched to the Kirk Stemmed component. Closed habitat species comprise increasingly greater proportions of the assemblage through time, increasing from 40% in the Late Paleoindian to over 50% in the Early Side-Notched and 70% in the Kirk Stemmed component. Species suggestive of ecotone habitats remain fairly stable, between 20-25% of the faunal remains (Walker 1998:141, Figure 7.3; Table 4.9).

Grover (1994) performed a more limited analysis of faunal remains from Test Units A and F, in which the Late Paleoindian and Early Side-Notched periods were consolidated. There are some differences between the results of the two studies, most noticeably in the number of white-tailed deer specimens recovered. Grover identified 61 specimens (MNI = 3) from Late Paleoindian/Early Side-Notched deposits, and 70 specimens (MNI = 3) from the Kirk Stemmed component. However, her overall results are similar to Walker's (1998; Walker et al. 2001). Birds, particularly waterfowl, comprise a higher proportion of the Late Paleoindian/Early Side-Notched assemblage than the Kirk Stemmed assemblage (Grover 1994:120). Grover (1994:120) also notes that the quantity of bone recovered from the earlier contexts is greater than that from the Kirk Stemmed component. Furthermore, the diversity and evenness of recovered species is greatest during the Late Paleoindian/Early Side-Notched contexts (Grover 1994:128). Walker's (2000) research also indicates that the Late Paleoindian assemblage is more diverse and evenly distributed among species than the other components.

The faunal assemblage can also be used to assess seasonal use of the site. The presence of migratory birds, such as the passenger pigeon, ducks, and geese, suggest late spring and early fall occupations (Walker 1998:148-150; Walker et al. 2001:183). A large fragment of deer antler still attached to the skull was recovered from the Early Side-Notched component, implying that this deer was taken during the fall to early winter (Walker 1998:150). Also supportive of a cooler season occupation is the low recovery of cold-blooded reptiles and amphibians (Walker 1998:153; Walker et al. 2001:183). A spring occupation may be suggested, however, by the presence of suckers, which

Table 4.9. Distribution of Species Assignable to Habitat by Component (Walker 1998).

Habitat	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Open	7 (35%)	6 (20%)	1 (7%)
Ecotone	5 (25%)	8 (27%)	3 (20%)
Closed	8 (40%)	16 (53%)	11 (73%)
Total	20	30	15

leave larger rivers for more shallow streams to spawn in the spring. The inhabitants of Dust Cave may have exploited these spawning runs in the small streams of the area, such as the one that likely ran in front of the site (Walker 1998:152).

In addition to the animal remains analyzed by Walker and Grover, Parmalee (1994) identified some 358 freshwater mussel valves from the entrance trench, although only 36 derive from the components considered here (Table 4.10). Notably few were recovered from the Late Paleoindian and Early Side-Notched components; the numbers increase significantly for the Kirk Stemmed component. Regardless of the low numbers, the mussel shells indicate that the occupants of Dust Cave occasionally supplemented their diet with this resource, which would have been available nearly year round (Parmalee 1994:159). The species recovered suggest that the occupants collected mussels not only from the Tennessee River, but also smaller streams and creeks, as well as shallow backwaters (Parmalee 1994). Parmalee (1994:159) also notes that aquatic gastropod shells are abundant in the site's deposits. These would have provided a considerable quantity of meat as well, and also would have been available throughout the year.

Also of interest is a *Canis* burial, excavated from the lower levels of the Early Side-Notched component in Test Unit F. Morey (1994:168-9) identified the five specimens, which include the right femur, two fragments of the left maxilla and one of the left mandible, as well as a fragment of a tooth, and estimated the age at nearly two years. Morey (1994:169) considers the individual too small to be a gray wolf, but the femur is also too long and slender to be a dog. Coyote is more likely, although the early Holocene range of coyotes may be considerably west of Alabama (Morey 1994:169).

Table 4.10. Mussels Recovered from the Late Paleoindian and Early Archaic Components at Dust Cave (Parmalee 1994: Table 2).

Taxon	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Actinonaias ligamentina	1		1
Cyclonaias tuberculata	3	1	1
Dromus dromas			2
Elliptio dilatata	1	3	1
Fusconaia barnesiana			1
Lampsilis ovata		1	4
Lexingtonia dolabelloides	1		3
Medionidus conradicus			1
Potamilus alatus			1
Toxolasma lividus			1
Villosa cf. *iris*			1
Villosa taeniata	1		5
Villosa sp.			2
Total	7	5	24

Botanical Analysis. Paul Gardner (1994) analyzed a set of floatation samples from Test Unit A. The Late Paleoindian and Early Side-Notched components were not well defined in this unit, and therefore Gardner discusses the samples from the lower levels as the Early Side-Notched component. Hickory nutshell, at around 2000 fragments, dominates the recovered plant remains, although acorn shell is relatively well represented by nearly 500 fragments. In contrast, only three black walnut fragments were recovered (Gardner 1994:192). Seeds were only found in the Early Side-Notched component, and include one grape seed and three chenopod seeds, which Gardner (1994:193) notes is indicative of a relationship between humans and this eventual cultigen since the beginning of the Holocene.

Gardner (1994) discusses several trends through time. The density of wood recovered from the samples increases significantly between the Early Side-Notched and Kirk Stemmed components, as does hickory nutshell (Gardner 1994:193,198). Acorn patterns differently, with a huge peak in occurrence associated with the uppermost Early Side-Notched level. Otherwise, acorn is recovered in relatively low amounts (Gardner 1994:193). Gardner (1994:206) also notes an increase in the ratio of nutshell to debitage between the Early Side-Notched and Kirk Stemmed components and suggests that it may indicate an increase in importance of nut gathering relative to hunting. This trend may in part be related to the higher quantities of debitage recovered from the Early Side-Notched (Meeks 1994; Randall 2001), and although it may be more indicative of differences in tool manufacture and maintenance than in hunting per se, the trend does suggest different use of the site between the two components.

Features. Homsey (2003, 2004) has elaborated upon a typology of Dust Cave features begun by Sherwood (2001) by combining geochemical and micromorphological analyses of feature matrix. Comparing these with field descriptions and feature morphology, Homsey (2004) divides the features into two major categories: those associated with burning deposits, and those associated with unburned deposits (Table 4.11). The latter include burials, possible storage/refuse pits, and rock clusters; of these, only rock clusters are found in the deposits considered in this project. Rock clusters may represent cooking stones kept near hearths for ready use (Homsey 2004:187).
Features related to burning activities are further divided into *in situ* fireplaces, fireplace rakeout, and mixed burning deposits. *In situ* fireplaces include prepared surfaces and a variety of hearths. Prepared surfaces are lenses of clay fashioned by the site's occupants, upon which they built fires, perhaps to grill fish, toast nuts, and/or simply warm the cave (Homsey 2004:144,146). Surface hearths tend to be larger than other hearths and are often lined with rocks; Homsey (2004:155-156) suspects that rock basins[5] are surface hearths from which the charcoal and ash have been largely washed away after deposition. These hearths may have been used not only to broil meat but also as sources of light and warmth for people performing other activities, such as tool maintenance (Homsey 2004:148-151). Expedient and pit hearths tend to be smaller in size, although pit hearths are generally deeper and often contain rocks. Both contain large amounts of charcoal and/or ash. Homsey (2004:163-167) suggests that pit hearths may have been used for nut processing, particularly

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[5] Note that rock basins constitute an entirely separate category from rock clusters.

Table 4.11. Distribution of Feature Types by Component (Homsey 2004: Table 7.1).

Feature Type	Late Paleoindian	Early Side-Notched	Kirk Stemmed
Human burial			(3)
Surface hearth	1		3
Pit hearth		1	5
Expedient hearth			7
Charcoal pit	9	14	12
Ash pit	2	1	6
Charcoal concentration	4	8	4
Ash concentration	1	1	
Charcoal/ash stringer	11	2	4
Rock pit	2	2	1
Unknown	3	3	8
Total	33	32	50 (53)

for heating stones for use in boiling. Expedient hearths often contain large amounts of burnt fish bone, as seen in micromorphological thin sections. As such, the site's occupants might have used expedient hearths to grill or smoke fish or other meats, or to make hot coals to parch nuts or to warm the cave at night (Homsey 2004:158-60).

Fireplace rake-out features are associated with burnt materials cleaned from hearths or prepared surfaces. These include small accessory pits with rocks located adjacent to larger features, which may represent piles of cooking stones kept ready near a hearth (Homsey 2004:169-170). Refuse pits, with large quantities of ash and no rocks, are also associated with surface hearths and likely represent ash and charcoals cleaned from these (Homsey 2004:172-173). Thin charcoal lenses, primarily located near the rear of the shelter, were likely formed as the result of raking-out and disposing of coals from hearths (Homsey 2004:174-176). Charcoal rings and charcoal/ash stringers appear to be ash and charcoal deposits that were altered after deposition by fluvial activity (Homsey 2004:176-177, 185-186).

The features demonstrate interesting spatial patterns through time, although it must be kept in mind that features are likely underrepresented in the entrance trench and test units, as these were excavated early in the site's investigation, with rather poor lighting due to the logistics of working in such a tight space and before the nature of the site's complex deposits were completely understood. Thirty-three features were recognized from the Late Paleoindian component (Table 4.11), and include mostly charcoal stains, charcoal/ash concentrations, and rock clusters, all of which were likely impacted by fluvial activities such as slope wash and flooding. A number of charcoal pits and one surface hearth appear to have been little affected by these post-depositional processes (Homsey 2004:204-205). The features cluster in the central portion of the entrance chamber, along with portions of prepared surfaces. In addition to features, Homsey (2004) mapped the distribution of lithics, bone, and shell, compiled from the water screen samples associated with each level. Bone may have been dumped along the back wall of the cave, where damp conditions likely precluded much use by the site's occupants. Artifacts otherwise generally cluster in the central area of the chamber, near the features (Homsey 2004:216-218).

Thirty-two features are associated with the Early Side-Notched component (Table 4.10). Most of these are charcoal pits, which often contained large amounts of fish bone. As noted above, Homsey (2004:205) suggests that they may have served as expedient hearths for cooking fish. Additional features include charcoal concentrations and stringers, one rock pit, one rock pit hearth, and one possible pit hearth (Homsey 2004:205). The majority of the features, including significant areas of prepared surfaces, are located west of the entrance trench. The scarcity of features within the entrance trench is certainly in part related to excavation procedures. Wetter conditions near the mouth of the cave may explain the relatively few features east of the entrance trench (Homsey 2004:223, 225). However, the distribution of bone indicates a concentration in this area (Homsey 2004: Figure 7.11), implying that it was a locus of activity or dumping. Homsey (2004:221) suggests that the back area of the cave again served as a dumping area, for charcoal as well as bone, shell, and lithics.

The number of features recognized in the Kirk Stemmed component increases significantly to 53 (Table 4.10). These include charcoal and ash pits; expedient, pit, and surface hearths; and a rock pit, the largest feature at the site (Feature 111) that may have been an earth oven (Homsey 2004:205-

206). Homsey also includes three burials, but two of these are actually in pits that likely originated at the contact between Zone N and P, and may be more fittingly assigned to the Eva/Morrow Mountain component (Sherwood et al. 2004:549). The third burial is associated with what appeared in the field to be an extremely large pit, over a meter in diameter and over 50 cm deep. Excavators repeatedly encountered human bone in this pit, including fragments of human skull, ribs, tarsals and metatarsals. Because of the fragmentary nature of this burial and the amorphous shape of the feature, it was unclear in the field whether it was a secondary burial or simply bioturbated, perhaps from overlying Eva/Morrow Mountain deposits. As such, I exclude it from my analysis here.

The Kirk Stemmed features cover a wider area of the entrance chamber than those of previous components. The hearths cluster on the east side of the entrance trench and are coincident with prepared surfaces. Homsey (2004:228) suggests that this clustering may represent conservation of space. Charcoal and ash pits occur more frequently on the west side of the chamber, perhaps representing rake-out of hearths or cleaning of prepared surfaces located adjacent to them. Refuse again appears to have been dumped in the back corner of the cave, with high concentrations of bone, lithics, and shell in this area. A secondary concentration of bone and shell is located west of the entrance trench, with lower concentrations in the eastern portion of the site (Homsey 2004:229-230). This lends further support to the idea that refuse from the eastern portion of the site may have been swept into the western part of the site.

In general, Homsey (2004:210-214) notes that features from the Late Paleoindian and Early Side-Notched components may have been significantly impacted by post-depositional processes, particularly fluvial activity. Features from these deposits tend to be smaller in size than those from later deposits, perhaps due to the dissolution of ash and/or compaction of sediments. Charcoal stains and rock clusters, both of which appear to have been formed or altered by water, are more common in the lower levels. The Late Paleoindian and Early Side-Notched components also had the lowest diversity of feature types, which Homsey (2004:214-215) suggests is related to post-depositional processes.

Previous Site Interpretations. Interpretations of the use of Dust Cave have been refined and redefined as research of the site's rich assemblage continues. Noting the relatively low density of artifacts, Goldman-Finn (1994: 215-216) suggests that occupation of the site was short-term and intermittent. She further hypothesizes that, given the low recovery of white-tailed deer, Dust Cave may have been occupied primarily during the cold season, when deer were lean or low in number, forcing occupants to rely upon plants and animals from a variety of ecological zones.

Walker and colleagues (2001:191) view the wide variety of resources locally available to the Late Paleoindian inhabitants of Dust Cave as a positive draw, providing ample opportunity for hunting, gathering, and collecting. They suggest groups visited the cave during the autumn and early winter as part of their seasonal rounds. Highlighting the increase in bifaces, expedient flakes, and scrapers in the Early Side-Notched component, Randall (2001) suggests that occupants may have stayed for longer periods than did preceding Late Paleoindian groups. Expanding upon this, he postulates that during their visits, occupants were discarding their exhausted tools and adding new ones, perhaps gearing up for extended forays into the uplands. While at Dust Cave, they also took advantage of the waterfowl, mussels, and ripening nuts and seeds that were locally abundant (Randall 2002:105).

From the perspective of the feature assemblage, Homsey (2004:289) suggests that use of Dust Cave does not change so much in terms of the types of activities performed there as in the intensity of these activities. She hypothesizes that groups, whose base camps were likely situated in the lowlands along the river, logistically used Dust Cave as a specialized extraction site (Homsey 2004:290). Based on the chemical signatures of features that closely mirror the signatures of hickory nuts, as well as visual identification of hickory nuts in thin sections of features, she suggests that this specialized extraction may have targeted hickory nuts. As climatic conditions warmed by roughly 10,000 cal B.P., and hickory stands subsequently improved, use of the site to process hickory nuts may have intensified (Homsey 2004:292-293).

SUMMARY

Early archaeological research in the Middle Tennessee Valley focused on prehistoric mound sites along the river, but by the 1950s active avocational archaeologists sought information about the region's earliest inhabitants, particularly from open-air sites. In 1960, the University of Alabama began a research program targeting rockshelter sites, in search of deep deposits containing early occupational debris. Such testing programs, along with surveys and excavations fueled by the Tennessee Valley Authority and other cultural resource management projects, have significantly added to the body of knowledge regarding prehistoric occupation of northwest Alabama.

These studies suggest that early hunter-gatherers performed a variety of activities at sites, including processing nuts, butchering animals and preparing hides, fashioning new tools and resharpening old ones. Most of the sites appear to represent a combination of these activities, perhaps because single-purpose sites are notoriously difficult to recognize – too little debris is left at them for archaeologists to find. A distinction between larger aggregation sites, such as the Quad locale and Seven Mile Island Archaeological District, and smaller habitation sites like Dust Cave is easier to make. Patterning in site distribution is also evident, and arguably related to cultural responses to environmental changes, primarily those that affect the positioning of the river.

The four rockshelter sites from which my botanical samples derive were investigated as part of larger research programs conducted by the University of Alabama. This research provides not only rich site-level contexts in which the plant remains can be analyzed and interpreted, but also a substantial regional context in which the rockshelters can be viewed. In the next chapter, I further describe the samples and detail the methods I used to analyze them, before turning to the results of my analysis and interpretations.

CHAPTER FIVE:
PALEOETHNOBOTANICAL ANALYSIS – DATA AND METHODS

Although plant remains are not frequently recovered from Paleoindian and Early Archaic sites in the southeastern United States, rockshelter sites are an important exception. Because they are sheltered from rain, deposits in rockshelters provide excellent conditions for preservation of organic remains. Preservation is further enhanced in limestone shelters: as groundwater seeps down through the limestone it becomes less acidic, supplying an almost constant drip of a nearly neutral solution from the ceiling of the shelter onto the deposits beneath (Sherwood 2001). These sheltered deposits thus present us with an opportunity to study plant and animal remains, the spoils of both gathering and hunting, within the same context.

In this chapter, I detail my analysis of plant remains from the four rockshelter sites included in this project. First, I describe the nature of the samples from each site and the methods used to collect them. I then specify the methods I used to identify and quantify the plant remains in the samples, as well as my approaches to analyzing the resulting data.

THE DATASET

The data included in my paleoethnobotanical analysis consist of carbonized plant remains. Elemental carbon, or charcoal, is not consumed by any organism, and therefore is resistant to decay (Dimbleby 1967:100). While uncarbonized plant remains may have been preserved in the dry confines of some rockshelters, it is also possible that these are intrusive materials, brought into the sites by animals, wind, or gravity, and therefore I exclude them from my analysis. This includes uncarbonized hackberry seeds. The pits of these drupes have high mineral contents, primarily calcium carbonate, and therefore have excellent preservation potentials (Wang et al. 1997). I exclude uncarbonized hackberry seeds from my analysis, however, because it is difficult to distinguish older seeds from modern hackberry seeds that may have been introduced by other creatures that have more recently inhabited the shelters.

Potential for Preservation

Because I focus on carbonized remains, the greatest factor affecting the nature of the plant assemblages is how these materials become carbonized in the first place. They may be introduced to fire in two ways: by accident or on purpose (Yarnell 1982). Items that are purposefully burned include fuel materials, such as wood, and the byproducts of food processing (Lopinot 1984; Welch and Scarry 1995:407). The latter include discarded nutshells and hulls, processed debris that site occupants dispose of by burning. We should therefore expect byproducts and fuel materials to be well represented in the samples.

In contrast, food items, such as nutmeats, fruits, and edible seeds, are eaten rather than discarded; these items are therefore likely to be burned only by accident (Scarry 1986, Yarnell 1982). We should expect fewer of these accidentally carbonized edible remains in the samples than fuel and byproduct materials. Another factor influencing introduction to fire is how often foods are used near fire: those used more frequently near fires are more likely to be carbonized. These include foodstuffs that are toasted, cooked, or otherwise prepared using fire, as well as those that are more frequently eaten in general (Yarnell 1982). Just as dishes that are more frequently used are more likely to be broken, foods that are eaten more often are more likely to be accidentally spilled and carbonized (Hubbard 1980:51).

Potential for carbonization is also affected by the nature of the food item. Materials that are denser and more robust, such as hickory nutshell, are much more likely to be carbonized than more fragile items, like the papery shell of chestnuts or small seeds, which are more likely to be completely consumed by fire and turned to ash. This also includes taxa that are relatively high in water content, such as leafy greens and flowers. In addition, some items cannot be readily recognized once carbonized, such as tubers and other materials high in starch. These too are likely to be underrepresented (Yarnell 1982).

These biases must be kept in mind, but should not significantly hamper archaeobotanical analyses. Human behavior is habitual and patterned; people repeatedly use the same foods and prepare them in similar manners (Mintz 1985). Items that are commonly used are likely to be accidentally spilled or purposefully burned and therefore are likely to appear in a carbonized assemblage, while those that are infrequently used are less likely to be recovered (Scarry 1986:180; Yarnell 1982). Thus, with an adequate sample size, we can recognize important resources and measure changes in their use across different contexts and over time.

The Samples and Recovery Techniques

Carbonized plant remains are best recovered from archaeological deposits using floatation. With this technique, a sample of a deposit is placed in a container of water; the plant remains, being lighter than water, float to the surface and are collected, dried, and analyzed. Developed in the United States by Stuart Streuver in the early 1960s, floatation was not widely implemented at archaeological sites until the latter part of that decade (Chapman and Watson 1993; Pearsall 2000; Watson 1976).

The four rockshelter sites considered here were excavated over a span of forty years, from 1960 through 2002. As a result, the techniques used to obtain botanical samples vary from site to site, as processing samples by floatation was developed, refined, and systematically implemented over that time span. Below I discuss the collection methods used at each site and briefly describe the samples used in my analysis.

Stanfield-Worley Bluff Shelter. Because the site was excavated in the early 1960s, the samples from Stanfield-Worley Bluff Shelter were not systematically collected and processed using floatation. Instead, plant materials were either recovered from the ¼-inch mesh used to screen all excavated deposits, or collected apparently as “pinch samples.” These are small samples of sediment that excavators collect from spatially-limited concentrations of carbonized materials. At Stanfield-Worley, these samples vary roughly between a handful and a quart of sediment in size.

The two sets of samples yield different data. The ¼-inch screen samples are skewed towards items that are relatively large and dense, such as nutmeats and hickory and walnut shell. Smaller and more fragile items that would pass through the mesh openings, such as seeds and acorn shell, should be underrepresented in these samples. The pinch samples likely provide a better indication of use of more fragile foodstuffs at the site. The two datasets are not directly comparable, and therefore the screen samples will not be used in quantitative analysis.

In spite of their limitations, the samples from Stanfield-Worley are important because they provide some indication of the gathering activities that occurred at the site. As discussed in Chapter Four, interpretations of the shelter’s deposits lean heavily towards a focus on hunting (DeJarnette et al. 1962). However, I found several large bags of carbonized acorn meats among the collections from the site, housed at the DeJarnette Laboratory at the University of Alabama Museums in Moundville, Alabama. In addition, I came across photographs from the 1963 excavations of nutting stones that were ground into bedrock at the base of the Dalton zone, and observed these in person at the site in 2001 (1963 photographs on file at the University of Alabama Museums). Stanfield-Worley’s early occupants were certainly engaged in more than hunting. Because of the preeminent position that the site holds within Alabama prehistory, I feel it is important to incorporate these data, although perhaps skewed, in my discussion of early lifeways in the region.

Because of the degree of stratigraphic mixing at the site, only those samples that are referred to directly as “Dalton” and are more than 45 inches below the surface are included in this analysis. These samples include six ¼-inch screen samples and 20 pinch samples (Table 5.1, Appendix A). All derive from general contexts, usually from particular excavation units or “squares.” The ¼-inch screen samples were collected from the 1960 exploratory trenches, while the pinch samples, collected during the 1961 season, are from the three excavation blocks isolated by the trenches (see Chapter

Table 5.1. Paleoethnobotanical Samples from Stanfield-Worley Bluff Shelter (1Ct125).

Sample Type: Catalog Number	Block	Unit	Level	Depth Below Surface (in)	Zone	Sample Weight (g)
Screen samples – 1960 Excavations:						
22*		125R1	9	45		5.95
30*		130R2	9	45		0.36
29*		130R2	11	55		0.37
27*		130R3	12	60		4.85
10		130R3/4			Dalton	8.00
36*		145R2	12	60		77.18
Pinch samples – 1961 Excavations:						
2261	Block 1	110R6	4		Dalton	10.11
2258	Block 1	110R8			Dalton	4.86
2260	Block 1	110R8	1		Dalton	5.25
2276	Block2		3		Dalton	106.36
2277	Block2		5		Dalton	74.50
2278	Block2		6		Dalton	40.06
2280	Block2		8		Dalton	59.77
2281	Block2	120R3	11		Dalton	0.37
2270	Block2	120R6	2		Dalton	11.45
2266	Block2	125R3	9		Dalton	22.40
2267	Block2	125R3	11		Dalton	9.88
2268	Block2	125R3	12		Dalton	6.93
2282	Block2	125R3	13		Dalton	9.94
2272	Block2	125R3	14		Dalton	3.54
2269	Block2	125R4	11		Dalton	0.87
2283	Block 3	135-140	1		Dalton	11.85
2285	Block3		2		Dalton	11.15
2286	Block3		3		Dalton	28.49
2287	Block3		4		Dalton	9.74
2284	Block3		10		Dalton	24.68

* Samples tentatively assigned to Dalton zone.

Four for more detail and maps of the excavations). No samples from 1963 are included because of the difficulties encountered by the field crew in identifying the various zones, including the Dalton zone. Although Goldmann-Finn (1997) has demonstrated that the Early Archaic and Dalton components can be teased apart to some degree using the vertical position of diagnostic points, I do not distinguish between the two here because of the vagaries of sample collection. Because detailed notes of the locations from which the samples were collected do not exist, such an exercise would be more speculative than productive.

Rollins Bluff Shelter. Collected during the 1968 excavation of the site, the samples from Rollins Bluff Shelter were processed using floatation. However, the samples were first screened through ¼-inch mesh (Stowe 1970), presumably to remove large artifacts. This screening exposed the plant remains to mechanical stress, likely breaking fragile items into smaller pieces. Thus we might expect the materials from these samples to be smaller in size, and biased towards more robust taxa. Once screened, the samples were floated using water (Stowe 1970).

I analyzed 29 samples, all deriving from general (or non-feature) contexts (Table 5.2, Appendix B). Of these, 24 were collected from the control block isolated at the center of the excavation; the remaining five are from Square 95L5 (see Chapter Four for maps and description of the excavation). Although Zone D may contain some Dalton deposits in some areas (Stowe 1970), there is not enough information available from the site report to determine which levels and which samples from Zone D may be assigned to Dalton. Therefore I consider the sixteen samples from the lower levels of Zone C and all of Zone D to be Early Archaic. Dalton samples include the seven from Zone E as well as the five samples from Square 95L5, whose depth below datum puts them well within the Dalton component at the site, given the vertical distribution of diagnostic projectile points (Stowe 1970:Table 14).

LaGrange Bluff Shelter. Excavated in 1972 and 1975, the samples from LaGrange represent a mix of collection strategies. The sediment was first screened with water through a set of graduated sieves, the smallest of which had 0.59 mm openings. To extract plant remains, the screened sediment was then floated in a laboratory using carbon-tetrachloride (DeJarnette and Knight 1976:5). This chemical solution, with a specific gravity greater than water, was widely used in the 1970s to enhance the floatation of plant remains, but its toxicity led to its eventual disuse. I analyzed

Table 5.2. Paleoethnobotanical Samples from Rollins Bluff Shelter (1Fr323).

Component: Catalog Number	Unit	Cut	Level	Depth Within Zone (ft)	Zone	Sample Weight (g)
Early Archaic:						
127/132	Control Block 1	1	1	0	D	18.4
136/137	Control Block 1	1	1	0	D	14.18
114	Control Block 1	1	3	0.4	D	5.82
154/155	Control Block 1	1	3	0.4	D	14.47
157	Control Block 1	1	3	0.4	D	143.08
133/138	Control Block 1	1	4	0.6	D	30.62
146	Control Block 1	1	4	0.6	D	9.68
121/126	Control Block 1	2	1	0	D	15.51
145/150	Control Block 1	2	2	0.2	D	19.15
158/159	Control Block 1	2	1	0	D	21
160	Control Block 1	2	1	0	D	81.17
142/143	Control Block 1	3	5	0.8	C	17.02
148/149	Control Block 1	3	2	0.2	D	9.54
130/131	Control Block 2		6	1	C	12.72
151/156	Control Block 2		1	0	D	16.87
147	Control Block 2		3	0.4	D	7.14
Dalton:						
124/125	Control Block 1	1	1	0	E	2.81
153	Control Block 1	1	1	0	E	13.95
128/129	Control Block 1	1	2	0.2	E	18.27
122/123	Control Block 1	2	1	0	E	2.42
139/140	Control Block 1	2	2	0.2	E	7.38
115/120	Control Block 1	3	1	0	E	12.65
118/141	Control Block 1	3	3	0.4	E	4.46
134/135	Control Block 2		5	0.8	L	21.43
119	Square 95L5		16	60"*		11.57
112/113	Square 95L5		16	60"*		32.62
152	Square 95L5		16	60"*		9.46
116/117	Square 95L5		17	64"*		17.17
144	Square 95L5		18	68"*		12.87

* Depth for Square 95L5 is given as inches below surface.

all 11 available floatation samples (Table 5.3, Appendix C). Six derive from Early Archaic contexts as determined by the distribution of diagnostic hafted bifaces. These contexts include the lower levels (12 through 15) of Zone B, Zone C, and the upper levels (14 and 15) of Zone D, as well as Burial 1, located in Zone C (DeJarnette and Knight 1976:Tables 3 and 5). The remaining five samples are designated as Dalton, again based on the distribution of diagnostic hafted bifaces, and include the lower levels of Zone D (16 through 18), Zone E, and Zone F (Dejarnette and Knight 1976).

In addition to the floatation samples, I analyzed 24 samples collected from the ¼-inch mesh at LaGrange (Table 5.3, Appendix C). Of these, 13 derive from Early Archaic and ten from Dalton zones, as determined above. The final sample was from Zone D but did not indicate the level from which it was collected, and therefore I did not assign a time period to it. The screen samples were included in order to supplement the limited number of floatation samples, to provide a better indication of the range of plant foods used by occupants of the site. However, I do not include these samples in quantitative comparisons between sites.

Dust Cave. The most extensive and best-documented set of samples was collected from Dust Cave during its excavation in the 1990-1994, 1996-2000, and 2002 seasons. All features from the site were floated in their entirety, and samples were collected from 50-x-50-cm columns in nearly half of the 1-x-1-m units excavated at the site. These columns were excavated in 5 cm arbitrary levels, as well as by zone. The majority of the samples were processed in the field using a modified SMAP machine (Watson 1976), which was fitted with a bubbler in the 1998 season to further enhance the floatation of plant remains. The samples were processed using either a 1 mm mesh or window screen (1/16-inch) to capture the heavy fraction, while 0.03 mm mesh was used for the light fraction. For each sample, the crew recorded the volume of sediment floated, the size of mesh, and whether the bubbler was used (Dust Cave Floatation Logs, 1990-2002). Several samples were not floated in the field, due to time constraints. These were processed in the laboratory by the

Table 5.3. Paleoethnobotanical Samples from LaGrange Bluff Shelter (1Ct90).

Context: Catalog Number	Unit	Level	Zone	Period	Sample Weight (g)
Screen Samples:					
71	S5E11	12		Early Archaic	2.2
70.5	S5E11	13		Early Archaic	0.08
49	S5E11	15	D	Early Archaic	0.29
47/74	S10E5	13	C	Early Archaic	0.45
88/89	S10E5	14	D	Early Archaic	0.44
78/79	S10E5	15	D	Early Archaic	0.52
41	S10E9	15	D	Early Archaic	5.36
77/84	S10E10	12	B	Early Archaic	0.83
61	S10E10	13	B	Early Archaic	2.66
46	S10E10	10	C	Early Archaic	1.75
75	S10E10	13	C	Early Archaic	0.49
48	S10E10	14	C	Early Archaic	0.83
76	S10E11	12	C	Early Archaic	0.31
42/80/81	S10E5	16	D	Dalton	4.43
54/82	S10E5	17	D	Dalton	6.6
43/83	S10E5	18	D	Dalton	0.78
44	S10E5	16	E	Dalton	1.95
51	S10E5	17	E	Dalton	1.08
52/53	S10E10	16	D	Dalton	2.63
55	S10E10	17	D	Dalton	0.76
96	S10E10	15	E	Dalton	0.12
50	S10E10	19	E	Dalton	0.56
40	S10E10	20	F	Dalton	0.56
87	S10E11		D		0.21
Floatation Samples:					
106	S10E10	14	B	Early Archaic	1.55
107	S10E10	14	B	Early Archaic	2.38
105	S10E10	15	C	Early Archaic	4.92
104	S10E5	14	D	Early Archaic	3.59
103	S10E5	15	D	Early Archaic	2.41
108	S10E10	Burial 1	C	Early Archaic	4.87
101	S10E5	16	D	Dalton	4.33
102	S10E5	16	D	Dalton	5.62
99	S10E10	19	E	Dalton	0.86
100	S10E10	19	E	Dalton	0.82
98	S10E10	22	F	Dalton	0.33

University of Alabama's Office of Archaeological Research, using a modified SMAP machine fitted with window screen to capture the heavy fraction and 0.03 mm mesh to collect the light fraction.

I selected three floatation columns for analysis: N62W64 (or Test Unit F) in the center of the entrance chamber; N62W62 on the east side of the chamber; and N60W65 in the west half of the chamber (see Chapter Four for details and a map of the excavation). I chose these columns because they are located within the heart of activity at the site (Homsey 2004), but also provide some spatial differentiation. The columns include 65 samples: 35 from the Late Paleoindian component (Zones U and T); 12 Early Side-Notched samples (Zone R); 10 samples from Zone Q, which is considered a mix of Early Side-Notched and Kirk Stemmed materials; and eight Kirk Stemmed samples from the lower levels of Zone P (Table 5.4, Appendix D).

In addition, I analyzed 41 samples from features. These include 14 from Late Paleoindian contexts, 11 from the Early Side-Notched component, six from Early Side-Notched/Kirk Stemmed samples, and ten samples from the Kirk component (Table 5.5, Appendix E). These samples are a subset of the total excavated features at the site, which include a total of 42 Late Paleoindian features, 30 Early Side-Notched features, 19 from Zone Q (mix of Early Side-Notched and Kirk Stemmed), and 28 from the lower portion of the Kirk Stemmed component.

I chose the feature samples for analysis as follows. First, I analyzed all available samples included in Homsey's (2004) geochemical and micromorphological analyses of Dust Cave features to allow for comparison between the two datasets. Second, I included a range of feature types, from small charcoal and ash pits to larger "hearths." And finally, I chose features from various locations within the cave. By selecting a variety of feature types, as well as samples from different areas of the site, I have attempted to obtain a set of samples more representative of the range of activities associated with features at the site than a random sampling of the features would afford.

Table 5.4. Paleoethnobotanical Samples from Dust Cave (1Lu496) Floatation Columns.

Bag Number	Unit	Level	Depth Below Datum (cm)	Zone	Period	Volume (L)	Sample Weight (g)
5176	N60W65	40	315-320	P2	Kirk Stemmed	4.5	283.57
5230	N60W65	42	325-330	P3e	Kirk Stemmed	8	350.56
5319	N60W65	44	335-340	P3e	Kirk Stemmed	6	549.16
5340	N60W65	46	345-350	P2	Kirk Stemmed	4	387.00
5512	N60W65	48	355-360	P14	Kirk Stemmed	1	29.77
5647	N60W65	50	365-370	Q4	ESN/Kirk Stemmed	7?	333.31
6131	N60W65	54	385-390	R3	Early Side-Notched	0.5	147.60
6152	N60W65	54	385-390	R3e	Early Side-Notched	4.7	153.16
6159	N60W65	55	390-395	R3e	Early Side-Notched	5.5	799.54
6192	N60W65	56	395-400	R3f	Early Side-Notched	6	548.06
6212	N60W65	57	400-405	R3f	Early Side-Notched	7.5	932.70
6296	N60W65	58	405-410	R3f	Early Side-Notched	7	686.61
6343	N60W65	59	410-415	R3f	Early Side-Notched	8	1235.01
6360	N60W65	60	415-420	R3f	Early Side-Notched	6	768.85
6378	N60W65	61	420-425	R3f	Early Side-Notched	8.3	525.66
6379	N60W65	61	420-425	T5	Late Paleoindian	7.5	706.19
6401	N60W65	62	425-430	T5	Late Paleoindian	4	536.22
6402	N60W65	62	425-430	U3	Late Paleoindian	8	272.74
6431	N60W65	63	430-435	U3	Late Paleoindian	12	668.04
6465	N60W65	64	435-440	U3	Late Paleoindian	11	289.08
6502	N60W65	65	440-445	U8	Late Paleoindian	13	175.50
6531	N60W65	66	445-450	U8	Late Paleoindian	9	286.41
6551	N60W65	66	445-450	U6	Late Paleoindian	7	211.58
6554	N60W65	67	450-455	U6	Late Paleoindian	5	196.79
6557	N60W65	68	455-bedrock	U6	Late Paleoindian	6.5	206.25
6565	N62W62	50	320-325	P18	Kirk Stemmed	6	122.89
6583	N62W62	51	325-330	P18	Kirk Stemmed	6	1657.84
6592	N62W62	52	330-335	P18	Kirk Stemmed	7	1519.44
6606	N62W62	53	335-360	Q5	ESN/Kirk Stemmed	8	1010.66
6647	N62W62	54	340-345	Q5	ESN/Kirk Stemmed	7	1129.55
6690	N62W62	55	345-350	Q5	ESN/Kirk Stemmed	7	778.71
6695	N62W62	56	350-355	Q5	ESN/Kirk Stemmed	9	845.54
6716	N62W62	57	355-360	Q5	ESN/Kirk Stemmed	8.5	888.60
6735	N62W62	58	360-365	Q5	ESN/Kirk Stemmed	8.5	1266.18
6749	N62W62	59	365-370	R1	Early Side-Notched	9	703.29
6825	N62W62	60	370-375	R1	Early Side-Notched	9	1071.66
6854	N62W62	61	375-380	R1	Early Side-Notched	1.5	1993.16
6870	N62W62	62	380-385	Q5	ESN/Kirk Stemmed	6	457.93
6886	N62W62	63	385-390	Q5a	ESN/Kirk Stemmed	6	773.68
6983	N62W62	64	390-395	Q5a	ESN/Kirk Stemmed	6	689.15
7135	N62W62	67	405-410	T10	Late Paleoindian	9	1092.80
7172	N62W62	68	410-415	T2g	Late Paleoindian	4	3447.99

Table 5.4 (continued). Paleoethnobotanical Samples from Dust Cave (1Lu496) Floatation Columns.

Bag Number	Unit	Level	Depth Below Datum (cm)	Zone	Period	Volume (L)	Sample Weight (g)
7189	N62W62	69	415-420	T10b	Late Paleoindian	7.5	1323.30
7250	N62W62	70	420-425	T10b	Late Paleoindian	10	2661.76
7288	N62W62	71	425-430	U1	Late Paleoindian	10	2609.81
7314	N62W62	72	430-435	U1	Late Paleoindian	9	4269.68
7356	N62W62	73	435-440	U2a	Late Paleoindian	10	3166.22
7396	N62W62	74	440-445	U2	Late Paleoindian	3	448.35
7426	N62W62	75	445-450	U2a	Late Paleoindian	7	1695.61
7429	N62W62	75	445-450	U2	Late Paleoindian	0.8	151.27
7443	N62W62	76	450-455	U2a	Late Paleoindian	5.5	1494.68
7484	N62W62	76	455-460	U2a	Late Paleoindian	10	1849.79
7496	N62W62	78	460-bedrock	U2c	Late Paleoindian	2	353.00
944	N62W64	32	430-435	T1	Late Paleoindian	10	637.91
965	N62W64	33	435-440	T1a	Late Paleoindian	6	610.30
980	N62W64	34	440-445	T1a	Late Paleoindian	6	700.78
981	N62W64	34	440-445	T1	Late Paleoindian	13	641.50
989	N62W64	35	445-450	T1	Late Paleoindian	14	748.86
999	N62W64	36	450-455	T1	Late Paleoindian	14	492.20
1012	N62W64	37	455-460	T1	Late Paleoindian	9	432.00
1022	N62W64	38	460-465	U	Late Paleoindian	10	1717.43
1036	N62W64	39	465-470	U2	Late Paleoindian	8	875.75
1049	N62W64	40	470-475	U2	Late Paleoindian	13	1266.16
1049.1	N62W64	40	475-bedrock	U2	Late Paleoindian	12	119.29

Table 5.5. Paleoethnobotanical Samples from Dust Cave (1Lu496) Features.

Component: Bag Number	Unit	Level	Depth Below Datum (cm)	Feature	Volume (L)	Sample Weight (g)
Kirk Stemmed:						
1702	N63W64	38	355	114	14	991.09
5209	N61W65	48	355	350	6	795.47
5444	N63W66	45	340	358	3	386.73
5630	N60W66	44	335	368	4.5	619.84
5700	N60W66	45	340	375	4.5	556.36
5967	N63W66	47	350	389	2	755.55
6572	N62W62	50	320	444	1.5	306.46
6600	N62W62	52	330	448	1	109.15
6622	N62W62	53	335	450	8	1795.49
6652	N60W62	49	315	451	8	1183.33
Early Side-Notched/ Kirk Stemmed:						
4395	N60W68	53	380	330	3.5	273.31
5469	N62W65	52	375	360	1	346.54
5649	N60W65	50	365	363a	3.5	468.38
6082	N60W66	52	375	397	4	9.19
6875	N60W62	59	365	459	13.5	2323.02
6943	N62W62	64	390	462	4	697.21
Early Side-Notched:						
1509	N60W64	42	375	111	16	2384.26
1751	N59W64	51	420	115	3.5	328.30
5706	N63W65	56	385	377	NA	557.95
5732	N63W65	57	395	380	2	170.61
6099	N60W65	53	380	402	1	407.49
6111	N60W66	53	380	405	1.5	408.43
6118	N60W65	53	380	406	3	480.88
6129	N60W65	53	380	410	1.5	454.20
6144	N60W66	55	390	413	5.8	787.31
6874	N61W62	53	375	458	NA	393.82
6972	N60W62	65	395	467	1	167.84
Late Paleoindian:						
293	N62W64	32	425	37	0.8	159.88
1001	N62W64	37	455	99	1	280.40
1761	N60W64	50	415	116	1	111.95
1900	N60W64	58	455	118	2	137.37
5747	N62W65	56	390	382	5	866.77
5790	N62W66	57	395	384	1	403.81
5826	N62W65	61	415	387	3	404.46
6283	N60W66	58	405	420	2.5	279.17
6308	N60W66	59	410	423	10	1309.87
6326	N60W65	59	410	117	8	1242.91
6493	N60W66	66	445	438	4	49.04

Table 5.5 (continued). Paleoethnobotanical Samples from Dust Cave (1Lu496) Features.

Bag Number	Unit	Level	Depth Below Datum (cm)	Feature	Volume (L)	Sample Weight (g)
7068	N62W62	66	400	473	8	1232.65
7076	N62W62	66	400	474	4	628.75
7438	N61W62	66	445	486	2	585.41

METHODS

Laboratory Methods

Although the five sample sets each represent distinct collection and processing techniques, I analyzed each sample, to the extent possible, using the same standard ethnobotanical methods (see Pearsall 2000; Hastorf and Popper 1988)[1]. After weighing, I partitioned each sample by size using geologic sieves. All materials greater than 2.00 mm in size were sorted into categories, including bone, lithic material, shell, and contaminants, as well as various plant taxa. The items in these categories were then weighed; all plant taxa were both counted and weighed. All materials less than 2.00 mm in size were scanned for seeds, as well as taxa not represented in the portion greater than 2.00 mm. In other words, if hazelnut was not recovered in the portion greater than 2.00 mm in size, I removed it from the next size grade (1.40 mm). I also counted and weighed these plant taxa.

There are two exceptions, however. Acorn shell and acorn meat counts include fragments from both the 2.00 mm and 1.40 mm size grades. This is done to mitigate the biases against their recovery, particularly in comparison to hickory and black walnut shell. For example, the more fragile acorn shell tends to break into smaller fragments than the denser shells of hickory and walnut (Lopinot 1984). I did not include 1.40 mm acorn shell from the ¼-inch screen samples, however,

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[1] A number of the Dust Cave samples were analyzed with the assistance of four students from the University of North Carolina – Chapel Hill, hired with funds from National Science Foundation Dissertation Improvement Grant #0332275.

since these are more likely represent fragments that broke after the samples were collected and would artificially inflate the number of acorn shells recovered.

Analytical Approach

Once the samples were sorted and the materials identified, I organized the resulting data in a database. With raw counts and weights compiled, I approach the data with several questions in mind. These include the following: Which plant species did early foragers living in northwest Alabama use? Are there differences in the use of plants between the Late Paleoindian and Early Archaic periods within each site? Are there differences in the use of plants between the different sites during a single time period? These questions can be answered on both qualitative and quantitative levels.

Qualitative analysis of the samples relies simply on the presence or absence of plant remains within the samples. The first question, regarding which plant species were used by early foragers, is answered succinctly with a list of the plant taxa recovered from the four rockshelter sites. Similarly, differences between time periods within sites and differences among sites within time periods can be addressed at some level using presence/absence data. Qualitative comparisons become particularly important among samples that were collected and/or processed using different techniques. Comparisons made with the ¼-inch mesh samples from Stanfield-Worley and LaGrange will be restricted to presence/absence data.

Quantitative analyses are used to further address questions regarding differences in time periods and differences between sites. I employ several standard measures such as ubiquity, density, and relative density to quantitatively compare data. *Ubiquity*, calculated as the number of samples in which a particular taxon is found divided by the total number of samples and expressed as a percent, measures frequency with which a taxon was recovered. These values are calculated only for those samples that include taxa other than wood. The higher the ubiquity of a taxon, the greater its use (Hubbard 1980; Popper 1988:60-61).

The use of ubiquity relies on two assumptions, however. First, it assumes that preservation is similar between all samples; otherwise a lower ubiquity may simply be related to poorer preservation (Kadane 1988). This assumption is generally safe to make for these sheltered sites. The possible exception may be the lower levels of Dust Cave, which is threatened by the fluctuation of the water table due to the raising and lowering of the Pickwick Reservoir (Driskell 1996). However, small and fragile seeds are recovered from all sites, including the lower levels, suggesting that preservation is not drastically different among the sites.

The second assumption is that the samples consist of comparable volumes of sediment (Kadane 1988). In general, larger samples yield a wider range of taxa (Jones et al. 1983). Volumes not only should be comparable in size, but also in the time span they represent. Depending on the sedimentation rate, a 50-x-50-x-5-cm sample can contain plant remains used over the span of five years or over five hundred. The volumes of the samples I analyzed appear to be roughly similar within sites, although the only site for which volumes are available is Dust Cave. Volumes appear to differ significantly between sites, however; those from the sandstone rockshelters may have been particularly small. Perhaps more significant are differences in sedimentation rate, both within and between sites. I therefore use ubiquity only tentatively to compare plant use between sites.

Density is calculated as the count or weight of a particular taxon or artifact category in a sample divided by the volume of sediment floated for that sample. By standardizing the count of each taxon by the volume floated, changes in the deposition and/or preservation of each taxon through time at a single site can be demonstrated (Miller 1988:73). As with ubiquity, possible changes in sedimentation rates must also be taken into account, as one liter of sediment may represent different time spans for different zones. One should also be aware of possible differences in preservation, as these directly affect the recovery of taxa and therefore the numerator of the ratio (Kadane 1988:212). Density ratios can only be calculated for the Dust Cave samples, as volumes were not recorded for samples from the other four sites.

Relative density, which measures the importance of a particular plant taxon relative to other plants, is calculated as the count of a taxon in a sample divided by the total weight of all plant materials recovered from that sample (Scarry 1986:206). This ratio is useful in that it does not hinge directly upon the volume of the sample. While infrequent taxa may not be present in smaller samples, relative density does take into account size difference in that the denominator will be greater for large samples and smaller for small samples. Similarly, sedimentation rates do not affect the measure. The influence of possible differences in preservation between taxa (such as wood compared to hickory) is lessened by including all taxa in the denominator. However, differences in preservation between sites or between components within a site would impact both the numerator and the denominator, making the ratio unsuitable for comparing the assemblages. As mentioned above, significant differences in preservation are not likely for these sheltered sites, but the possibility should be explored.

Along a similar vein, density relative to another plant taxon can also be measured. For example, acorn density relative to hickory can be calculated as the count of acorn shell divided by the count of hickory. Relative density is useful to detect changes in the use of taxa relative to other plant materials through time within sites.

I approach the quantitative data from the perspective of exploratory data analysis (Scarry 1986; Velleman and Hoaglin 1981). This framework is useful for two reasons. First, it advocates the use of robust descriptions of data, such as medians and quartiles, which are less influenced by outliers than descriptors such as means and standard deviations. This is important because archaeobotanical data often include such outliers (one sample may contain an extraordinary number of a particular taxon) and cannot be assumed to follow a normal distribution. Second, exploratory data analysis emphasizes the use of graphs to facilitate the detection of patterns within the data. These graphs succinctly summarize datasets, enabling researchers to see the larger picture as well as identify outliers. Both can be important for understanding the range of activities performed by the occupants of a site.

To explore the quantitative data from my samples, I use boxplots to demonstrate change through time. Boxplots succinctly present and compare summary data for a set of samples, either by site or by time component (Figure 5.1). The range of the data is depicted in the form of a notched box, the "waist" of which is the median; the ends of the box mark the 25th and 75th percentiles of the data. The notch itself denotes the 95% confidence interval around the median. If the notches of two boxes do not overlap, then their differences are statistically significant at the 95% confidence level. "Whiskers" extend from the ends of the boxes to the lowest values within 1.5 times the hinge spread, which is the distance between the 25th and 75th percentiles. Outliers are shown as asterisks, and defined as values beyond 1.5 times the hinge spread. Extreme outliers, defined as values beyond 3 times the hinge spread, are displayed as open circles (Wilkinson et al. 1992). In Figure 5.1, then, the assemblage from Site A is significantly different from Site B, because their notches do not overlap. Note that the notches, or 95% confidence intervals, extend beyond the horizontal bars marking the 25th and 75th percentiles, particularly for Sites B and C. However, the differences in the assemblages from Sites A and C are not statistically significant. Furthermore, the data from Site A includes one outlier, while Site C includes an extreme outlier.

I further compare the data, particularly between sites, using a correspondence analysis. This technique essentially reduces the variation of a data matrix (rows and columns) into two (or more) dimensions, and then displays the data along these dimensions, or x- and y-axes, in a graph (Baxter 1994). Correspondence analysis can be viewed as a particular form of principal component analysis, in which the data have been transformed into chi-square residuals. Of the two, correspondence analysis is considered more appropriate for discrete data, such as the counts of taxa I use in my analysis, while principal component analysis is more appropriately used with continuous data (Baxter 1994:100). Wymer (1987) and Bush (2004) have employed correspondence analysis in their investigations of archaeobotanical assemblages. VanDerwarker and Scarry (VanDerwarker et al. 2005) have also successfully applied principal component analysis to archaeobotanical materials.

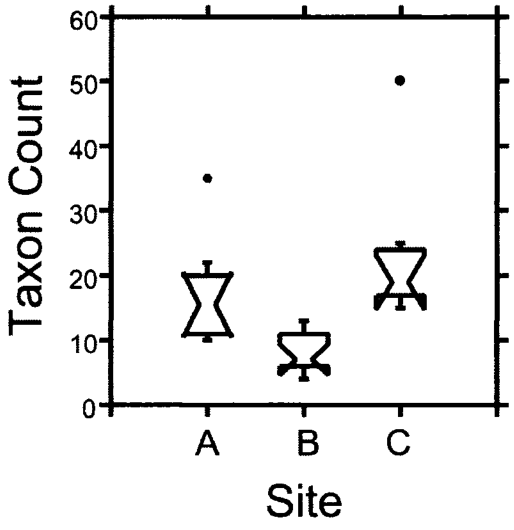


Figure 5.1. Example of a boxplot comparing summary data for assemblages from sites A, B, and C.

Correspondence analysis is based upon a chi-squared analysis of the data matrix. The chi-squared statistic tests the null hypothesis that there is not an association between the rows and columns of the matrix (Baxter 1994:112). For example, using the data in Table 5.7, the null hypothesis is that the four taxa are distributed equally among the three sites. In short, correspondence analysis "is an attempt to 'explain' as much of this [chi-squared] statistic as possible in a low number of dimensions" (Baxter 1994:114).

The formula for the chi-squared statistic is $X^2 = \sum (O - E^2) / E$, where O is the observed value and E is the expected value if no association is present. Applying this to the data matrix, the expected values are defined as E = (row total x column total) / overall total. The importance of each cell's contribution to the X^2 is termed the cell's residual, and is defined as $r_{i,j} = (O_{i,j} - E_{i,j}) / (E_{i,j})^{1/2}$. So for Site A in Table 5.6, Taxon 1 has an expected value of (68 x 45) / 193 = 15.85. Its observed value is 27, however, and greater than would be expected if there were no association between taxon and site. This cell's residual can be calculated as $r = (27 - 15.85) / (15.85)^{1/2} = 2.80$.

Table 5.6. Hypothetical Data Matrix Used in Correspondence Analysis (adapted from Baxter 1994, Bush 2004: Table 6.1).

Site	Taxon 1	Taxon 2	Taxon 3	Taxon 4	Row total
A	27 ($x_{1,1}$)	16 ($x_{1,2}$)	7 ($x_{1,3}$)	18 ($x_{1,4}$)	68 ($\sum x_{1,j}$)
B	13 ($x_{2,1}$)	32 ($x_{2,2}$)	11 ($x_{2,3}$)	41 ($x_{2,4}$)	97 ($\sum x_{2,j}$)
C	5 ($x_{3,1}$)	12 ($x_{3,2}$)	3 ($x_{3,3}$)	8 ($x_{3,4}$)	28 ($\sum x_{3,j}$)
					Overall total
Column total	45 ($\sum x_{i,1}$)	60 ($\sum x_{i,2}$)	21 ($\sum x_{i,3}$)	67 ($\sum x_{i,4}$)	193 ($\sum x_{i,j}$)

The residual can then be plotted on a graph as $y_{i,j} = r_{i,j} / (\sum x_{i,j})^{1/2}$ (Baxter 1994:112-113). The origin of the graph is the expected value, and the axes are drawn in the direction of the greatest spread of points (Baxter 1994:114, Bush 2004:106). Row values are thus plotted with respect to how they differ from the expected value. Those that differ most will be plotted farthest from the origin, and those that differ in similar ways will be plotted near each other. Similarly, column values are plotted along the same axes. The variables (columns, or taxa) that cause the rows (site assemblages) to differ from the expected profile are those that plot near the rows (Baxter 1994:114).

I use SYSTAT 9 (SPSS 1999) to perform the correspondence analyses. This program generates correspondence plots, and also computes the inertia, or total variation, in the data. Additional statistics produced by the program include the proportion of the inertia explained by each axis (or factor), as well as the mass, quality, and inertia of each column and row (or variable). The mass is the row total or column total divided by the overall total, and denotes the influence of each variable on the correspondence analysis. Quality describes how well each variable is represented in the plot. The inertia of each variable indicates the proportion of the total variation in the data for which that variable accounts.

Correspondence analysis is useful to this study for several reasons. First, it reduces the various taxa, recovered at the sites in varying quantities, to two factors and then plots these, facilitating the identification of similarities and differences among the samples. Second, it handles samples of different sizes, enabling me to compare assemblages from the four sites even though some are relatively small, both in number and size. Although these smaller samples may or may not adequately represent the use of plants at the sites, their use within correspondence analysis is mathematically justified (Bush 2004:107).

SUMMARY

My data include carbonized plant remains from four rockshelter sites in the Middle Tennessee River Valley. These shelters provide excellent conditions for preservation of organic materials, and also contain deeply stratified deposits that include Late Paleoindian, Dalton and Early Archaic occupations. While similar in terms of preservation, the assemblages from the sites differ in size, collection technique, and processing method. I analyzed the samples from the sites using standard archaeobotanical techniques. While I use ubiquity and various ratios to describe the resulting data, I approach the data from the framework of exploratory data analysis, using graphical displays such as boxplots and correspondence analysis to facilitate the detection of patterning within the data. With these analytical devices and an exploratory approach in mind, I turn to the results of the archaeobotanical analysis in the next chapter.

CHAPTER SIX:
PALEOETHNOBOTANICAL ANALYSIS – RESULTS

The plant materials recovered from the four rockshelter sites can be placed in five categories. These include wood, nuts, fruits, edible seeds, and weedy seeds (Table 6.1). Nut taxa include acorn shell and meats, black walnut shell, hickory nutshell, hazel nutshell, shell identified as belonging to the Walnut or Beech Family, and nutmeats belonging to the Walnut Family (see Table 6.1 for scientific names of plant taxa discussed in text). The fruit category includes persimmon, recovered in the form of seed, seed coat, and in some instances whole fruits, as well as the seeds of hackberry, grape, sumac, mulberry, and possible black gum, honey locust and nightshade. Edible seeds are represented primarily by chenopod and wild legumes, which recur frequently at several sites, suggesting that they were used regularly by early foragers. Other taxa that may have been eaten but are found more infrequently include maygrass, purlsane, smartweed, seeds from the Grass Family, and seeds that may be chenopods or amaranths (cheno-ams). Among the weedy seeds are seeds that have no known dietary use, such as bedstraw, poke, yellow stargrass, and possible morning-glory seed. These seeds are likely commensal taxa, brought into the sites accidentally or by natural agents. Additional weedy seeds include those that could not be identified to the species level, such as possible members of the Mustard and Composite family. Also recovered from the samples are cane, possible pine nut and possible squash rind, which likely were not used for food.

In this chapter, I detail the plant food taxa recovered from each site and discern patterns in the data, particularly changes through time. I then compare the four site assemblages and explore possible trends in plant use across space. I further discuss uses of individual plant taxa in Chapter Seven, and the activities surrounding plant use at each site in Chapter Eight.

Table 6.1. Plant Taxa Recovered from the Four Rockshelter Sites.

Category: Common Name	Scientific Name
Nuts:	
Acorn	*Quercus* spp.
Beech family	Fagaceae
Black walnut	*Juglans nigra*
Hazel	*Corylus* sp.
Hickory	*Carya* spp.
Walnut family	Juglandaceae
Fruits:	
Black gum cf.	*Nyssa sylvatica* cf.
Grape	*Vitis* spp.
Hackberry	*Celtis* sp.
Honey locust cf.	*Gleditsia triacanthos* cf.
Maypop cf.	*Passiflora incarnata* cf.
Mulberry	*Morus* sp.
Persimmon	*Diospyros virginiana*
Sumac	*Rhus* sp.
Edible seeds:	
Bean cf. (intrusive)	*Phaseolus vulgaris* cf.
Chenopod	*Chenopodium* sp.
Chenopod-amaranth	*Chenopodium/Amaranthus* sp.
Grass family	Poaceae
Purslane	*Portulaca* sp.
Smartweed	*Polygonum* sp.
Wild bean cf.	*Strophostyles* sp. cf.
Wild legume	Fabaceae
Weedy seeds:	
Bedstraw	*Galium* sp.
Composite family cf.	Asteraceae cf.
Morning-glory cf.	*Ipomoea* sp. cf.
Mustard family cf.	Brassicaceae cf.
Nightshade cf.	*Solanum* sp. cf.
Poke	*Phytolacca americana*
Miscellaneous:	
Cane	*Arundinaria gigantea*
Pine nut cf.	*Pinus* sp. cf.
Squash rind cf.	*Cucurbita* sp. cf.
Yellow stargrass	*Hypoxis hirsuta*

STANFIELD-WORLEY BLUFF SHELTER

The plant remains recovered from the Stanfield-Worley samples are listed in Table 6.2; more detailed information about the sample materials can be found in Appendix A. Among the ¼-inch

Table 6.2. Plant Materials Recovered from the Stanfield-Worley Bluff Shelter (1Ct125) Samples.

Type: Catalog	Unit	Level	Depth	Zone	Plant Weight (g)	Wood Weight (g)	Shell Weight (g)	Lithic Weight (g)	Bone Weight (g)	Acorn Count	Acorn meat Count	Black walnut Count	Hickory Count	Jugland-aceae Count	Persimmon Count	Other
Screen samples:																
22*	125R1	9	45"		1.14	1.14	0.00	0.00	3.34							
30*	130R2	9	45"		0.36	0.36	0.00	0.00	0.00							
29*	130R2	11	55"		0.37	0.37	0.00	0.00	0.00							
27*	130R3	12	60"		4.85	4.85	0.00	0.00	0.00							
10	130R3/4			Dalton	7.99	6.46	0.00	0.00	0.00		3		7		1	
36*	145R2	12	60"		69.19	3.09	0.00	0.23	0.19		240	1	1			
Pinch samples:																
2261	110R6	4		Dalton	0.80	0.30	0.00	0.01	0.56		2	8	10	4		
2258	110R8			Dalton	0.10	0.01	0.00	0.00	1.23			1	2	1		
2260	110R8	1		Dalton	0.09	0.04	0.00	0.00	0.00				3			
2276	Block2	3		Dalton	12.82	8.19	0.00	0.45	6.61	5	11	59	84	11	8	1 hazel
2277	Block2	5		Dalton	7.10	4.00	0.00	0.00	1.00			73	79	31	3	
2278	Block2	6		Dalton	4.16	1.90	0.00	0.00	0.52	4	3	43	56	16	4	1 sumac cf.
2280	Block2	8		Dalton	5.35	2.32	0.00	0.08	2.81		7	36	110	36	3	1 hazel, 2 grape
2281	120R3	11		Dalton	0.03	0.00	0.00	0.00	0.00			1	1	2		
2270	120R6	2		Dalton	0.93	0.59	0.00	0.00	0.07	1		1	21			
2266	125R3	9		Dalton	3.18	1.96	0.00	0.01	0.24		3	13	47	4	3	
2267	125R3	11		Dalton	4.23	4.12	0.00	0.00	0.00	1	7	1	2			
2268	125R3	12		Dalton	2.39	1.97	0.00	0.00	0.04	1	2	12	2	6		
2282	125R3	13		Dalton	2.28	2.03	0.00	0.00	0.04		2		9		1	
2272	125R3	14		Dalton	0.98	0.71	0.00	0.00	0.86	2	3	3	11	1		
2269	125R4	11		Dalton	0.15	0.14	0.00	0.00	0.00					1		
2283	135-140	1		Dalton	0.40	0.05	0.00	0.00	0.85	2		5	9	1		3 honey locust cf.
2285	Block3	2		Dalton	2.19	0.27	0.00	0.00	0.10	2	1	56	34	6	12	
2286	Block3	3		Dalton	1.54	0.97	0.00	0.00	0.56	5	10	5	25	4	2	3 hazel
2287	Block3	4		Dalton	1.00	0.27	0.00	0.02	0.27		1	7	32	2	1	
2284	Block3	10		Dalton	1.43	0.94	0.00	0.06	7.35			1	32	1		1 sumac

*Samples tentatively assigned to Dalton zone.

screen samples, wood is the primary plant material recovered, with one exception. Sample 36, from Square 145R2, towards the back of the shelter, contained large amounts of acorn meats. No acorn shell was recovered, although it is likely to have fallen through the screen during recovery and might be underrepresented. This sample in particular may represent a cache of cleaned acorn meats that was accidentally burned, perhaps during toasting. However, this sample is only tentatively assigned to the "Dalton" zone and must be viewed cautiously. In general, among the screen samples acorn shell is poorly represented, and hickory and black walnut are also sparse.

This contrasts with the materials found in the pinch samples, where black walnut and hickory represent the majority of non-wood plant taxa recovered. Acorn meats are regularly recovered, although in much lower quantities than the screen samples. A wider range of plant taxa are also present in the pinch samples. This includes persimmon, which appears regularly. Several fragments of hazelnut shell were also recovered, along with two grape seeds, one definite and one possible sumac seed, and three possible honey locust seed fragments.

The differences between the screen and pinch samples can readily be attributed to the different methods used to collect them. A comparison of ubiquity values for the two datasets further bears this out (Table 6.3). It is not surprising that smaller and more fragile items, such as sumac and grape seeds, were not recovered from the ¼-inch screen samples. The pinch samples appear to be more representative of the food habits of the shelter's occupants, and indicate regular use of acorns, black walnuts and hickory nuts, as well as persimmons. Of course it is important to keep in mind that other nuts and fruits, like hazel, grape and sumac, may have also been regularly gathered and eaten, but are simply underrepresented in the samples.

ROLLINS BLUFF SHELTER

The plant materials recovered from Rollins Bluff Shelter are listed in Table 6.4, and in further detail in Appendix B. The samples are dominated by hickory nutshell, which is ubiquitous. Additional nut taxa include acorn shell, which occurs in nearly all samples, and black walnut,

Table 6.3. Ubiquity of Plant Remains in Samples from Stanfield-Worley (1Ct125).

Taxon	¼-Inch Screen Samples[a] Percent (%)	Pinch Samples[b] Percent (%)
Acorn shell		45
Acorn meat	33	60
Black walnut	17	85
Hazel		15
Hickory	33	95
Juglandaceae shell		80
Grape		5
Persimmon	17	45
Sumac		5

[a] N = 6.
[b] N = 20.

recovered in low numbers in roughly one-third of the samples. Acorn meats were identified in several samples.

Fruit taxa are represented by six fragments of persimmon seed, 11 grape seeds, one possible grape seed, and two sumac seeds. In addition, one wild legume, one possible squash rind fragment, and one possible common bean were recovered. The latter is certainly intrusive, as bean is not recovered from Eastern Woodland sites until approximately 800 BP, shortly after the advent of maize agriculture (Hart et al. 2002). It is not implausible, however, for the possible squash rind to be an early, weedy variety, which may have been used as a container or net float rather than a foodstuff (Fritz 2000:227; Prentice 1986; but see Cowan 1997:70-72).

Comparisons between the Late Paleoindian and Early Archaic period occupations at the site suggest several trends. Ubiquity measures indicate a possible increase in use of acorn through time, as acorn shell rises from 50% to 94% in the Early Archaic, although the value for acorn meats is roughly the same (Table 6.5). Black walnut, however, seems to decrease in use, as its ubiquity drops from 50% to 25%. Hickory is present in all samples in both periods, demonstrating its importance to the occupants of the shelter. These shifts do not seem to be related to differences in preservation, as

Table 6.4. Plant Materials Recovered from the Rollins Bluff Shelter (1Fr323) Samples.

Context: Catalog#	Cut	Level	Depth (ft)	Zone	Period*	Plant wt (g)	Wood wt (g)	Shell wt (g)	Lithic wt (g)	Bone wt (g)	Acorn count	Acorn meat count	Black walnut count	Hickory count	Persimmon count	Other
Control Block 1																
127/132	1	1	0	D	E.A.	4.58	0.44	0.00	0.01	0.00	2			324		1 grape, 1 wild legume
136/137	1	1	0	D	E.A.	3.69	0.34	0.00	0.00	0.00	2			280		
114	1	3	0.4	D	E.A.	5.05	1.02	0.00	0.00	0.08	15			158		1 black walnut cf.
154/155	1	3	0.4	D	E.A.	1.89	0.13	0.00	0.04	0.00				119		
157	1	3	0.4	D	E.A.	16.82	10.01	0.00	0.18	0.11	57			572	1	1 black walnut cf.
133/138	1	4	0.6	D	E.A.	4.55	0.18	0.00	0.18	0.00	1		1	375		2 black walnut cf., 1 grape
146	1	4	0.6	D	E.A.	1.42	0.09	0.00	0.08	0.00	1			103		1 black walnut cf.
121/126	2	1	0	D	E.A.	3.59	0.36	0.00	0.03	0.00	2			229		
145/150	2	2	0.2	D	E.A.	3.00	0.14	0.00	0.16	0.21	1		1	248		
158/159	2	1	0	D	E.A.	5.3	3.04	0.01	0.01	0.09	8	1		156		1 common bean cf. (likely intrusive), 3 unidentifiable seed
160	2	1	0	D	E.A.	10.07	8.05	0	0.00	0.12	21	8		204	3	
142/143	3	5	0.8	C	E.A.	3.24	1.08	0.00	0.04	0.00	3		1	178		
148/149	3	2	0.2	D	E.A.	1.29	0.29	0.00	0.26	0.02	4			97		
124/125	1	1	0	E	Dalton	0.89	0.08	0.00	0.00	0.00	2		1	70		1 grape cf.
153	1	1	0	E	Dalton	2.02	0.07	0.00	0.04	0.00	1		4	203		3 Juglandaceae nutshell
128/129	1	2	0.2	E	Dalton	1.51	0.05	0.00	0.04	0.00	3	3	1	149		4 grape
122/123	2	1	0	E	Dalton	0.44	0.03	0.00	0.01	0.00		3		40	1	5 grape
139/140	2	2	0.2	E	Dalton	0.36	0.06	0.00	0.00	0.00	1			31	1	
115/120	3	1	0	E	Dalton	1.35	0.14	0.00	0.00	0.00				127		
118/141	3	3	0.4	E	Dalton	0.19	0.01	0.00	0.00	0.00				19		1 black walnut cf.
Control Block 2																
130/131		6	1	C	E.A.	4.02	0.74	0.00	0.00	0.00	1		1	248		4 black walnut cf.
151/156		1	0	D	E.A.	3.75	0.41	0.00	0.01	0.03	3			270		1 black walnut cf.
147		3	0.4	D	E.A.	2.05	0.79	0.00	0.00	0.00	1	1		115		
134/135		5	0.8	L		8.84	1.61	0.00	0.00	0.00	3			607		2 black walnut cf.

Table 6.4 (continued). Plant Materials Recovered from the Rollins Bluff Shelter (1Fr323) Samples.

Context: Catalog#	Cut	Level	Depth (ft)	Zone	Period*	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Acorn meat count	Black walnut count	Hickory count	Persimmon count	Other
Square 95L5																
119		16	60		Dalton	0.73	0.08	0.00	0.03	0.00				58		
112/113		16	60		Dalton	0.44	0.09	0.00	0.08	0.00	1			41	1	1 unidentifiable seed
152		16	60		Dalton	1.31	0.15	0.00	0.00	0.00			2	103		1 acorn cf., 1 squash rind cf., 2 unidentified seed
116/117		17	64		Dalton	2.00	0.18	0.00	0.04	0.00	1		5	195		1 black walnut cf., 1 sumac
144		18	68		Dalton	0.87	0.19	0.00	0.02	0.00			1	57		1 sumac

*E.A. stands for Early Archaic.

Table 6.5. Ubiquity of Plant Remains in Samples from Rollins Bluff Shelter.

Taxon	Dalton Samples[a] (%)	Early Archaic Samples[b] (%)
Acorn shell	50	94
Acorn meat	17	19
Black walnut	50	25
Hickory	100	100
Grape	17	13
Persimmon	25	13
Squash rind cf.	8	
Sumac	17	
Wild legume		6

[a] N = 12.
[b] N = 16.

small seeds are recovered from both components. Sample size may be a factor, but because volumes were not recorded prior to floatation, it cannot be assessed.

The possibility of different rates of deposition – of either sediment or of plant materials – also cannot be ruled out. If the sedimentation rate increased in the Early Archaic, so that fewer years are represented by the same amount of sediment, then the increase in acorn may be understated – more acorn would have been deposited over fewer years. Along the same lines, the decrease in black walnut may be overstated – fewer black walnut shells would have been deposited over a span of fewer years. Different rates of plant deposition over time may also affect ubiquity. If plant remains are being deposited at a higher rate, for example due to increased occupation of the site, then the increase in the ubiquity of acorn may be overstated and the decrease in black walnut more significant. In other words, more acorn shells may have been recovered, but there are more plant remains in general. In contrast, fewer black walnut shells were recovered among the greater quantities of plant materials. An increased rate of plant deposition, related to an increase in the intensity of site use, may well be the case; debitage increases significantly in the Early Archaic component as well (Stowe 1970), also suggesting more intensive use of the site.

Relative densities of the various taxa give further information regarding possible changes through time. While the density of wood relative to other plant materials does not change significantly between the two periods, as shown by the overlapping notches of the boxplots in Figure 6.1, Early Archaic samples do include higher values for the relative density of wood charcoal. This difference is not likely related to preservation issues; as noted above, preservation of small and fragile taxa seems to be similar for the two periods. In contrast, the relative density of hickory is significantly lower in Early Archaic samples, a shift overshadowed by the 100% ubiquity values. Similarly, the boxplots show a different picture from the ubiquity values for acorn shell, with a slight decrease in use relative to other plants in the Early Archaic. The notches of the boxplots overlap slightly, however, so the trend is not statistically significant. The relative density of black walnut, which drops in Early Archaic samples, does coincide with its lower ubiquity for this period. Comparing the nut taxa amongst each other (Figure 6.2), it appears that acorn and hickory are used in similar quantities relative to each other in both periods; in other words, neither hickory nor acorn become more important than the other in the Early Archaic as compared to the Late Paleoindian period. In contrast, black walnut decreases in use relative to hickory in the Early Archaic.

Drawing on these patterns, it appears that the occupants' use of nut taxa, particularly hickory and black walnut, changed significantly from the Late Paleoindian to the Early Archaic period. This shift may be related to the nuts' consumption, processing and deposition, and/or use as a fuel source. Shifts in acorn use are not as clear. Acorn shell did not increase in use relative to other plants, but did have a higher ubiquity in the Early Archaic period. This suggests that the higher ubiquity may be related to changes in use of the site at this time. Increased use of the shelter, along with an increased deposition of plant materials in general, may account for an increase in ubiquity. If this is the case, the decrease in the ubiquity of black walnut is even more significant.

The relatively narrow range of taxa recovered from the Rollins Bluff Shelter is notable. While hickory, acorn, and black walnut appear in the Rollins samples, hazel nutshell was not recovered, unlike the Stanfield-Worley samples. Similarly, the major fruit taxa are present, namely

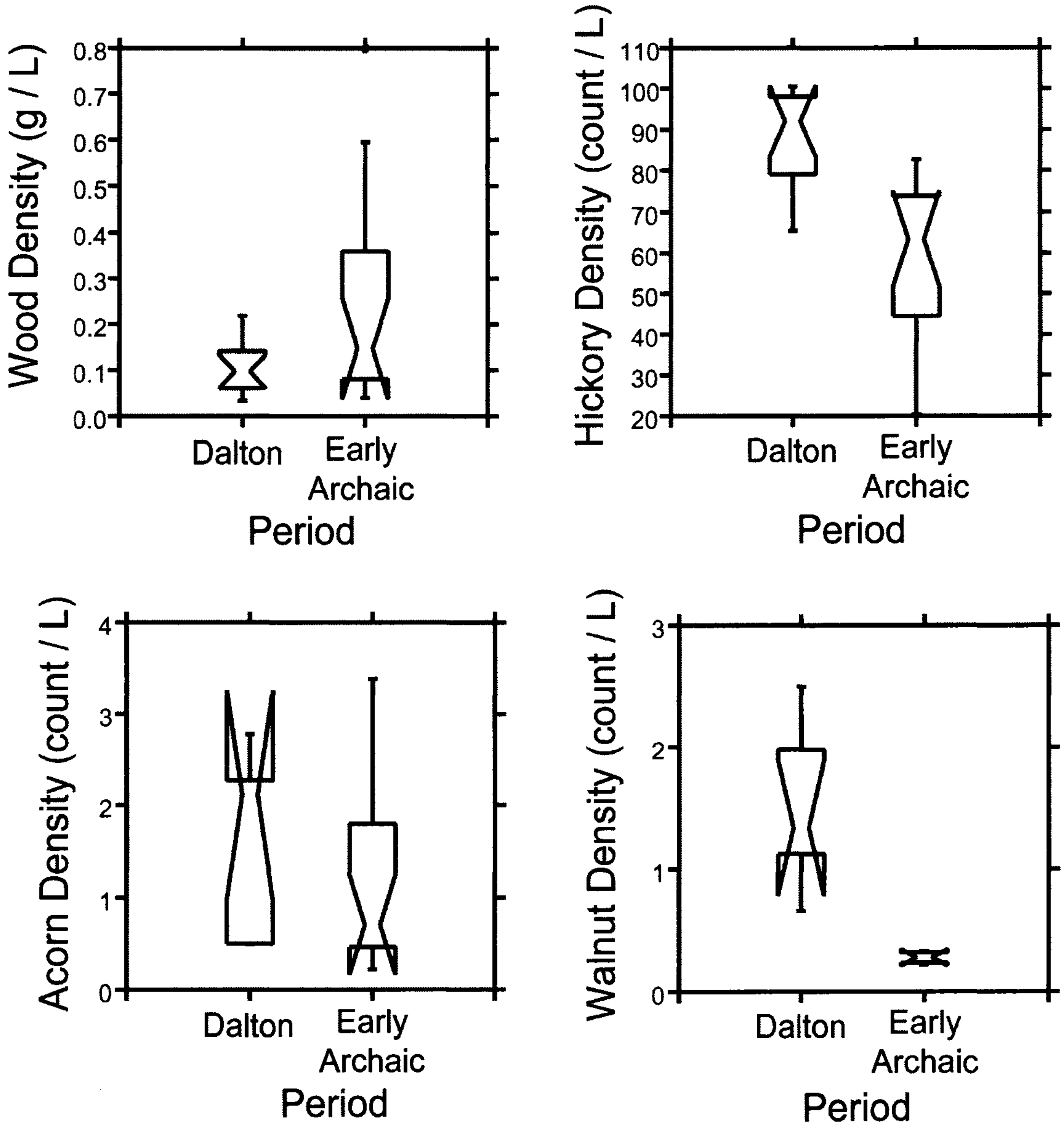


Figure 6.1. Boxplots comparing the relative densities of wood, hickory, acorn, and black walnut in floatation samples from Rollins Bluff Shelter.

persimmon, grape, and sumac, but the only other taxa recovered were a single wild legume and possible squash rind fragment. While smaller seeds may have been adversely affected by the screening of materials prior to floatation, it seems likely that if they were used by the site's occupants in significant quantities, they would have been recovered along with the grape, sumac, and wild

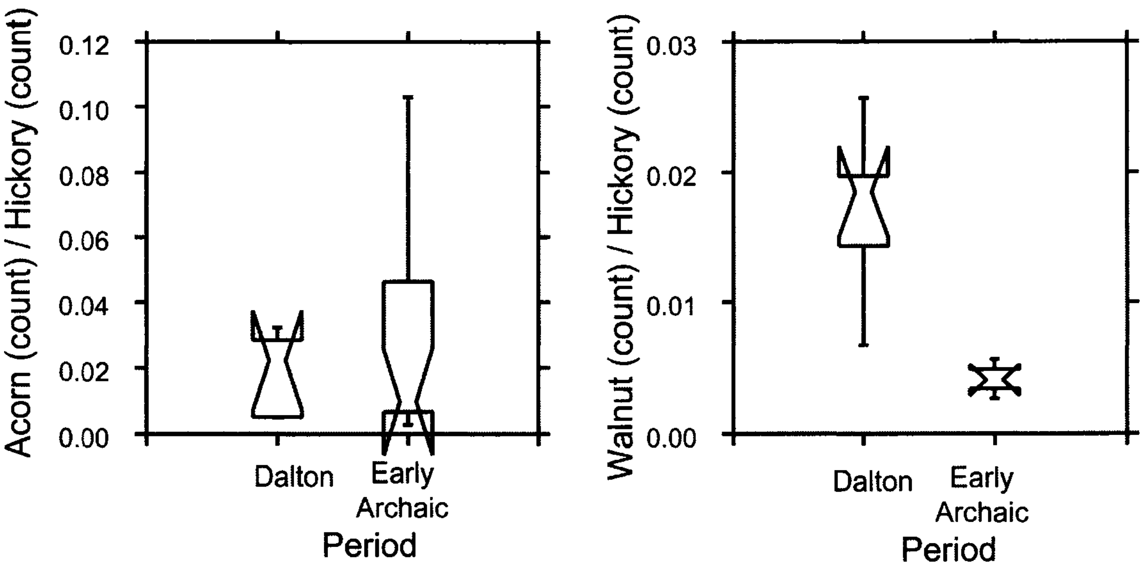


Figure 6.2. Boxplots comparing the relative quantities of acorn and hickory (acorn count/hickory count) and black walnut and hickory (black walnut count/hickory count) in samples from Rollins Bluff Shelter.

legume. I suggest instead that the occupants of Rollins Bluff Shelter used a relatively limited range of nut, fruit, and edible seed taxa.

LAGRANGE BLUFF SHELTER

Plant remains recovered from LaGrange are listed in Table 6.6, with more detailed information given in Appendix C. Samples that derive from the ¼-inch screen are best represented by wood, black walnut and hickory nutshell. Four acorn meats and two persimmon seeds were also recovered, but small and fragile taxa, such as acorn shell and smaller seeds, are missing. This is highlighted by the regular, although low, recovery of acorn shell in the floatation samples, as well as by the significant number and range of smaller taxa in these samples. In addition to hazel nutshell, these include grape, mulberry, sumac and possible maypop among fruits; chenopod, a seed from the Grass family, a possible cheno-am, possible wild bean and other wild legumes representing edible seeds; and tentatively identified members of the Mustard and Composite families.

Table 6.6. Plant Remains Recovered from the LaGrange Bluff Shelter (1Ct90) Samples.

Sample Type: Catalog	Unit	Level	Period*	Zone	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Acorn meat count	Black walnut count	Hickory count	Jugland. count	Persimmon count	Other
Screen Samples:																
71	S5E11	12	E. A.		1.00	0.49	0.00	0.00	0.00				7			
70.5	S5E11	13	E. A.		0.04	0.04	0.00	0.00	0.00							
49	S5E11	15	E. A.	D	0.27	0.27	0.00	0.00	0.00							
47/74	S10E5	13	E. A.	C	0.08	0.00	0.00	0.00	0.31			1	1			
88/89	S10E5	14	E. A.	D	0.43	0.07	0.00	0.00	0.00			2	1			
78/79	S10E5	15	E. A.	D	0.32	0.06	0.00	0.00	0.14				2			
41	S10E9	15	E. A.	D	0.94	0.00	0.00	0.00	1.54			10	15			
77/84	S10E10	12	E. A.	B	0.69	0.07	0.00	0.00	0.00				16			
61	S10E10	13	E. A.	B	0.40	0.00	0.00	0.34	0.00			1	5			
46	S10E10	10	E. A.	C	1.00	1.00	0.00	0.00	0.00							
75	S10E10	13	E. A.	C	0.48	0.00	0.00	0.00	0.00				8			
48	S10E10	14	E. A.	C	0.49	0.00	0.00	0.00	0.00			1	3			
76	S10E11	12	E. A.	C	0.30	0.00	0.00	0.00	0.00				1			
42/80/81	S10E5	16	Dalton	D	0.59	0.00	0.00	0.00	0.00			8	11	3		
54/82	S10E5	17	Dalton	D	0.85	0.02	0.00	0.00	0.03		3	14	5	1		
43/83	S10E5	18	Dalton	D	0.39	0.00	0.00	0.00	0.02			5				
44	S10E5	16	Dalton	E	0.35	0.00	0.00	0.00	0.00			8	2	5		
51	S10E5	17	Dalton	E	0.10	0.00	0.00	0.00	0.00			4	7			
52/53	S10E10	16	Dalton	D	0.91	0.00	0.00	0.00	0.16			4	14		1	
55	S10E10	17	Dalton	D	0.54	0.00	0.00	0.00	0.00			2	15			
96	S10E10	15	Dalton	E	0.11	0.00	0.00	0.00	0.00				1			
50	S10E10	19	Dalton	E	0.07	0.00	0.00	0.00	0.00				1			
40	S10E10	20	Dalton	F	0.04	0.01	0.00	0.00	0.00				1			
87	S10E11			D	0.21	0.00	0.00	0.00	0.00				2			

Table 6.6 (continued). Plant Remains Recovered from the LaGrange Bluff Shelter (1Ct90) Samples.

Sample Type: Catalog	Unit	Level	Period*	Zone	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Acorn meat count	Black walnut count	Hickory count	Jugland. count	Persimmon count	Other
Flotation Samples:																
106	S10E10	14	E. A.	B	0.32	0.04	0.00	0.00	0.13	1			26			1 wild legume
107	S10E10	14	E. A.	B	0.51	0.03	0.00	0.00	0.13	1		2	34	7		
105	S10E10	15	E. A.	C	1.33	0.19	0.00	0.00	0.00	3			89	1		1 Composite family cf., 1 mulberry
104	S10E5	14	E. A.	D	1.43	0.10	0.00	0.00	0.18	3	6	34	27	10	15	1 chenopod, 1 chenopod cf., 1 grape, 1 hazel, 1 wild bean cf., 1 sumac, 7 wild legume, 1 unidentifiable seed
103	S10E5	15	E. A.	D	0.86	0.04	0.00	0.00	0.09	4		14	47	1		2 chenopod, 1 chenopod cf., 1 grape, 1 maypop cf., 5 wild legume, 1 unidentified seed
108	S10E10	Burial 1	E.A.	C	1.21	0.28	0.00	0.01	0.07	1			74			1 acorn cf., 1 bedstraw, 1 cheno-am cf., 1 grape, 2 unidentified seeds
101	S10E5	16	Dalton	D	1.63	0.14	0.00	0.00	0.11	1		30	71	6		1 chenopod, 1 hazel, 3 wild legume, 2 unidentified seeds
102	S10E5	16	Dalton	D	1.85	0.09	0.00	0.00	0.56	5		29	92	6	1	2 chenopod cf., 2 grape, 1 Grass family, 1 hazel, 1 sumac, 6 unidentifiable seeds
99	S10E10	19	Dalton	E	0.36	0.02	0.00	0.00	0.00	1		7	11	4		1 Brassica family cf., 1 hazel, 1 sumac
100	S10E10	19	Dalton	E	0.13	0.02	0.00	0.00	0.00	1		1	12	1		
98	S10E10	22	Dalton	F	0.01	negl.	0.00	0.00	0.00				1			

*E.A. stands for "Early Archaic" period.

Although the number of samples, particularly floatation samples, is small, some brief quantitative comparisons can be made. Not surprisingly, ubiquity values demonstrate that smaller and more fragile items, including most seeds, acorn shell, and hazel, are underrepresented in the ¼-inch screen samples (Table 6.7). Hickory is nearly 100% ubiquitous at the site. Among floatation samples, acorn also has a high ubiquity, present in all but one sample. These high values likely reflect their importance to the site's occupants. Black walnut appears to decrease in use from the Dalton to Early Archaic occupation. Hazel may show a similar decrease, although again the number of samples is small. Fruits and seed taxa do not seem to change significantly through time, although sumac may decrease somewhat while grape and wild legumes may increase slightly. Preservation does not appear to be a factor in these ubiquity values, as small seeds are recovered in similar numbers from both Dalton and Early Archaic samples. Possible differences in deposition rates, either of sediment or of plant materials, are unclear.

Boxplots of relative densities of taxa recovered from the floatation samples demonstrate greater similarities than differences between the Early Archaic and Dalton samples at LaGrange (Figure 6.3). The notches for wood, hickory, walnut, and acorn overlap significantly. Of course, this could be related to the lownumber of samples available. It is of note, however, that the possible drop in black walnut suggested by the ubiquity values of both screen and floatation samples is not borne out by the relative densities of the floatation samples.

In general, then, there seem to be more similarities between the Dalton and Early Archaic samples than not, reflected by ubiquity and relative density measures. In addition to hickory, black walnut, acorn and hazel, both Dalton and Early Archaic occupants of LaGrange apparently used a wide variety of fruits and wild seeds. These include persimmon, grape, and sumac, as well as chenopod and wild legumes. This variety of plant foods stands in contrast to the more narrow range of foods seen at Stanfield-Worley and Rollins Bluff Shelters.

Table 6.7. Ubiquity of Plant Remains in Samples from LaGrange (1Ct90).

Taxon	Screen Samples		Floatation Samples	
	Dalton[a] (%)	Early Archaic[b] (%)	Dalton[c] (%)	Early Archaic[d] (%)
Acorn shell	0	0	80	100
Acorn meat	10	0	0	17
Black walnut	70	50	80	50
Hazel	0	0	60	17
Hickory	90	100	100	100
Grape	0	0	20	50
Persimmon	10	0	20	17
Sumac	0	0	40	17
Chenopod	0	0	20	33
Wild legume	0	0	20	50
Other seeds	0	0	60	67

[a] N = 10.
[b] N = 10.
[c] N = 5.
[d] N = 6.

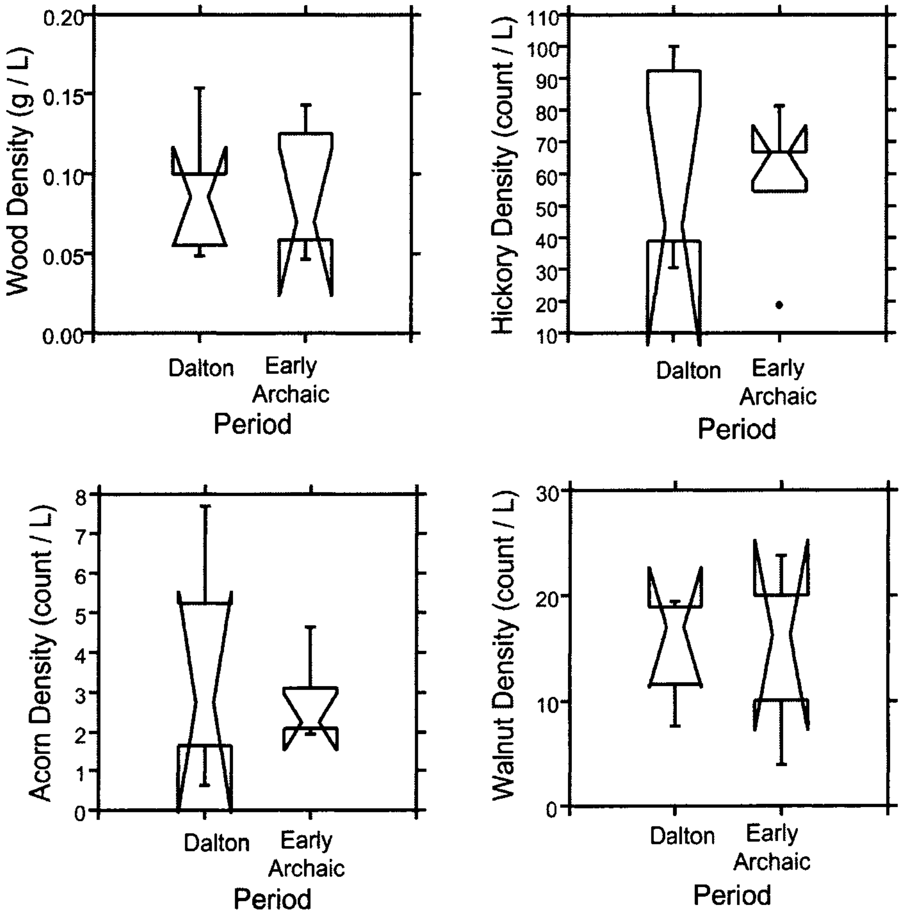


Figure 6.3. Boxplots comparing densities of wood, hickory, black walnut and acorn in floatation samples from LaGrange.

DUST CAVE

The samples from Dust Cave allow us to examine early foodways in much broader fashion than those from the previous sites. Not only are more samples available for analysis, the samples also come from various contexts, including features and floatation columns, and from several components within the site. In addition, more information is available for each sample: the volume of each sample was recorded, and detailed notes were taken for each feature. In addition, Homsey's (2004) geomorphological and geochemical analysis of features is available for comparison. The Dust Cave samples are thus amenable to a wider range of analyses.

I discuss the column samples separately from the feature samples. The latter represent activities that are relatively isolated in time and space. The features include, for example, plant remains from rock-lined hearths that may have been used on several occasions, or charcoal pits that were used and filled over a relatively short period of time. Column samples, on the other hand, represent general contexts, or an aggregate of plant remains that were swept up, trampled about, bioturbated out of features and mixed into the matrix of anthropogenic sediments that comprise the cave's deposits. These aggregate deposits may be considered to provide an averaged account of plant use at the site, while the features reflect use of plants that is bounded both in time and space.

Column Samples

The plant remains recovered from the Dust Cave column samples are listed in Table 6.8, while more detailed information about the samples is given in Appendix D. A cursory glance shows that hickory is the dominant taxon: not only is it found in all samples, it also often outnumbers other taxa within samples. Hackberry, however, is also frequently recovered, also in significant quantities. Additional nut taxa present include acorn, black walnut, and hazelnut. Interestingly, nutmeats from the Juglandaceae family (hickory or black walnut) were recovered as well as acorn meats. Twelve fragments of nutshell were also assigned to the Fagaceae family; I could not determine whether these were acorn, chestnut, or beechnut. Fruits other than hackberry include the familiar grape, persimmon

Table 6.8. Plant Materials Recovered from Column Samples at Dust Cave (1Lu496).

Unit: Bag Number	Level	Depth (cm)	Zone	Period	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Chenopod count	Other
N60W65:																
5176	40	315	P2	KS	4.5	11.95	0.74	7.58	6.52	11.74	16		980	19	3	16 Juglandaceae nutmeat, 1 poke cf.
5230	42	325	P3e	KS	8	8.16	0.73	19.95	5.06	13.25	12		1021	18		4 persimmon, 4 sumac, 6 unidentifiable seed
5319	44	335	P3e	KS	6	6.03	1.70	27.91	4.44	8.51	9		342	7		1 grape, 2 wild legume, 1 unidentifiable seed
5340	46	345	P2	KS	4	4.64	0.59	12.86	15.95	5.12	46		285	5		1 hazel, 1 persimmon seed coat, 2 sumac, 3 unidentifiable seed, 1 unidentified seed
5512	48	355	P14	KS	1	0.86	0.04	0.20	0.00	3.70	10		70	1		2 wild legume, 1 unidentifiable seed
5647	50	365	Q4	ESN/KS	7?	1.83	0.06	18.82	18.07	20.24	24		121	34		2 acorn cf.
6131	54	385	R3	ESN	0.5	0.28	0.10	0.61	4.53	2.47	1		16	12		
6152	54	385	R3e	ESN	4.7	0.82	0.25	4.34	128.88	16.56	8		24	66	7	2 grape, 1 grape meat cf.
6159	55	390	R3e	ESN	5.5	0.97	0.31	4.05	20.10	19.21	7		24	58	5	1 unidentifiable seed
6192	56	395	R3f	ESN	6	1.32	0.53	5.43	53.28	31.21	7		46	61	2	3 bedstraw, 3 chenopod cf., 1 unidentifiable seed
6212	57	400	R3f	ESN	7.5	1.11	0.30	5.52	57.85	21.73			36	57	5	
6296	58	405	R3f	ESN	7	0.61	0.16	4.91	190.40	25.21	1		14	44	7	6 chenopod cf., 1 persimmon cf., 1 sumac
6343	59	410	R3f	ESN	8	0.54	0.26	4.18	61.59	37.32	5		7	51	4	4 chenopod cf.
6360	60	415	R3f	ESN	6	0.53	0.22	0.71	28.76	17.78	6		2	35	4	4 chenopod cf.
6378	61	420	R3f	ESN	8.3	0.39	0.22	0.83	26.47	15.36	2		5	22	5	4 chenopod cf., 2 pine nut cf.
6379	61	420	T5	LP	7.5	0.42	0.39	0.10	22.61	7.91			2	5	3	2 chenopod cf., 3 poke cf.
6401	62	425	T5	LP	4	0.13	0.11	0.22	4.39	6.35	1		2	2	1	8 chenopod cf., 1 stargrass
6402	62	425	U3	LP	8	0.33	0.19	0.19	22.98	20.32		1	8	11	2	5 chenopod cf., 1 stargrass
6431	63	430	U3	LP	12	0.53	0.17	0.04	19.23	14.19	4	11	23	3	3	3 chenopod cf., 1 stargrass
6465	64	435	U3	LP	11	0.49	0.30	0.15	1.68	21.10		2	25			
6502	65	440	U8	LP	13	0.77	0.56	0.00	3.32	19.15			37		2	

Table 6.8 (continued). Plant Materials Recovered from Column Samples at Dust Cave (1Lu496).

Unit: Bag Number	Level	Depth (cm)	Zone	Period	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Chenopod count	Other
6531	66	445	U8	LP	9	0.30	0.10	0.00	5.99	10.85		2	26		1	1 acorn cf., 1 acorn meat
6551	66	445	U6	LP	7	0.14	0.01	0.00	10.11	7.70	1		16	1	1	1 chenopod cf.
6554	67	450	U6	LP	5	0.09	0.04	0.03	2.82	11.29	1		8		1	2 chenopod cf., 1 nightshade cf., 1 poke cf.
6557	68	455	U6	LP	6.5	0.00	0.00	0.00	0.91	5.38			1			
N62W62:																
6565	50	320	P18	KS	6	2.40	0.28	33.72	3.57	7.28	2		149	21		1 grape, 1 persimmon, 1 pine cone, 1 sumac, 1 wild legume
6583	51	325	P18	KS	6	1.52	0.15	13.51	1.15	9.48	10		113	20		1 hazel
6592	52	330	P18	KS	7	0.91	0.06	12.73	2.39	11.50	1		70	19		3 acorn meat, 1 Fagaceae shell (acorn or chestnut), 14 Juglandaceae nutmeat
6606	53	335	Q5	ESN/KS	8	0.39	0.05	6.42	30.03	11.49	1	3	28	12		1 chenopod cf., 1 persimmon, 3 wild legume
6647	54	340	Q5	ESN/KS	7	0.85	0.53	4.08	4.55	24.15	1		24	17		7 acorn meat, 1 cheno-am
6690	55	345	Q5	ESN/KS	7	0.42	0.00	2.38	9.44	14.40	1		7	14		
6695	56	350	Q5	ESN/KS	9	0.52	0.22	3.93	14.79	17.34	4		8	44		4 acorn meat, 5 grape, 1 unidentifiable seed, 1 unidentified seed
6716	57	355	Q5	ESN/KS	8.5	1.56	0.23	8.80	21.97	33.79	9	10	131	63	10	2 black walnut cf., 4 cheno-am, 3 grape
6735	58	360	Q5	ESN/KS	8.5	0.45	0.08	7.86	6.34	15.28	14		24	27	1	1 acorn cf., 7 acorn meat, 6 Juglandaceae nutmeat, 1 sumac cf.
6749	59	365	R1	ESN	9	0.58	0.14	6.68	105.76	10.55	2		5	89		2 chenopod cf.
6825	60	370	R1	ESN	9	0.69	0.13	13.47	52.75	19.12	1		11	93	3	5 acorn meat, 2 chenopod cf., 2 thin hickory
6854	61	375	R1	ESN	1.5	0.23	0.12	25.10	0.99	2.41	1		1	20		1 chenopod cf.
6870	62	380	Q5	ESN/KS	6	0.08	0.05	4.28	1.61	1.75	4		1	6		1 acorn meat, 1 chenopod cf.

Table 6.8 (continued). Plant Materials Recovered from Column Samples at Dust Cave (1Lu496).

Unit: Bag Number	Level	Depth (cm)	Zone	Period	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Chenopod count	Other
6886	63	385	Q5a	ESN/KS	6	0.39	0.19	4.38	19.94	8.41	6		2	47		10 Fagaceae shell (acorn or chestnut)
6983	64	390	Q5a	ESN/KS	6	0.38	0.05	3.16	18.00	9.80	1		2	64		4 chenopod cf., 2 pine cone, 3 poke, 2 unidentifiable seed
7037	65	395	T2h	LP	12	0.65	0.03	6.25	77.65	31.34	3		6	119	5	1 cheno-am, 1 purslane, 2 unidentifiable seed
7095	66	400	T2h	LP	13	3.36	0.09	9.99	75.45	56.27	1		2	222	1	1 cheno-am
7135	67	405	T10	LP	9	0.83	0.19	10.42	83.36	45.39	2		5	131	17	15 chenopod cf., 3 Juglandaceae nutmeat, 2 smartweed
7172	68	410	T2g	LP	4	0.51	0.12	10.10	31.66	14.10	4		6	52		5 hazel, 5 Juglandaceae nutmeat
7189	69	415	T10b	LP	7.5	0.71	0.01	3.57	28.22	17.29	1		9	90	1	1 bedstraw, 4 hazel, 2 unidentified seed
7250	70	420	T10b	LP	10	1.19	0.01	2.26	11.28	34.47	1		8	140		8 hazel, 29 Juglandaceae nutmeat, 1 unidentifiable seed, 3 unidentified seed
7288	71	425	U1	LP	10	0.83	0.14	1.29	6.18	32.21			19	48	1	1 grape, 17 hazel, 1 unidentified seed
7314	72	430	U1	LP	9	0.20	0.12	0.37	2.65	15.98	6		4	8	1	1 acorn meat, 1 acorn meat cf., 1 hazel, 1 unidentifiable seed, 1 unidentified seed
7356	73	435	U2a	LP	10	0.89	0.12	0.62	16.97	35.94	8	1	29	56	2	1 hazel, 4 unidentifiable seed, 2 unidentified seed
7396	74	440	U2	LP	3	0.20	0.05	0.02	0.92	6.89		2	16	6		1 hazel cf.
7426	75	445	U2a	LP	7	0.27	0.05	0.00	1.27	34.61		2	6	3	2	15 chenopod cf., 1 wild legume
7429	75	445	U2	LP	0.8	0.05	0.02	0.06	0.13	5.54		1	3		1	1 chenopod cf.
7443	76	450	U2a	LP	5.5	0.11	0.01	0.05	0.74	51.60		2	6	2	4	8 chenopod cf., 1 unidentifiable seed
7484	76	455	U2a	LP	10	0.06	0.00	0.09	1.35	69.96		1	7	2		10 chenopod cf.

Table 6.8 (continued). Plant Materials Recovered from Column Samples at Dust Cave (1Lu496).

Unit: Bag Number	Level	Depth (cm)	Zone	Period	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Chenopod count	Other
7496	78	460	U2c	LP	2	0.00	0.00	0.02	0.01	3.27			1			
N62W64:																
944	32	430	T1	LP	10	0.57	0.16	0.56	60.63	21.56		1	10	69	5	1 grape cf., 1 thin hickory cf., 2 unidentifiable seed
965	33	435	T1a	LP	6	0.29	0.03	1.05	5.22	12.44			2	290		1 acorn cf.
980	34	440	T1a	LP	6	0.48	0.02	1.25	5.30	5.38			2	116		
981	34	440	T1	LP	13	0.25	0.12	0.07	14.50	24.30		1	11	44		12 poke cf.
989	35	445	T1	LP	14	1.46	0.13	0.00	17.50	16.01	1		107			1 hazel
999	36	450	T1	LP	14	0.17	0.07	0.01	11.84	8.44			16			1 purslane cf., 2 unidentified
1012	37	455	T1	LP	9	0.34	0.04	0.11	1.51	9.93			37	10		7 poke cf., 1 unidentifiable seed
1022	38	460	U	LP	10	1.99	0.13	0.03	17.51	23.90		39	93	12		1 stargrass
1036	39	465	U2	LP	8	0.32	0.07	0.33	3.49	19.25	1		4	152		1 Fagaceae shell (chestnut or beechnut)
1049	40	470	U2	LP	13	0.03	0.01	0.25	6.36	10.91			4	3		9 poke cf.
1049.1	40	470	U2	LP	12	0.06	0.02	0.07	11.74	16.14			4	6	1	

and sumac, as well as possible black gum and nightshade. In addition, a range of smaller seed taxa are present in the samples, including chenopod, wild legumes, bedstraw, cheno-am, poke, purslane, smartweed, and stargrass.

Comparisons of ubiquity for the column samples demonstrate several trends through time (Table 6.9). Of note is the 100% ubiquity of hickory nutshell, which reflects its importance to the cave's occupants. Acorn shell shows a significant increase in ubiquity after the Late Paleoindian component, although this is not necessarily the case for acorn meats. Juglandaceae nutmeats similarly display a slight increase through time. Black walnut may decrease through time, although it is important to note that its absence from Early Side-Notched and Kirk Stemmed samples is not significant, as black walnut is recovered in feature samples from these components (see below). Similarly, no straightforward trend is apparent for hazel.

Among fruit taxa, hackberry is 100% ubiquitous in all but the Late Paleoindian samples, although its ubiquity value is still high. The remaining fruits show a somewhat more plausible increase through time, from values below 10% for the Late Paleoindian and Early Side-Notched samples to 25% or above for the Kirk Stemmed component. Wild legume shows a similar increase through time, but the ubiquity of chenopod shifts in the opposite direction, dropping from above 50% to 20% or below after the Early Side-Notched component.

While differences in preservation between the components are probably not a significant factor (small seeds are found in all samples, and the excellent preservation of bone – even fish scales – in all zones speaks to this), different rates of deposition certainly influence the ubiquity values for the column samples. As shown in Table 6.10, the components represent varying spans of time – from 300 to 1,500 years – and vary in average thickness from 15 to 54 cm. To better understand the ubiquity values, these sedimentation rates must be taken into account.

To estimate sedimentation rates for the Dust Cave components, I take the average depth of each and divide by its estimated time span to give "years per cm." These suggest that the mixed Early Side-Notched/Kirk Stemmed component had a relatively slower sedimentation rate than the

Table 6.9. Ubiquity of Plant Remains in Column Samples from Dust Cave (1Lu496).

Taxon	Late Paleo.[a] (%)	E. Side-Notched[b] (%)	ESN/Kirk Stemmed[c] (%)	Kirk Stemmed[d] (%)
Acorn shell	39	92	100	100
Acorn meat	6	8	40	13
Black walnut	36	0	20	0
Hazel	19	0	0	25
Hickory	100	100	100	100
Jugland. nutmeat	8	0	10	25
Grape	3	8	20	25
Hackberry	75	100	100	100
Persimmon	0	0	10	38
Sumac	0	8	0	38
Chenopod	56	75	20	13
Wild legume	3	0	10	38

[a] N = 36.
[b] N = 12.
[c] N = 10.
[d] N = 8.

Table 6.10. Sedimentation Rates for the Components at Dust Cave.

Component	Avg. thickness (cm)[a]	Date range (cal. BP)[b]	Years	Years/cm	Years/L
Kirk Stemmed	54	9570-7800	1770	32.7	13.1
Mixed ESN/KS	16	10,200-9570	630	40.0	16.0
Early Side-Notched	23	11,300-10,800	500	22.1	8.86
Late Paleoindian	40	12,650-11,300	1350	34.1	13.6

[a] Derived from the profile drawings given in Sherwood 2001:Figures 8.2, 8.3, and 8.12, and compared with Sherwood's (2001) estimated zone thickness.
[b] Derived from the calibrated radiocarbon dates for the zones given in Sherwood et al. 2004:Table 1.

other zones. This may be exaggerated, however, because radiocarbon dates from the base of this component (Zone Q) are lacking. A disconformity in the deposits between Zone Q and the underlying Zone R (Early Side-Notched component) points to an event(s) that eroded sediments from the cave, apparently removing deposits dating between 10,800 and 10,200 cal. BP (Sherwood 2001; Sherwood et al. 2004). The estimate given here is still informative, however. The sedimentation rates are similar for the Kirk Stemmed and Late Paleoindian components, suggesting that their ubiquity values can be directly compared. The Early Side-Notched component has a slightly higher sedimentation rate, so that if plant remains are being deposited at the same rate as in previous components, fewer plant remains per volume of sediment should be expected. Thus the increases seen in ubiquity, for example for acorn and chenopod, may be understated.

Possible changes in plant use through time can be further explored in boxplots of plant density by component (Figure 6.4). These demonstrate a significant increase in the quantity of plant materials recovered per liter after the Late Paleoindian period, and particularly during the Kirk Stemmed occupation. However, density ratios do not take into account different sedimentation rates; a liter of sediment from one zone can represent a much different time span than a liter from another. Each of the column samples is hypothetically 50-50-5-cm in size, or 12.5 liters in volume. Dividing, this gives approximately 12.5 liters per 5 cm, or 2.5 liters/cm. "Years per liter" can be calculated by dividing "years per cm" (see above) by 2.5 liters/cm (Table 6.10). The density of plant materials (plant weight in grams/volume in liters) can then be divided by "years per liter" to give an estimated "plants per year."

Boxplots of "plants per year" by component (Figure 6.5) are quite similar to the plant density boxplots (Figure 6.4), but further emphasize differences between the components, particularly the Late Paleoindian and Early Side-Notched. A marked increase through time in the quantity of plants recovered is still apparent. The increase may be related to more intensive use of plant foods at the site, or more intensive occupation of the cave, which may include more frequent visits or longer stays. Also notable is the drop in the density of plant materials during the mixed Early Side-Notched/Kirk Stemmed component. This is likely related to the nature of this zone (Zone Q), which appears to represent a time of relatively sparse occupation accompanied by possible episodes of slope wash and bioturbation that mixed what little occupation there was with the underlying Early Side-Notched zone (Zone R) (Sherwood 2001:360). However, it is also possible that the "years per cm," and therefore the denominator used in the ratio, is overestimated for the mixed Early Side-Notched/Kirk Stemmed component, unduly exaggerating the differences between it and the other components.

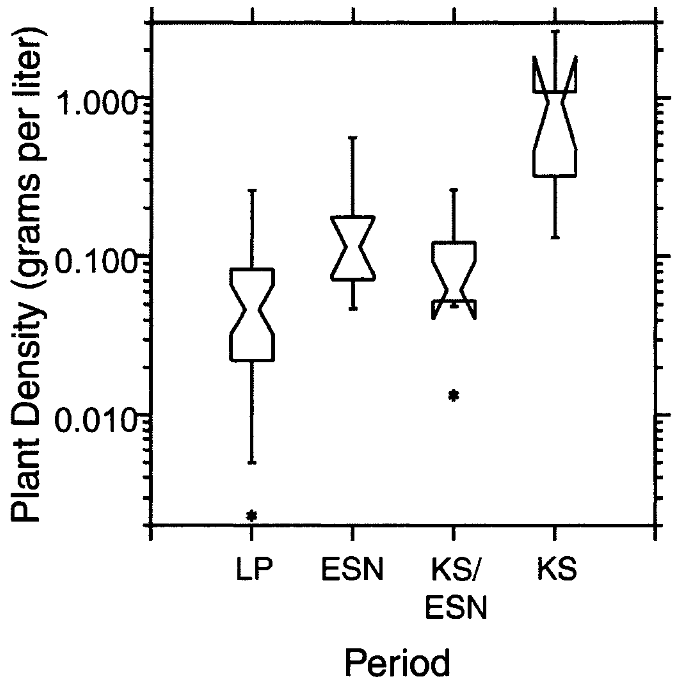


Figure 6.4. Boxplot comparing plant density by component in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

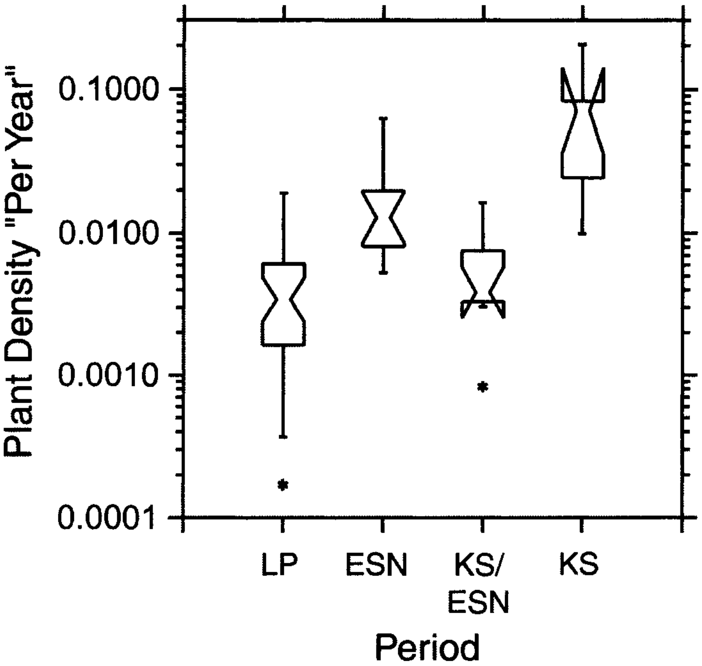


Figure 6.5. Boxplots comparing plant density "per year" by component in the Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

The low density of plant remains recovered in the Late Paleoindian period may be related to differences in depositional history as much as intensity of cave occupation. Micromorphological studies of these deposits indicate significant fluvial activity at the site during the Late Paleoindian period (Sherwood 2001). As such, carbonized materials may have been swept out of the cave. In addition, the lower zones of the cave have been subjected to repeated flooding since the construction of Pickwick Dam in 1938; each spring, the Tennessee Valley Authority raises the water level, which brings the water table high enough to impact the lower deposits. This cycle of wetting and drying over the past sixty or so years may negatively affect fragile remains such as wood charcoal and acorn shell. However, the preservation of bone in these lower levels is still remarkable (Walker 1998; Walker et al. 2001; Walker and Parmalee 2004; Walker and Richardson 1999), and small seeds such as chenopod are recovered in notable quantities, suggesting that organic remains have yet to be significantly impacted by this recent flooding.

It is also instructive to review the ubiquity values in light of the plant densities. Because the quantity of plant materials increases over time, the effective sample size increases, and the likelihood of finding rare items increases. The increase in ubiquity of "rare," or smaller and more fragile, items such as acorn shell and seeds may thus be related to the increase in plant materials recovered. The decrease through time of taxa such as chenopod is also notable, apparently unrelated to any increase in effective sample size.

The densities of various taxa also show an increase through time, which is not particularly surprising. The density of wood "per year" increases significantly in the Early Side-Notched and again in the Kirk Stemmed component, although there is overlap between the Late Paleoindian and mixed Early Side-Notched/Kirk Stemmed samples (Figure 6.6). A similar pattern is seen for acorn. As mentioned above, this pattern may be related in part to fluvial processes that may have washed these lighter, more fragile items away. Hickory, however, does not increase significantly until the Kirk Stemmed component, where its density rises by a degree of magnitude. Changes in the density

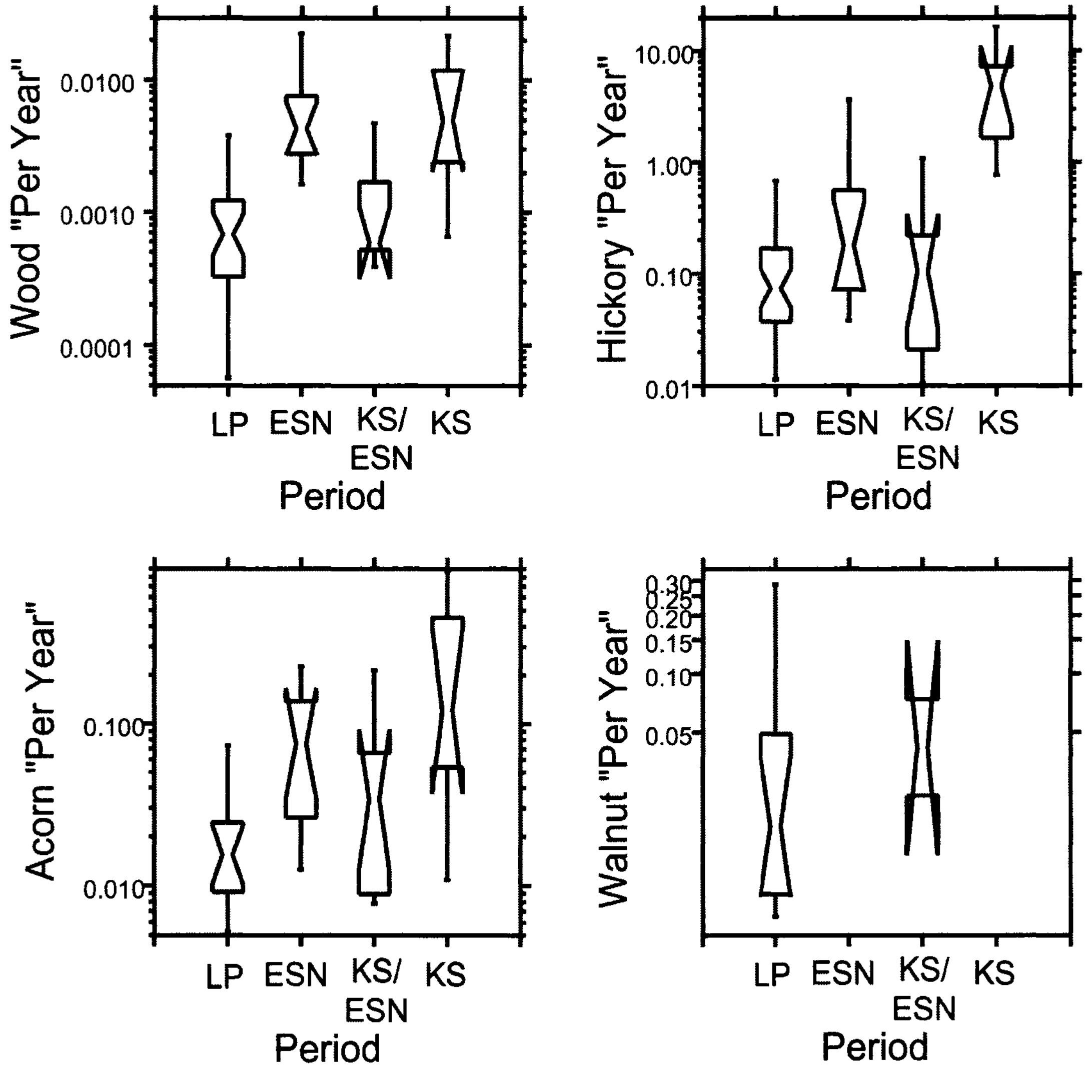


Figure 6.6. Boxplots of the density "per year" of wood, hickory, acorn, and black walnut in column samples from Dust Cave. Note the y-axes are scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

of black walnut are less clear. While its ubiquity decreased slightly, the density of black walnut is not significantly different between the Late Paleoindian and mixed components.

Among the remaining taxa, few notable patterns are apparent (Figure 6.7). There is considerable overlap in boxplots for hazel and fruits other than hackberry. Weedy seeds seem to

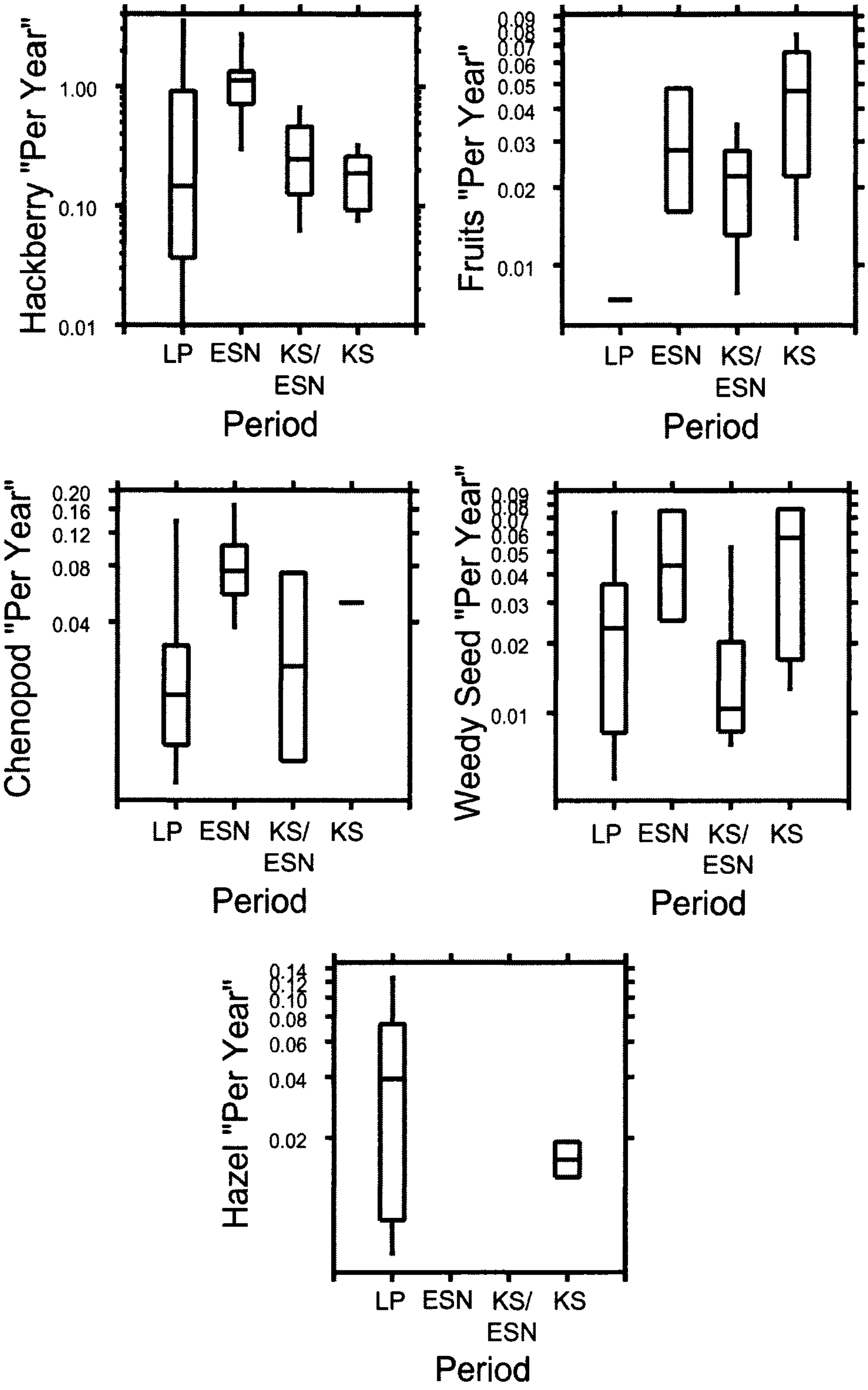


Figure 6.7. Boxplots of the density "per year" of hackberry, fruits other than hackberry, chenopod, weedy seeds, and hazel in column samples from Dust Cave. Note that the y-axes are scaled logarithmically. Notches (confidence intervals) were not used due to small sample sizes. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

increase through time, but this shift is not significant as the boxplots overlap. However, there is a significant increase in hackberry and chenopod during the Early Side-Notched component.

Additional information about plant use at Dust Cave can be gleaned from the relative densities of the various plant taxa recovered from the column samples. Figure 6.8 demonstrates that relative to other plants, the recovery of wood decreases significantly in the Kirk Stemmed component. This coincides with a significant increase in hickory nutshell. It may be that hickory nutshell to some extent replaces wood as a fuel source at this time, perhaps related to more intensive use of hickory. Acorn use drops to some extent, although the notches overlap slightly. No changes through time are apparent for the use of black walnut, other than its absence from the Early Side-Notched and Kirk Stemmed samples.

The remaining plant taxa tend to decrease in the Kirk Stemmed component relative to other plants (Figure 6.9). A significant drop is seen for hazel, hackberry, and weedy seeds. Chenopod and fruits other than hackberry also appear to drop, although this decrease is not statistically significant for the fruits, and chenopod is represented by a single sample in the Kirk Stemmed component. This is likely due in large part to the increase in hickory, which has a sizeable impact on the denominator of this ratio. Possible changes in smaller taxa may thus be masked by the increase in hickory.

To summarize the trends seen in the Dust Cave column samples, plant use significantly increases through time at the site. Increases in nearly all taxa are apparent. The major exception is the mixed Early Side-Notched component, although the nature of this occupation, accompanied by significant erosion and possible slopewash of deposits, is at present unclear. The lower quantities of plant materials, particularly wood and acorn, in the Late Paleoindian deposits may be related to fluvial activity at the site during this time (Sherwood 2001), which may have washed these lighter fragments out of the sediments. However, the significant recovery of chenopod and other small seeds from these early samples is then difficult to explain. Alternatively, it is possible that recent seasonal inundation of these lower deposits may have adversely affected fragile wood and acorn shell fragments, with little impact on the preservation of seed coats.

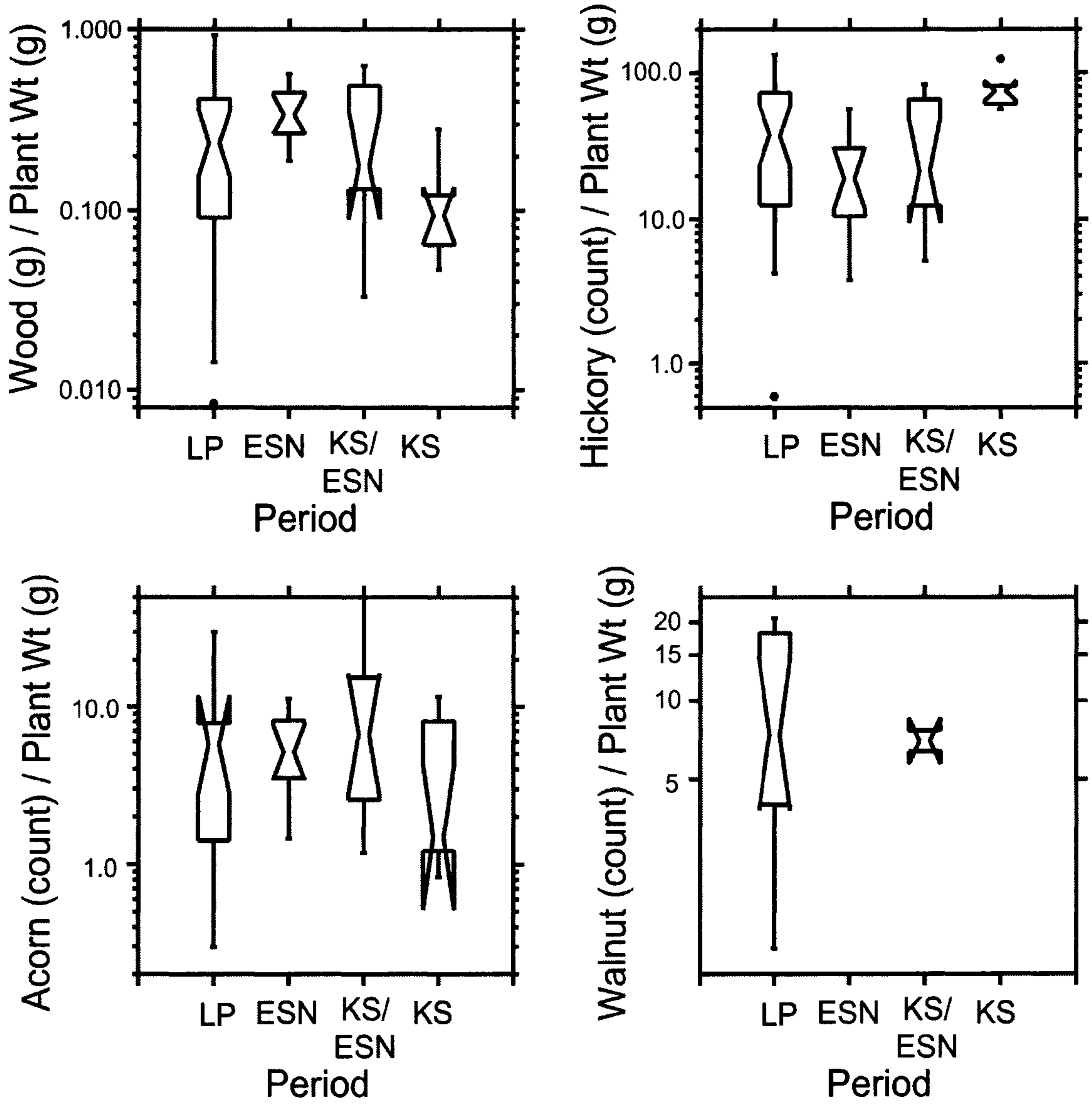


Figure 6.8. Boxplots comparing relative densities of wood, hickory, acorn and black walnut in column samples from Dust Cave. Note the y-axes are scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

The ways in which plant resources are used at the site do not change until the end of the Early Archaic, during the Kirk Stemmed component. At this time, hickory increases significantly while wood decreases. Other small taxa, generally recovered in low numbers, also decrease, including hazel, hackberry, chenopod, and weedy seeds, but this apparent drop may be heavily influenced by

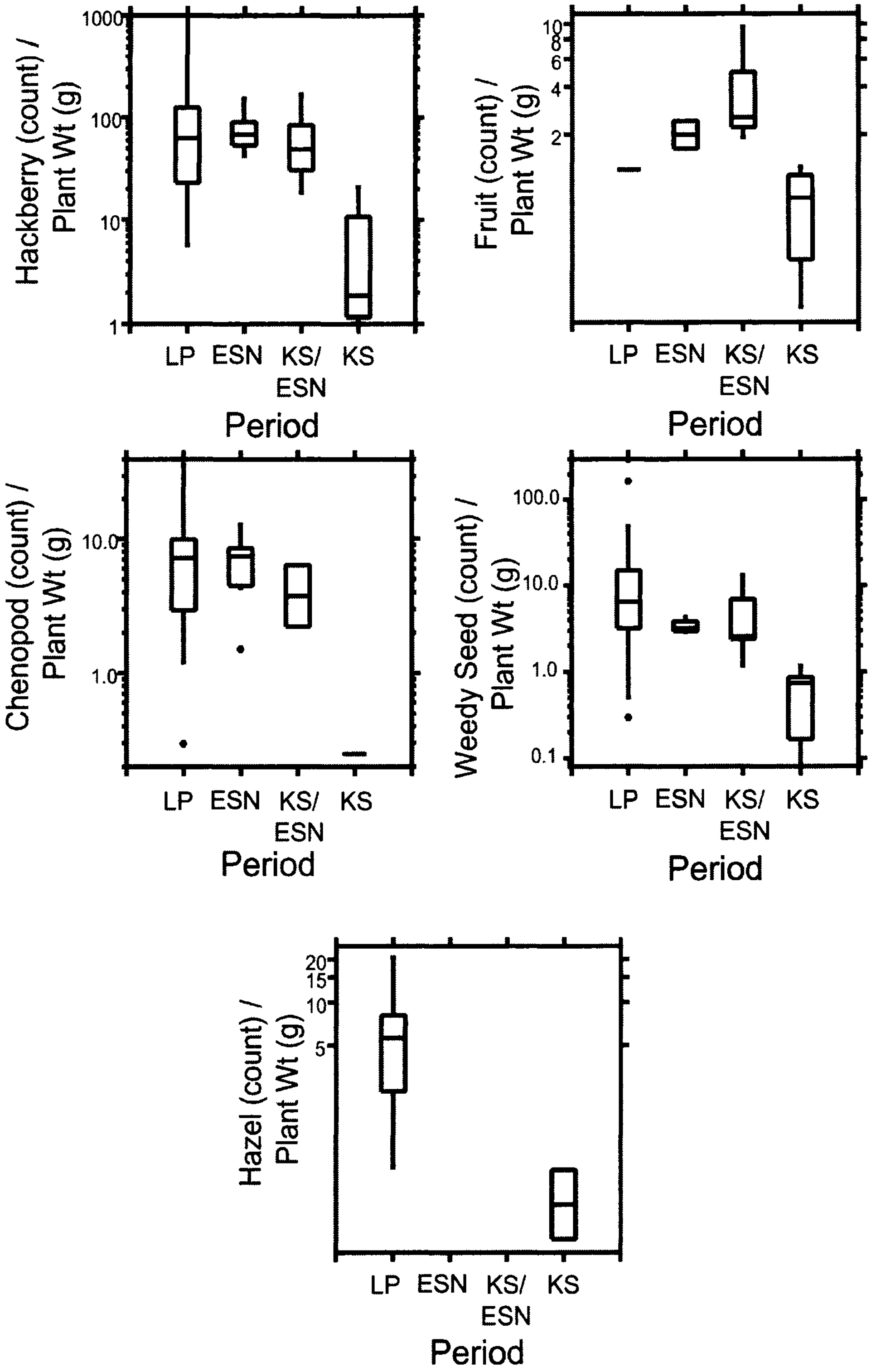


Figure 6.9. Boxplots of relative densities of hazel, hackberry, fruits other than hackberry, chenopod, and wild seeds in the column samples from Dust Cave. Note that the y-axes are scaled logarithmically. Notches (confidence intervals) were not used due to small sample sizes. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

the increase in hickory. Acorn use relative to other plant foods, however, does not appear to change significantly over time.

Feature Samples

The plant materials recovered from Dust Cave feature samples are listed in Table 6.11, with further detail given in the Appendix. An initial glance reveals that the feature contents are similar to the column samples. Hickory is again the dominant taxon, although acorn shell is much better represented. Several samples in particular contain large quantities of acorn shell. These include a Kirk Stemmed hearth (Feature 350) with over 500 fragments, and a charcoal ring feature (Feature 363a) from the mixed Early Side-Notched/Kirk Stemmed component with over 1000 acorn shell fragments. Black walnut is recovered from all four components, mostly in small quantities, with the exception of an expedient hearth (Feature 405) from which 51 shell fragments were recovered. Hazel appears in small quantities, and interestingly only in Kirk Stemmed samples.

Among fruit taxa, hackberry is by far most frequently recovered. Persimmon is generally well represented, while grape and sumac are present in few samples. Chenopod is recovered more frequently from Late Paleoindian features, and wild legumes from Kirk Stemmed features. Several cheno-ams were also found in Late Paleoindian samples. Weedy seeds present include bedstraw, poke, yellow stargrass, and a possible morning-glory seed.

Quantitative comparisons of the Dust Cave feature samples are in some ways less complicated than the column samples. The features represent snapshots of activities at the cave. While the features may have been used over a number of years – and indeed some of the hearths, with their layers of ash and charcoal, appear to have been reused on a number of occasions (Homsey 2004) – this time span is relatively negligible. Unlike the column samples, then, differing sedimentation rates are not a concern for the features.

Of interest, however, is the range of activities that the features represent. A variety of feature types were chosen for analysis, from rings of charcoal to ash pits and rock-lined hearths. While all

Table 6.11. Plant Materials Recovered from Dust Cave (1Lu496) Feature Samples.

Period: Bag No.	Unit	Level	Depth (cm)	Fea#	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Cheno. count	Other
Kirk Stemmed:																
1702	N63W64	38	355	114	14	7.04	3.70	33.91	12.56	28.40	44		353	37		2 persimmon, 1 pine cone, 1 wild legume
5209	N61W65	48	355	350	6	11.06	0.69	18.71	3.14	11.78	505		716	20		1 acorn cf., 9 acorn meat, 1 hazel, 16 persimmon, 2 sumac, 8 wild legume, 1 unidentifiable seed
5444	N63W66	45	340	358	3	6.07	1.08	39.43	19.87	9.26	3		390	9		1 chenopod cf., 1 unidentifiable seed
5630	N60W66	44	335	368	4.5	8.55	4.80	13.30	17.48	14.98	16		250	18		13 acorn meat, 1 hazel, 1 unidentifiable seed
5700	N60W66	45	340	375	4.5	14.81	2.96	14.39	10.78	8.71	59	5	932	19		1 acorn meat, 1 bedstraw, 2 chenopod cf., 8 persimmon
5967	N63W66	47	350	389	2	1.23	0.14	29.72	7.24	9.69	48		107	24		1 hazel, 3 persimmon, 1 poke, 11 wild legume, 1 unidentifiable seed
6572	N62W62	50	320	444	1.5	1.65	1.32	1.58	0.31	0.85	1		33			
6600	N62W62	52	330	448	1	0.23	0.06	0.09	0.00	0.51	1		7	5		11 persimmon, 1 unidentifiable seed
6622	N62W62	53	335	450	8	3.36	0.40	27.70	21.27	22.83	2	1	242	22		
6652	N60W62	49	315	451	8	8.57	5.70	25.26	11.80	7.58	4		211	11	2	5 acorn meat, 1 unidentifiable seed, 1 unidentified seed
Early Side-Notched/Kirk Stemmed:																
4395	N60W68	53	380	330	3.5	1.12	0.83	136.74	7.45	11.01	2		25	10		1 acorn cf., 1 persimmon
5469	N62W65	52	375	360	1	0.35	0.10	3.03	6.64	18.10	2		18	23		1 grape, 1 hazel cf.
5649	N60W65	50	365	363a	3.5	4.28	0.94	6.99	4.07	4.79	1063		172	8		2 sumac, 1 wild legume
6082	N60W66	52	375	397	4	0.04	0.02	0.01	0.00	0.29	1	1	2	1		
6875	N60W62	59	365	459	13.5	1.39	0.73	889.08	56.72	100.34	6	1	75	36		1 black walnut cf., 1 grape, 4 persimmon

Table 6.11 (continued). Plant Materials Recovered from Dust Cave (1Lu496) Feature Samples.

Period: Bag No.	Unit	Level	Depth (cm)	Fea#	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Cheno. count	Other
6943	N62W62	64	390	462	4	2.72	1.98	1.94	6.83	10.25	226		4	36	1	1 acorn cf.
Early Side-Notched:																
1509	N60W64	42	375	111	16	1.60	0.30	76.20	49.07	41.51	15	1	142	59		1 acorn cf., 3 unidentifiable seed
1751	N59W64	51	420	115	3.5	0.67	0.31	0.76	2.45	7.09	12		3	44		1 chenopod cf.
5706	N63W65	56	385	377		1.92	1.00	2.15	31.04	26.24	109	7	36	35		1 Juglandaceae nutshell, 5 persimmon
5732	N63W65	57	395	380	2	0.51	0.16	2.17	17.19	7.00	1		10	34		8 acorn meat, 1 unidentifiable seed
6099	N60W65	53	380	402	1	2.10	0.81	17.55	17.67	24.49	1	7	109	14		
6111	N60W66	53	380	405	1.5	3.12	0.36	10.43	69.34	23.61		51	225	25		7 pieces of one whole persimmon fruit
6118	N60W65	53	380	406	3	1.91	0.48	48.04	76.71	17.22		6	96	24		
6129	N60W65	53	380	410	1.5	0.58	0.19	15.82	18.70	14.56	1		38	34	1	1 black walnut cf., 1 pine cone
6144	N60W66	55	390	413	5.8	2.68	0.53	10.92	54.56	33.36	1	3	173	102		1 acorn cf., 1 persimmon, 1 sumac
6874	N61W62	53	375	458		0.15	0.11	4.34	23.27	7.10	1		1	8		
6972	N60W62	65	395	467	1	0.03	0.02	0.47	10.69	6.50	1		1	3		2 poke
Late Paleoindian :																
293	N62W64	32	425	37	0.8	0.03	0.01	0.04	0.74	4.31			1	8	1	14 grape cf., 1 unidentified
1001	N62W64	37	455	99	1	0.31	0.08	0.02	0.60	4.11	8		22	5	1	1 poke cf.
1761	N60W64	50	415	116	1	0.28	0.22	1.34	8.84	2.32	5		4	36		
1900	N60W64	58	455	118	2	0.52	0.01	0.02	3.87	3.99		5	39			1 black gum cf.
5747	N62W65	56	390	382	5	0.41	0.21	2.72	109.23	25.14	1		19	11		4 acorn cf.
5790	N62W66	57	395	384	1	0.27	0.07	0.55	149.46	10.51	2		17	12		
5826	N62W65	61	415	387	3	3.47	3.42	0.07	8.32	6.05	1		2	1		1 bedstraw, 7 persimmon
6283	N60W66	58	405	420	2.5	0.26	0.20	0.42	31.33	10.14	2		4	3	1	1 bedstraw
6308	N60W66	59	410	423	10	0.87	0.33	6.88	52.34	29.69	2		32	45	5	11 chenopod cf.

Table 6.11 (continued). Plant Materials Recovered from Dust Cave (1Lu496) Feature Samples.

Period: Bag No.	Unit	Level	Depth (cm)	Fea#	Vol. (L)	Plant Wt (g)	Wood Wt (g)	Shell Wt (g)	Lithic Wt (g)	Bone Wt (g)	Acorn count	Black walnut count	Hickory count	Hackberry count	Cheno. count	Other
6326	N60W65	59	410	117	8	0.94	0.54	2.21	25.44	29.57	1		1	64	1	3 chenopod cf., 1 hickory cf., 1 unidentifiable seed
6493	N60W66	66	445	438	4	0.11	0.04	0.00	2.92	4.53			10			
7068	N62W62	66	400	473	8	0.75	0.23	8.82	53.74	21.85	6		13	69	5	1 cheno-am, 1 stargrass, 1 unidentifiable seed
7076	N62W62	66	400	474	4	0.47	0.13	0.79	19.78	13.68	2		4	46	9	1 cheno-am, 1 morning-glory cf.
7438	N61W62	66	445	486	2	0.21	0.00	0.02	1.61	9.04			18	1		2 acorn cf., 1 black walnut cf., 2 unidentified

are associated with burning activities, these activities may include cooking, heating and lighting the cave, as well as the sweeping of coals and ash out of hearths into separate pits. The contents of the features may well vary considerably, as do the activities they represent. As such, I compare the feature samples by component as well as by type.

Trends through Time. Comparisons of ubiquity values by component for the various taxa demonstrate several possible trends through time (Table 6.12). Acorn shell increases in ubiquity from the Late Paleoindian through the Kirk Stemmed components from 71% to 100%. Acorn meats show a similar increase through time. Unlike the column samples, black walnut is present in samples from all components, and appears to peak in the Early Side-Notched rather than the Late Paleoindian period. Hazel is much more restricted, however, recovered only from Kirk Stemmed samples. In contrast, hickory is present in all samples. While hackberry has a high ubiquity in all components, the ubiquity of persimmon increases from 7% among Late Paleoindian features to 50% among Kirk Stemmed features. Grape and sumac display low ubiquities; grape is further restricted to mixed Early Side-Notched/Kirk Stemmed samples. Chenopod and wild legumes show opposite trends in ubiquity, with chenopod decreasing through time and wild legumes increasing.

Similar to the column samples, the density of plant materials recovered from features also increases through time (Figure 6.10). Comparing the various taxa separately, it appears that wood and hickory account for this change (Figure 6.11). Mirroring the boxplots for all plant materials, wood and hickory both increase significantly in the Early Side-Notched features and continue to rise in quantity through the Kirk Stemmed component, although the later rise is not statistically significant. This trend through time may be related to post-depositional processes; it seems unlikely that Late Paleoindians are using less fuel in their fires than Early Archaic peoples. The fluvial activity in the cave during the Late Paleoindian period (Sherwood 2001) may have reworked the features, washing ash and charcoal from them (Homsey 2004). It is somewhat surprising, then, that acorn does not follow this trend in the feature samples, although it is present in significantly smaller

Table 6.12. Ubiquity of Plant Remains in Feature Samples from Dust Cave.

Taxon	Late Paleo.[a] (%)	E. Side-Notched[b] (%)	ESN/Kirk Stemmed[c] (%)	Kirk Stemmed[d] (%)
Acorn shell	71	82	100	100
Acorn meat	0	9	0	30
Black walnut	7	55	33	20
Hazel	0	0	0	20
Hickory	100	100	100	100
Grape	0	0	33	0
Hackberry	86	100	100	90
Persimmon	7	27	33	50
Sumac	0	9	17	10
Chenopod	50	9	17	10
Wild legume	0	0	17	30

[a] N = 14.
[b] N = 11.
[c] N = 6.
[d] N = 10.

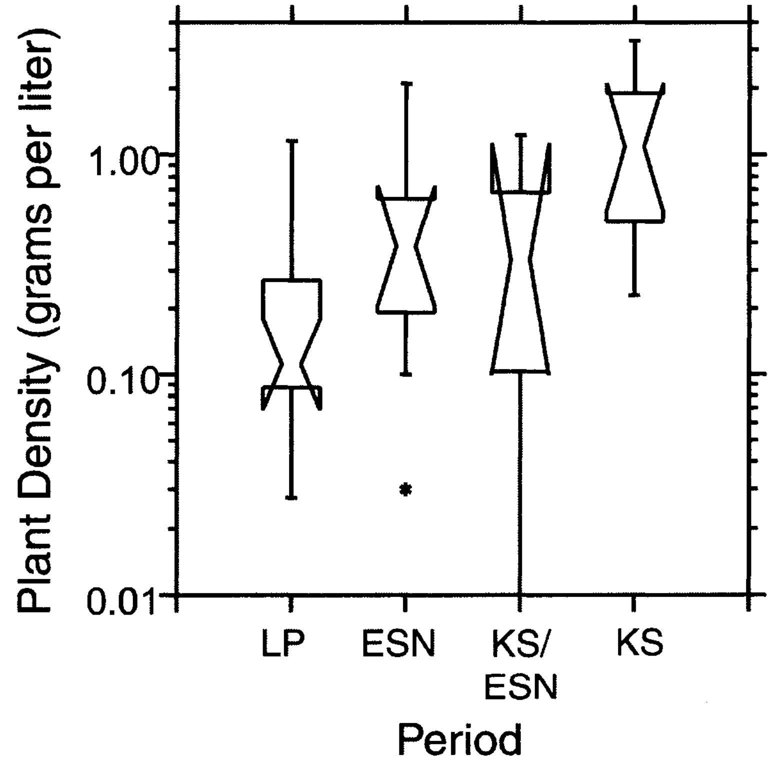


Figure 6.10. Boxplots comparing plant density in Dust Cave feature samples through time. Note the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

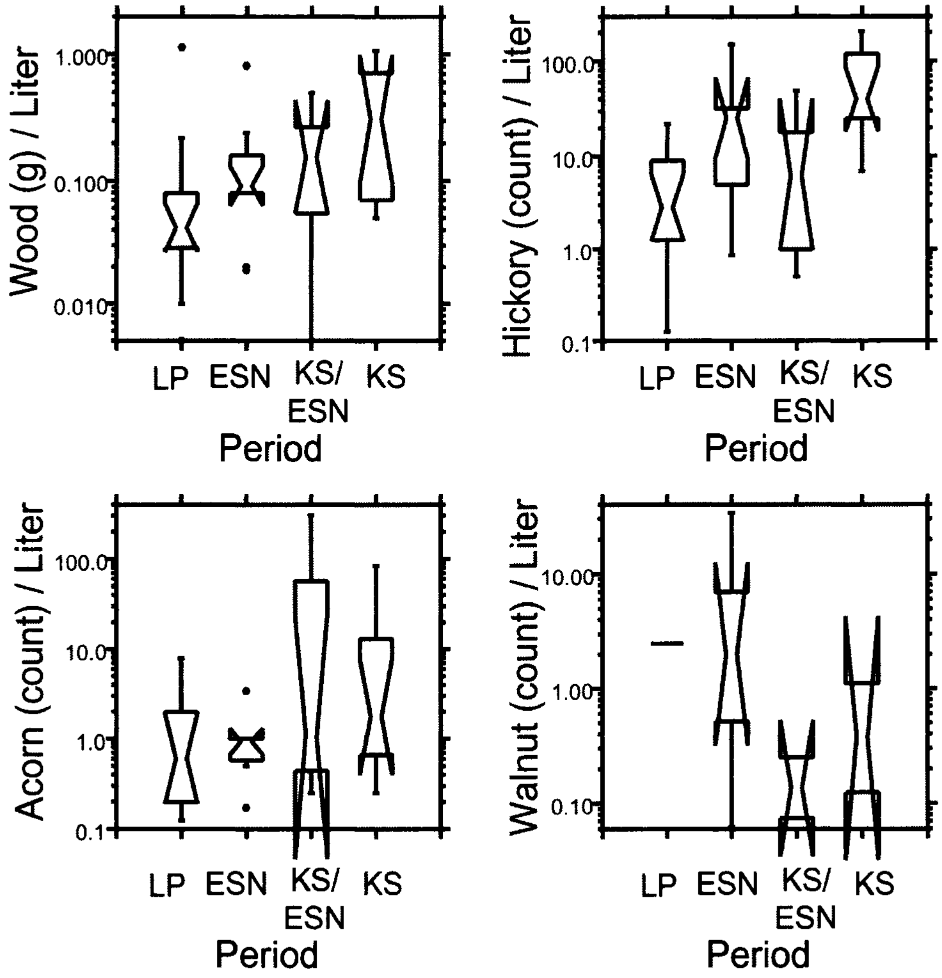


Figure 6.11. Boxplots comparing density of wood, hickory, acorn, and walnut in Dust Cave feature samples through time. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

quantities in Late Paleoindian column samples (see above). No simple explanation for lower quantities of plant materials in the Late Paleoindian features seems to suffice; a combination of fluvial reworking and less occupation of the site seems likely.

Boxplots of the densities of fruit and seed taxa do not reveal distinct patterning through time, as most of the notches overlap (Figure 6.12). Hackberry appears to decrease from the Early Side-Notched through Kirk Stemmed component. Edible seeds are heavily influenced by chenopod in Late Paleoindian samples, while wild legumes affect the Kirk Stemmed values. In general, however, no

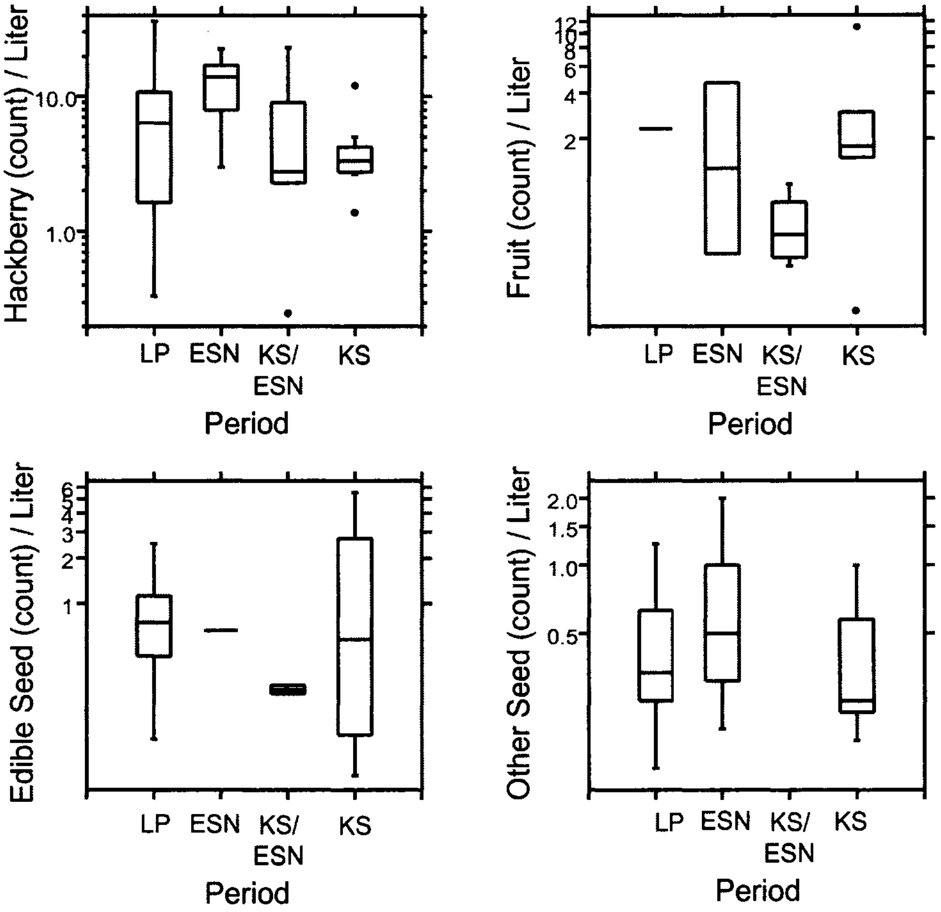


Figure 6.12. Boxplots comparing the densities of hackberry, fruits other than hackberry, edible seeds, and other seeds in Dust Cave feature samples through time. Note that the y-axis is scaled logarithmically. Notches (confidence intervals) were not used due to small sample sizes. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

significant differences are apparent for these taxa represented by smaller seeds and seed fragments, likely due to the fact that they are recovered in low quantities.

Although the density of wood and hickory recovered from features changes significantly through time, the relative densities of these taxa do not show similar patterns (Figure 6.13). Instead, the relative densities of wood and hickory, as well as acorn, are comparable in all components. This also contrasts with the column samples, which demonstrate a significant decrease in the relative density of wood and increase in hickory in the Kirk Stemmed component (Figure 6.8). If wood and

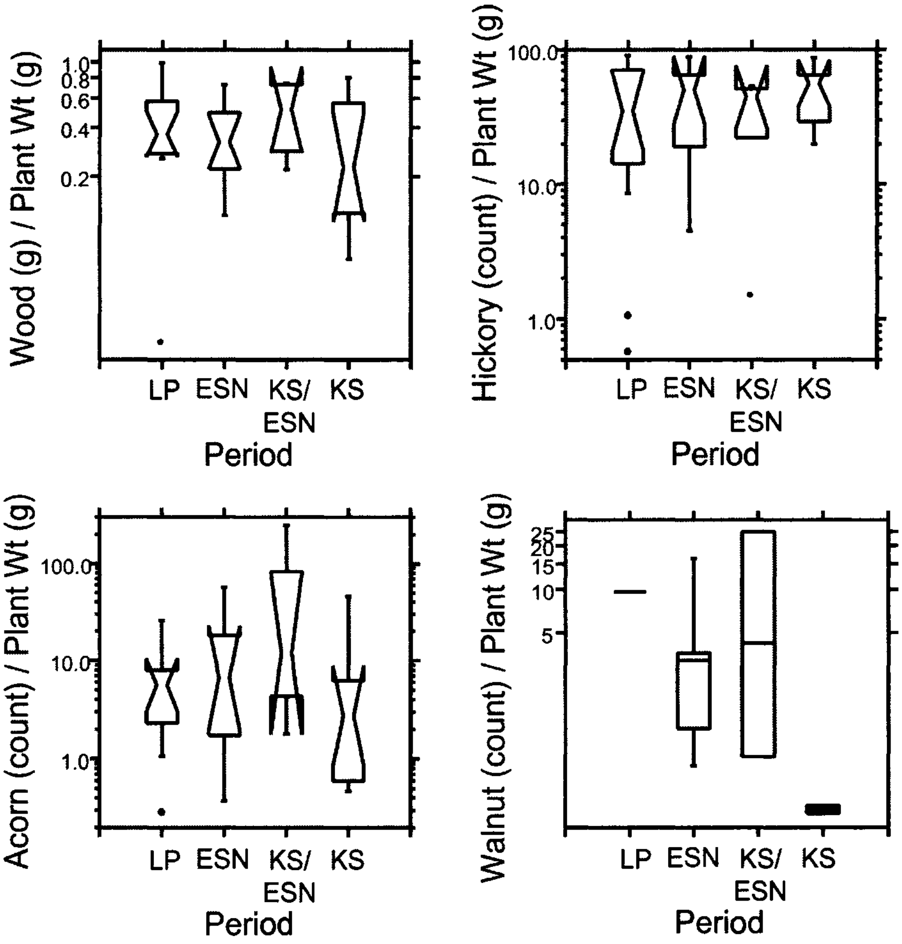


Figure 6.13. Boxplots comparing relative densities of wood, hickory, acorn and black walnut in Dust Cave feature samples through time. Note that y-axes are scaled logarithmically. Notches (confidence intervals) were not used for black walnut due to small sample size. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

acorn were indeed adversely affected by reworking of the deposits by floodwaters in the Late Paleoindian component and their presence is underrepresented, their relative densities for this component may well be understated. However, the significant shift in hickory and wood in column samples are seen in the Kirk Stemmed samples, not the Early Side-Notched component.

It may be that hickory nutshell is over-represented in column samples relative to feature samples, particularly in the Kirk Stemmed component. This may be related to the increased occupation of the cave at this time, as suggested by increases in the density of plant remains. More fragile acorn shell and wood fragments may not have weathered the trampling, sweeping, and disturbance associated with peoples' occupation of the cave as well as denser hickory nutshells. Wood and acorn may therefore be underrepresented in the general living contexts associated with column samples, particularly at times when the cave was intensively occupied, such as the Kirk Stemmed component. The importance of acorn relative to other plant foods may thus be significantly understated.

Among the other taxa, black walnut does seem to decrease relative to other plants to some degree (Figure 6.13), as do hackberries, edible seeds and other seeds (Figure 6.14). This trend is similar to that seen among column samples. It appears that hickory and perhaps acorn became targeted resources by the end of the Early Archaic, overshadowing use of these other food items. Fruits other than hackberries show no significant changes through time, however.

In sum, the feature samples show some patterning through time. The density of plant remains recovered increases through time, although this may be exaggerated as plant materials in Late Paleoindian features may have been adversely affected by fluvial processes. Most notable, however, is the lack of change in the relative densities of plant taxa recovered. Hickory does not increase significantly relative to other plant materials in the Kirk Stemmed component. It is possible, then, that the increase observed in column samples overstates the use of hickory. Along the same lines, the importance of acorn may be understated in column samples. Chenopod and wild legumes seem to complement each other, the former decreasing in use through time while the latter becomes more important. Fruits such as persimmon, grape and sumac show little change in use, while use of hackberries may decrease by the end of the Early Archaic period.

Trends by Feature Type. Lara Homsey (2004) has created a typology for features at Dust Cave using geochemical, macro- and micromorphological characteristics. The range and organization of features at Dust Cave is discussed in greater detail in Chapter Four. Of importance

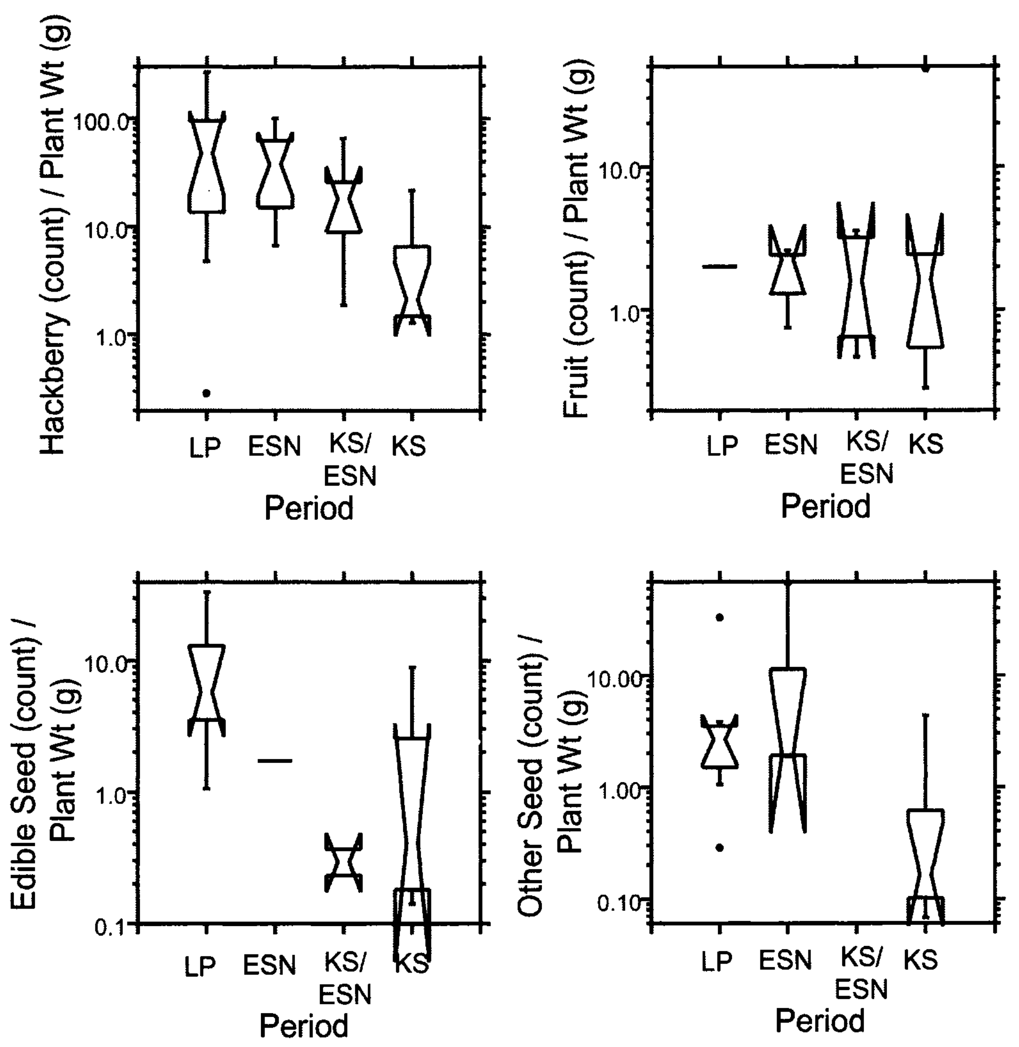


Figure 6.14. Boxplots comparing the relative densities of hackberry, fruits other than hackberry, edible seeds, and other seeds in Dust Cave feature samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

here are the categories associated with the feature samples included in my analysis. These include features associated with burning activities: in situ fireplaces, or hearths and rock basins; and fireplacerake-outs, including ash pits, charcoal pits, and charcoal rings (Homsey 2004:Table 6.2). Hearths are multipurpose features, used for cooking both plant and animal foods, as well as serving as a source of heat and light for other activities, such as tool making (Homsey 2004). Rock basins appear to be rock-lined hearths from which the charcoal has largely been washed away (Homsey 2004:155-6). Ash and charcoal pits are features created as the cave's occupants cleaned out hearths; indeed, these pits are primarily located adjacent to hearths at the site (Homsey 2004). On the other hand, charcoal rings appear to have been created by standing water, which may have collected in depressions on the cave floor as it dripped from the ceiling, seeped up through the water table, or flooded into the cave. Charcoal seems to have floated out of these water-logged sediments and settled to the bottom of the depressions as the water receded (Homsey 2004:176-7). My feature samples also include one "rock cluster", which Homsey (2004:187) includes among unburned deposits and suggests may have served as cooking stones, piled and ready for use in hearths. Four of the features could not be assigned a feature type at this time, due to vagaries in field descriptions of these features.

Plant densities vary considerably among the feature types (Figure 6.15), although this variation could be due in large part to differences by component as well. In general, charcoal rings tend to have greater plant densities than other feature types, particularly in comparison to charcoal pits. Perhaps not surprisingly, similar trends are seen among densities of wood and hickory plotted by feature type (Figure 6.16). No patterning is evident for acorn or black walnut, however. Fruit and seed taxa also show little patterning, with the exception of the significantly low value of "other seeds" among hearths (Figure 6.17).

Similar to comparisons by component, relative densities of the various taxa sorted by feature type show few significant differences among the samples (Figures 6.18, 6.19). The exceptions include the significantly greater quantity of hickory nutshell in hearths relative to ash pits and charcoal pits (Figure 6.18); the lower quantities of hackberries and other fruits found in charcoal rings (Figure 6.19); and the lower relative density of edible seeds in hearths (Figure 6.19).

While boxplots have shown little patterning by taxa among the different feature types, correspondence analysis holds some promise, as it illustrates relationships among taxa within samples. I performed a correspondence analysis using the following variables: acorn, black walnut, edible seeds, hackberry, and hickory. The resulting plot explains the greatest amount of variation in

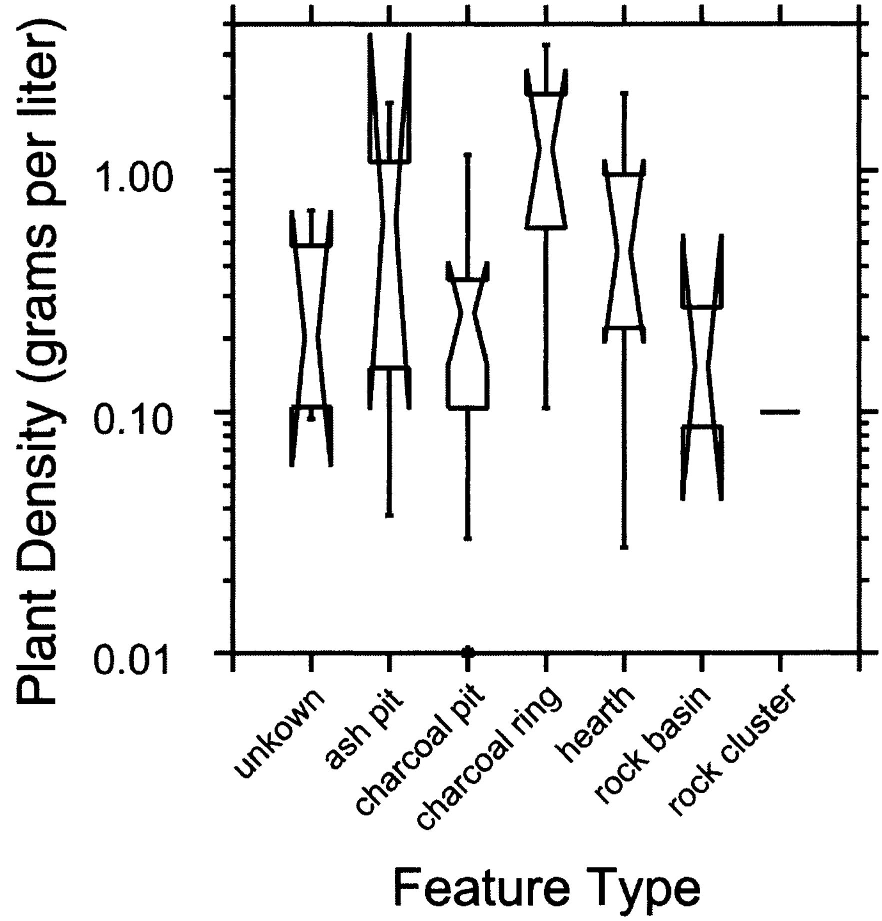


Figure 6.15. Boxplots comparing plant density by feature type in Dust Cave feature samples. Note that the y-axis is scaled logarithmically.

the data (85%) along two axes. The first axis separates acorn from the other taxa; the second axis groups hickory and black walnut apart from hackberry and edible seeds (Tables 6.13 and 6.14, Figure 6.20).

By plotting the samples along these axes, the taxa that have the greatest influence on the samples are apparent (Figure 6.21). Most of the samples, regardless of type, tend to fall along the left side of the first axis, nearer hickory and black walnut. At least one sample from each type, except for ash pits and rock features, is influenced by acorn, falling on the right side of the graph. This includes

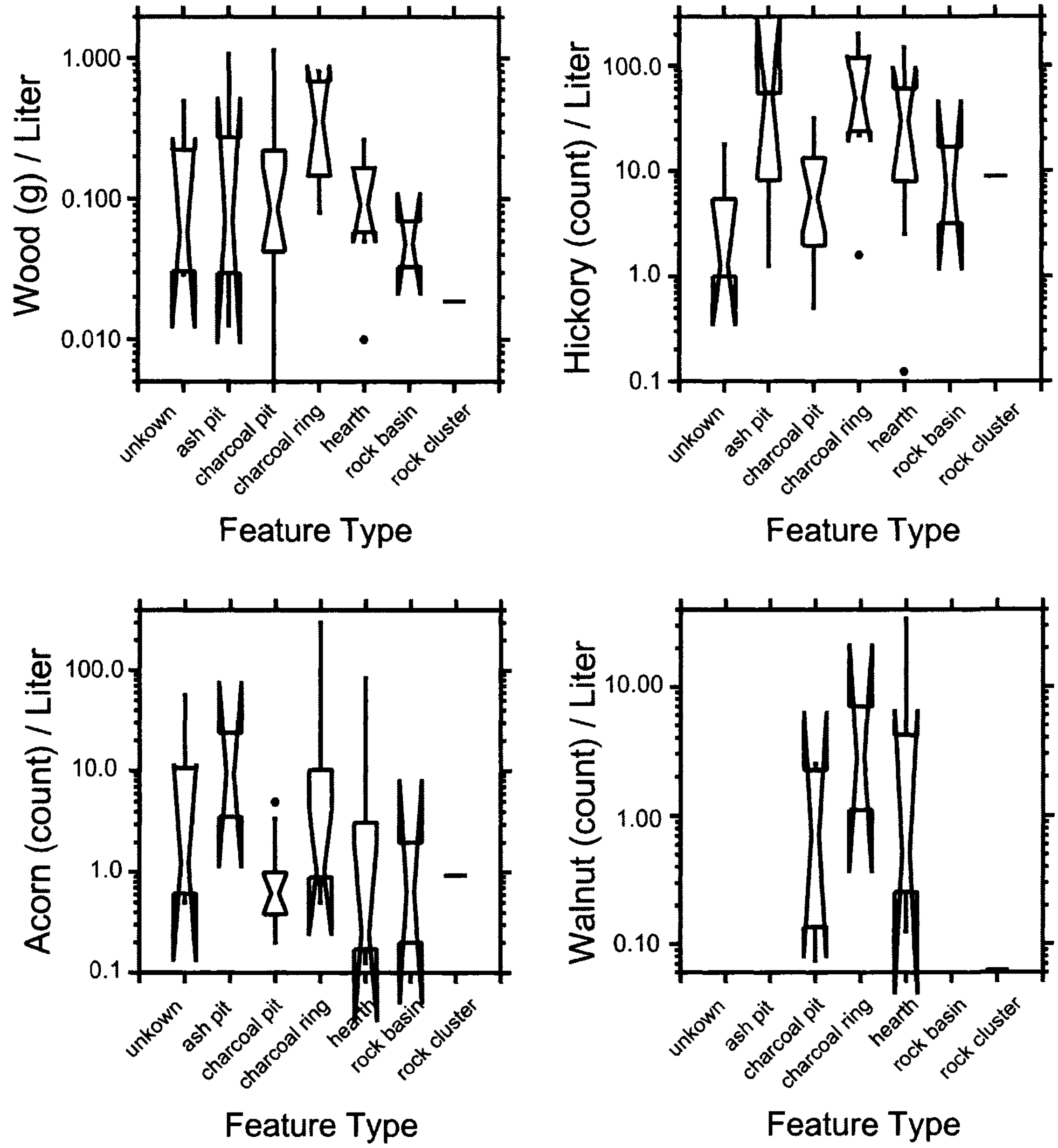


Figure 6.16. Boxplots comparing the densities of wood, hickory, acorn, and black walnut by feature type in Dust Cave feature samples. Note that the y-axes are scaled logarithmically.

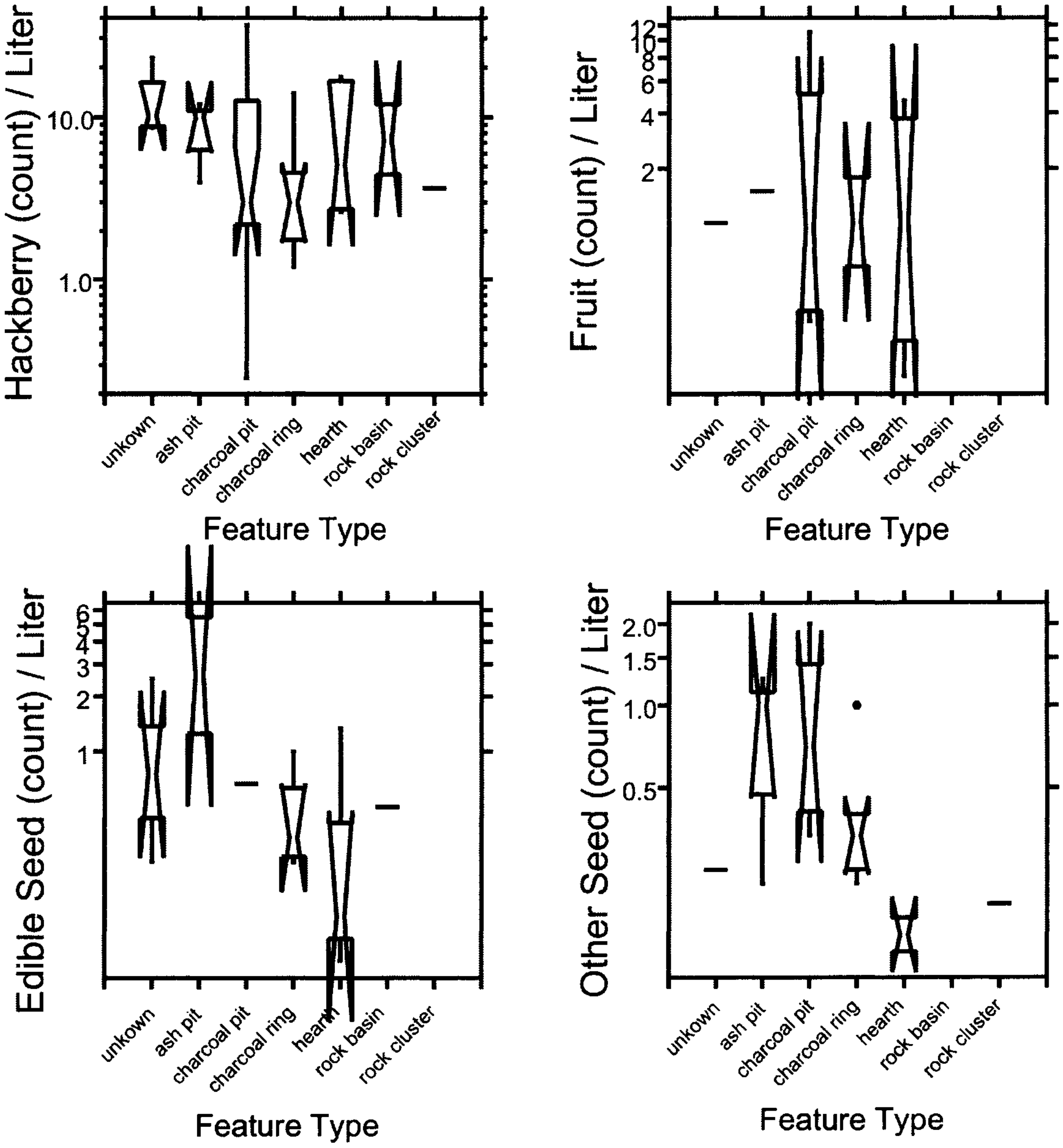


Figure 6.17. Boxplots comparing densities of hackberry, fruits other than hackberry, edible seeds, and other seeds by feature type in Dust Cave feature samples. Note that the y-axes are scaled logarithmically.

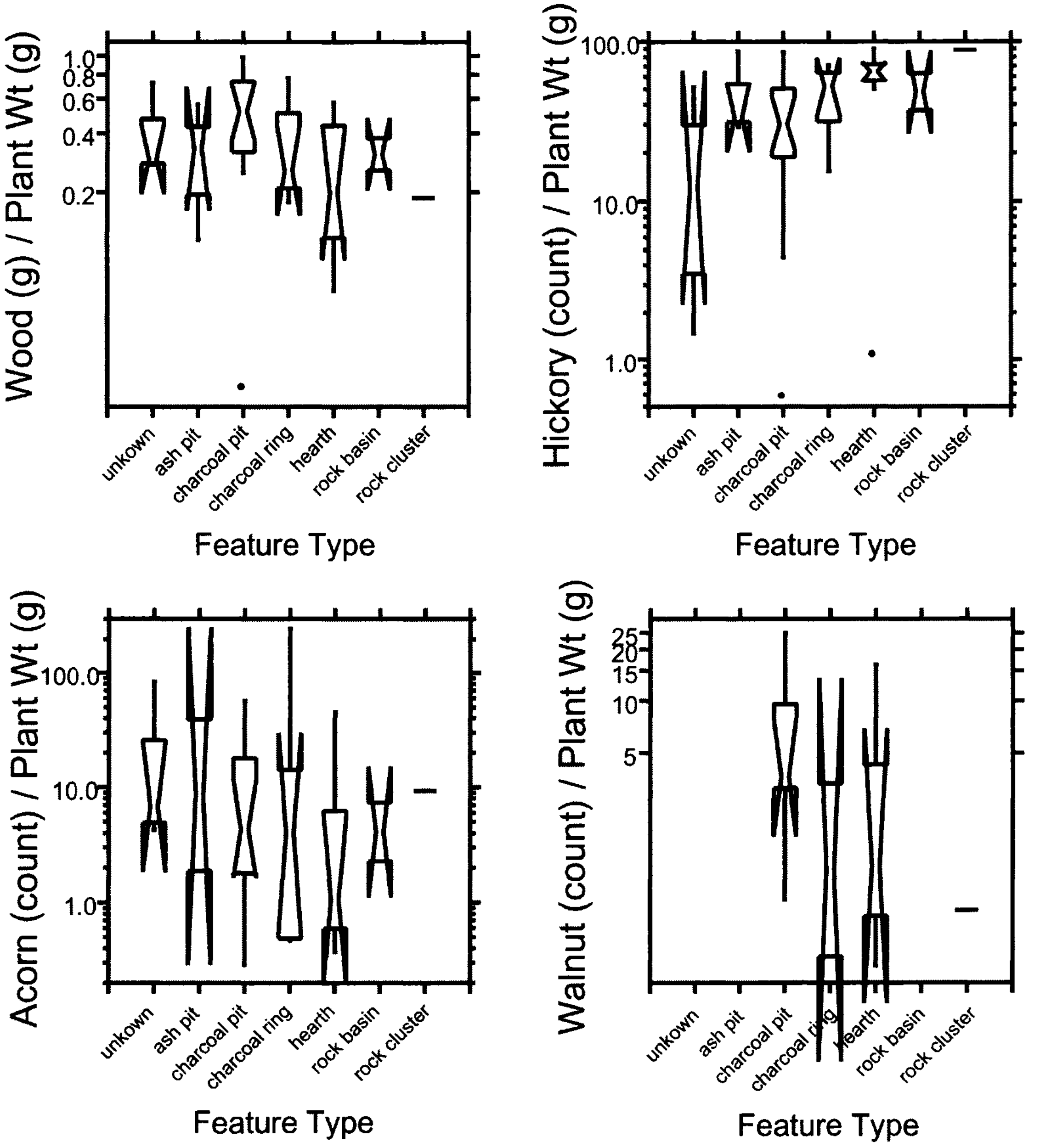


Figure 6.18. Boxplots comparing relative densities of wood, hickory, acorn and black walnut by feature type in Dust Cave feature samples. Note that the y-axes are scaled logarithmically.

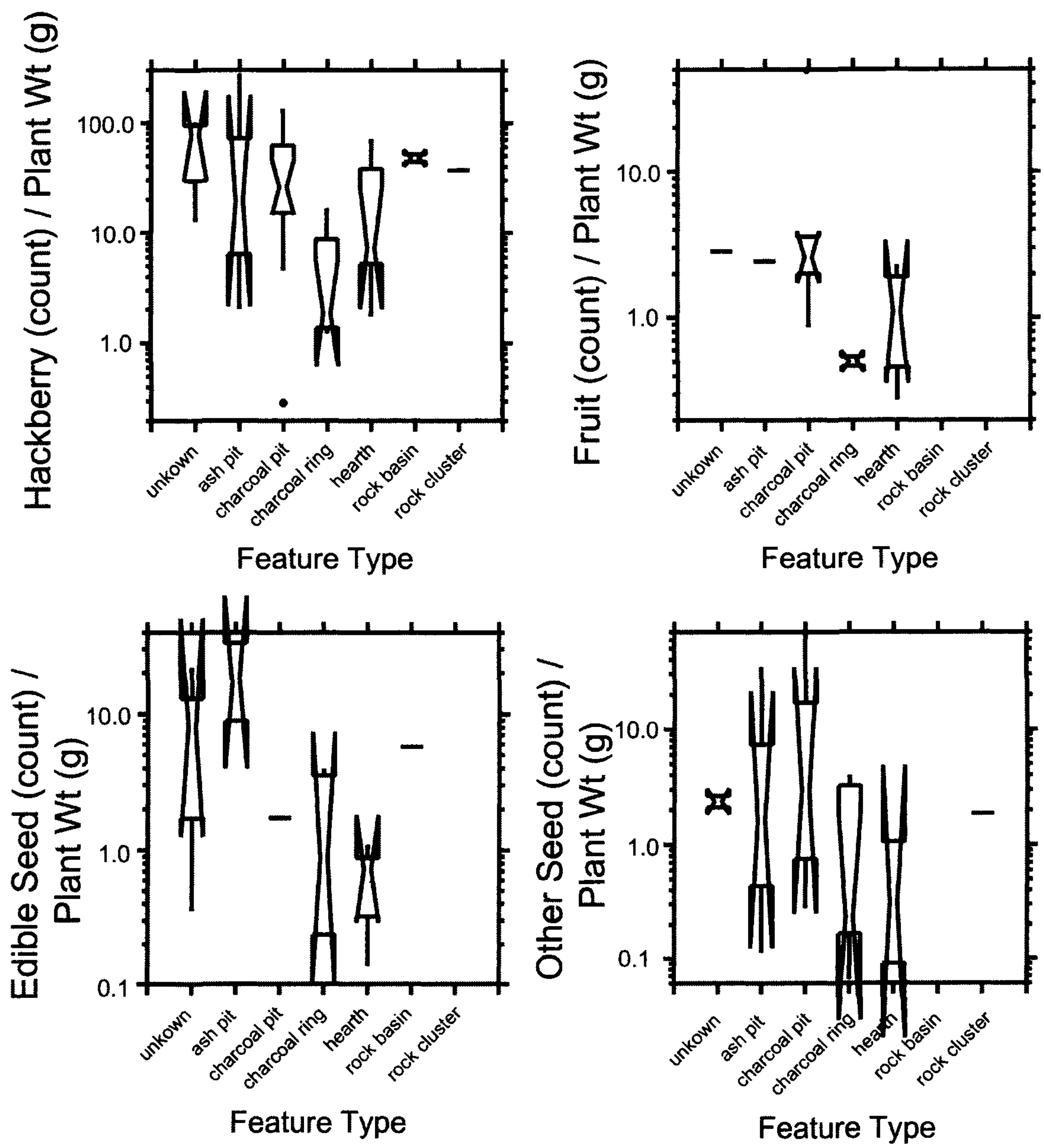


Figure 6.19. Boxplots comparing relative densities of hackberry, fruits other than hackberry, edible seeds, and other seeds by feature type in Dust Cave feature samples. Note that the y-axes are scaled logarithmically.

Table 6.13. Diagnostic Statistics for Correspondence Analysis of Dust Cave Features.

Factor	Eigenvalue	Percent	Cumulative Percent
1	0.505	50.69	50.69
2	0.345	34.58	85.26
3	0.102	10.28	95.54
4	0.044	4.46	100.00

Table 6.14. Loading of Variables on Factors 1 and 2 for Dust Cave Features.

Type: Variable	Mass	Quality	Inertia	Factor 1	Factor 2	Contribution to Factor 1	Contribution to Factor 2	Squared Correlation Factor 1	Squared Correlation Factor 2
Taxon:									
Acorn	0.279	0.999	0.363	1.138	-0.059	0.716	0.003	0.997	0.003
Black walnut	0.011	0.076	0.107	-0.76	0.389	0.013	0.005	0.06	0.016
Edible seed	0.006	0.275	0.059	-0.356	-1.554	0.002	0.045	0.014	0.261
Hackberry	0.123	0.992	0.299	-0.564	-1.45	0.077	0.748	0.13	0.862
Hickory	0.581	0.983	0.169	-0.41	0.344	0.193	0.199	0.577	0.407
Feature:									
111	0.028	0.897	0.010	-0.487	-0.292	0.013	0.007	0.660	0.237
114	0.055	0.877	0.013	-0.374	0.249	0.015	0.010	0.607	0.269
115	0.008	0.934	0.028	-0.296	-1.833	0.001	0.073	0.024	0.911
116	0.006	0.936	0.025	-0.508	-1.935	0.003	0.062	0.060	0.876
117	0.009	0.97	0.055	-0.750	-2.392	0.010	0.142	0.087	0.883
118	0.006	0.501	0.008	-0.632	0.595	0.004	0.006	0.266	0.235
330	0.005	0.877	0.002	-0.517	-0.277	0.002	0.001	0.681	0.196
350	0.160	0.927	0.026	0.310	0.237	0.031	0.026	0.587	0.341
358	0.051	0.93	0.032	-0.565	0.513	0.032	0.039	0.510	0.420
360	0.005	0.923	0.009	-0.591	-1.081	0.004	0.019	0.213	0.711
363a	0.159	0.999	0.261	1.283	-0.023	0.516	0.000	0.998	0
368	0.038	0.891	0.011	-0.377	0.334	0.011	0.012	0.499	0.392
37	0.001	0.915	0.007	-0.743	-2.182	0.001	0.018	0.095	0.820
375	0.129	0.953	0.060	-0.454	0.489	0.053	0.090	0.442	0.512
377	0.024	0.793	0.016	0.634	-0.383	0.019	0.010	0.581	0.212
380	0.007	0.929	0.017	-0.346	-1.491	0.002	0.044	0.047	0.882
382	0.004	0.902	0.003	-0.583	-0.521	0.003	0.003	0.502	0.400
384	0.004	0.903	0.003	-0.520	-0.641	0.002	0.005	0.358	0.545
387	0.000	0.895	0.000	0.077	-0.662	0.000	0.000	0.012	0.883
389	0.024	0.065	0.01	-0.049	-0.161	0.000	0.002	0.006	0.060
397	0.001	0.031	0.002	-0.283	-0.147	0.000	0.000	0.024	0.007
402	0.017	0.810	0.009	-0.609	0.258	0.012	0.003	0.687	0.123
405	0.038	0.224	0.099	-0.678	0.345	0.035	0.013	0.178	0.046
406	0.016	0.825	0.008	-0.641	0.008	0.013	0.000	0.825	0
410	0.009	0.975	0.011	-0.646	-0.871	0.008	0.021	0.346	0.630
413	0.036	0.932	0.027	-0.653	-0.533	0.030	0.029	0.559	0.372
420	0.001	0.387	0.002	-0.198	-0.791	0.000	0.002	0.023	0.364

Table 6.14 (continued). Loading of Variables on Factors 1 and 2 for Dust Cave Features.

Type: Variable	Mass	Quality	Inertia	Factor 1	Factor 2	Contribution to Factor 1	Contribution to Factor 2	Squared Correlation Factor 1	Squared Correlation Factor 2
423	0.011	0.927	0.023	-0.636	-1.260	0.009	0.049	0.188	0.739
438	0.001	0.935	0.001	-0.576	0.586	0.001	0.001	0.460	0.476
444	0.004	0.931	0.003	-0.512	0.566	0.002	0.004	0.419	0.512
448	0.002	0.901	0.001	-0.492	-0.642	0.001	0.002	0.333	0.567
450	0.034	0.942	0.016	-0.580	0.329	0.023	0.011	0.712	0.230
451	0.030	0.898	0.013	-0.502	0.388	0.015	0.013	0.562	0.336
458	0.001	0.936	0.005	-0.532	-1.928	0.001	0.014	0.066	0.870
459	0.015	0.918	0.007	-0.536	-0.381	0.009	0.006	0.610	0.308
462	0.034	0.994	0.058	1.238	-0.419	0.103	0.017	0.892	0.102
467	0.001	0.927	0.001	-0.271	-1.385	0.000	0.004	0.034	0.893
473	0.012	0.977	0.049	-0.592	-1.908	0.008	0.127	0.086	0.892
474	0.008	0.710	0.060	-0.655	-2.225	0.007	0.114	0.057	0.653
486	0.002	0.926	0.001	-0.588	0.425	0.002	0.001	0.607	0.318
99	0.005	0.214	0.000	-0.120	-0.081	0.000	0.000	0.147	0.066

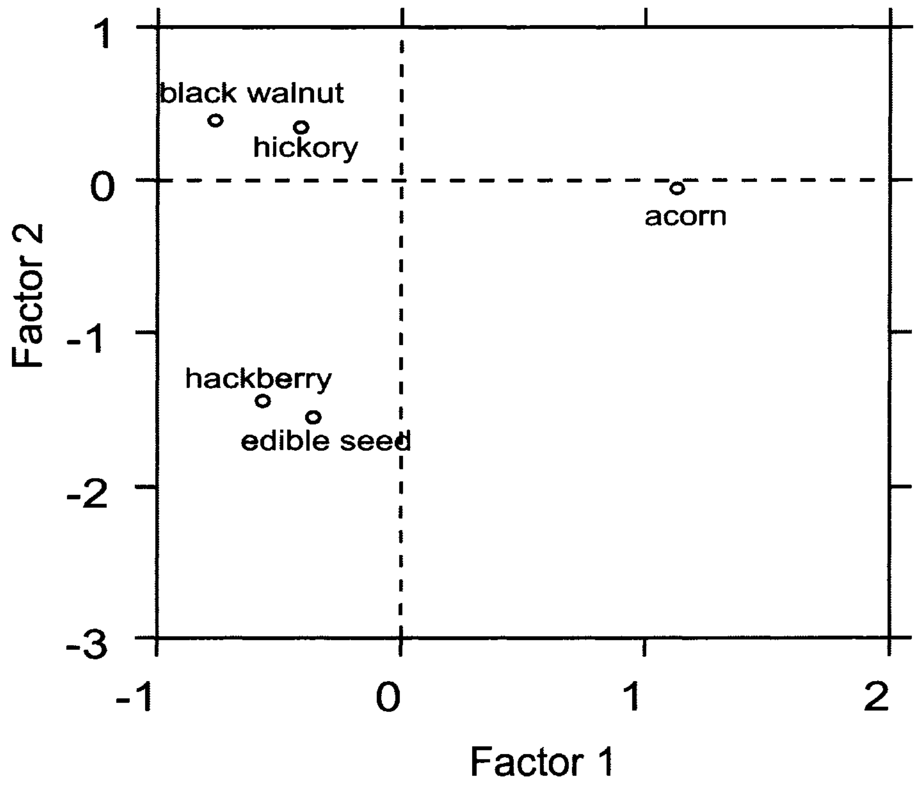


Figure 6.20. Correspondence map of plant taxa in Dust Cave features.

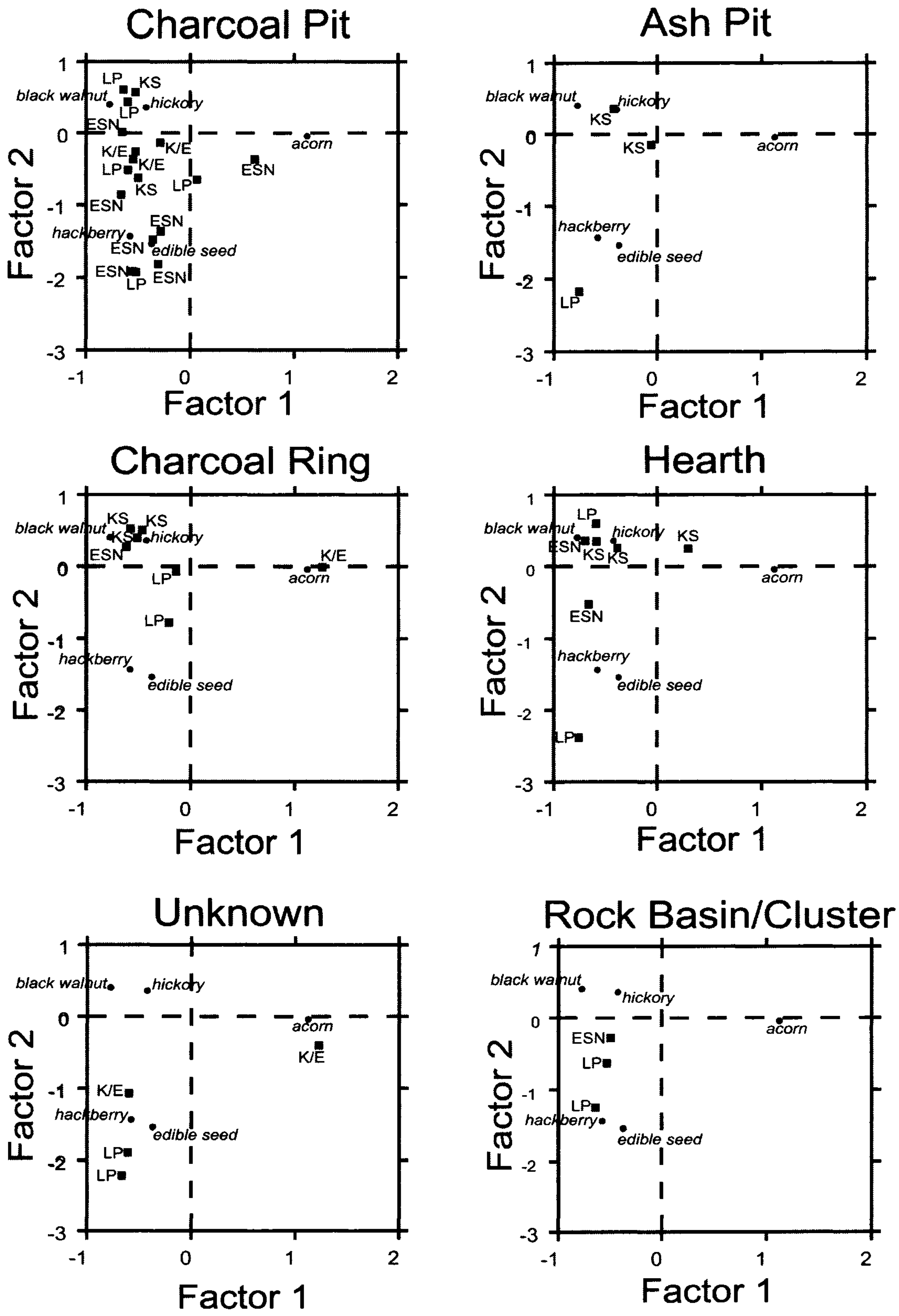
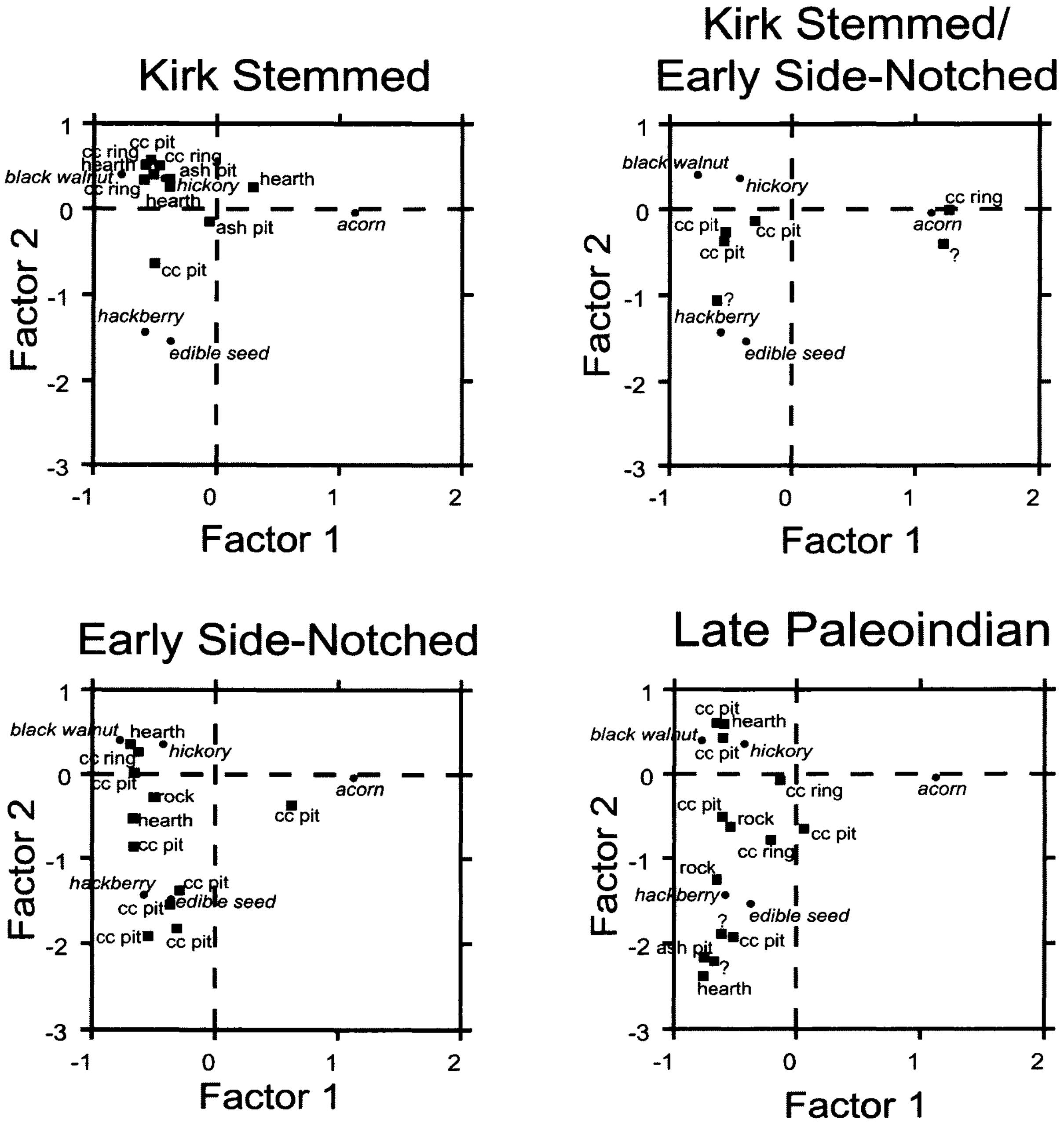


Figure 6.21. Correspondence map of Dust Cave features by type using five variables. Features are labeled by associated period (LP = Late Paleoindian; ESN = Early Side-Notched; K/E = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed).

a Kirk Stemmed hearth and an Early Side-Notched charcoal pit, as well as a charcoal ring and unknown feature type from the mixed Early Side-Notched/Kirk Stemmed component (Zone Q). More of the samples separate along the second axis. Most of the hearths cluster near hickory and black walnut, with the exception of a Late Paleoindian sample, pulled distinctly toward the hackberry and edible seed end of the axis. Charcoal rings tend to cluster nearer the nut taxa, while a number of the Early Side-Notched and Late Paleoindian charcoal pits plot near the hackberry and edible seeds. Similarly, the Late Paleoindian ash pit, rock feature, and unknown features tend toward the lower end of the second axis.

Comparing the feature types, it appears that hearths and charcoal rings tend to include greater quantities of hickory while charcoal pits contain a greater range of seed and fruit taxa. The unknown features are more similar to charcoal pits, plotting further from hickory and black walnut. These patterns, however, are not as pronounced as differences by component (Figure 6.22). Among all feature types, Late Paleoindian and Early Side-Notched samples are drawn toward the hackberry and edible seeds; mixed Early Side-Notched (Zone Q) samples tend to plot nearer acorn; and samples from the Kirk Stemmed component cluster nearer hickory and black walnut. The feature samples group more by component than by type.

In sum, the macrobotanical contents of the various Dust Cave features are strikingly similar when compared by feature type. Charcoal rings are notable for their relatively high densities of plant remains, particularly wood and hickory. If these features are indeed created by fluvial redeposition, as Homsey (2004:176) suggests, the process is apparently efficient in accumulating carbonized remains. Hearths also display high quantities of hickory shell, particularly relative to other plant materials. This coincides nicely with Homsey's (2004) interpretation of these features for nut processing, particularly during the Kirk Stemmed occupation. Charcoal pits, features associated with the cleaning of hearths, contain markedly lower amounts of hickory.



Kirk Stemmed

Kirk Stemmed/ Early Side-Notched

Early Side-Notched

Late Paleoindian

Figure 6.22. Correspondence map of Dust Cave features by component using five variables. Features are labeled by feature type (abbreviations: cc pit = charcoal pit; cc ring = charcoal ring; rock = rock basin/cluster; ? = unknown).

A correspondence analysis of the feature samples reveals less patterning among the samples by type than by component. Late Paleoindian and Early Side-Notched features contain larger quantities of hackberries and edible seeds, particularly chenopod. Acorn is associated largely with samples from the mixed Early Side-Notched/Kirk Stemmed component, while Kirk Stemmed features are associated with hickory nutshell. Boxplots, however, suggest that the use of hickory and acorn relative to other plant materials changes little through time.

Summary

The plant remains from the Dust Cave samples present several interesting patterns. The column samples demonstrate an increase in plant remains through time, suggesting an increase in use of the site. Feature samples show a similar increase, however, leading me to suspect that plant remains from the lower deposits were affected by fluvial activity at the cave during the Late Paleoindian period, which may have washed charcoal from features. They may also have been impacted by recent seasonal flooding due to manipulation of the water level in Pickwick Reservoir by TVA. This yearly cycle of wetting and drying may have adversely affected the preservation of fragile items like wood and acorn shell. Of note is the fact that small seeds, such as chenopod, are regularly recovered from these lower deposits and features. This may favor an argument for more recent impact, as these small seeds probably would have been washed away by fluvial agents as well. Regardless, plant density in column samples increases by an order of magnitude, and certainly reflects, at least in part, more intensive use of the site. Increasing occupation is indicated as well by geochemical signatures of the cave's deposits (Homsey 2004).

Among feature samples, little change in use of nut taxa through time is suggested. This differs from column samples, in which hickory increases significantly in the Kirk Stemmed component. It is possible that hickory nutshell is overrepresented in these general context samples, being denser and therefore more resistant to the stresses of trampling, cleaning, and bioturbation associated with more intensive use of the cave. As indicated by the column samples, use of nuts increases in the Kirk Stemmed component, but the feature samples suggest that both hickory and acorn were targeted.

The use of fruit taxa changed little through time, perhaps decreasing relative to nut use during the Kirk Stemmed period. More notable is the decrease in chenopod and possible increase in wild legumes over time. The drop in chenopod is illustrated both by boxplots of column and feature samples, as well as the correspondence analysis of features. This decrease in use might be related to changes in availability of chenopod, perhaps due to changes in local ecology. Such changes may also have increased the availability of nut resources. If hickory nuts and acorns are higher ranked foodstuffs, then an increase in their availability may be related to a decrease in use of lower ranked items, which may include chenopod. Gatherers may have been better able to meet their dietary needs with nut resources in Kirk Stemmed times, but needed to turn to lower ranked foods during the Late Paleoindian and Early Side-Notched periods. Alternatively, the use of the cave may have changed significantly, from a general purpose camp to a locus specifically for processing nuts. These possibilities will be further discussed in the following chapters.

INTERSITE COMPARISONS

While intrasite patterns can provide information regarding changes in plant use through time, intersite comparisons may indicate differences in plant use across ecological settings. Of particular interest are possible differences between sites within the uplands and those situated in or with access to the floodplain. Here I make broad comparisons between assemblages from the four sites using ubiquity measures as well as correspondence analysis. I do not include ¼-inch screen samples in these intersite comparisons, nor do I include the Dust Cave feature samples, in an attempt to use samples that are most comparable. I also consider the different components of the sites separately where possible.

Ubiquity

The ubiquity values of the various plant taxa suggest broad patterns among the sites (Table 6.15). Of particular note is the nearly 100% ubiquity of hickory nutshell at all sites, during all time periods. Hickory was recovered from all but one sample, a "pinch" sample from Stanfield-Worley. Its ubiquity at the sites is indicative of the importance of hickory in the diets of early foragers, as well as its high potential for preservation. Acorn also displays a relatively high ubiquity, which seems to increase from Late Paleoindian/Dalton to Early Archaic occupations. While this increase at Dust Cave may in part be related to poorer preservation of acorn in early deposits (see above), the rise in ubiquity may also reflect more intensive use of this mast resource.

Black walnut generally has higher ubiquity values at upland sites, which may be related to the availability of this species in the various ecological settings. In contrast, hazel appears to be more frequently recovered at sites with access to the wide creek bottoms of the Tennessee Valley, namely Dust Cave and LaGrange. Its absence from Rollins Bluff Shelter, located farthest from the Tennessee Valley, is notable.

Hackberry stands out among the fruit taxa, present only at Dust Cave. This is undoubtedly related to the preference of this species for floodplain settings. Grape, persimmon and sumac, however, are recovered at all sites, albeit in low numbers. The repeated recovery of these taxa likely reflects their regular use by early foragers in the area.

Wild seed taxa display higher ubiquity at sites with access to the Tennessee Valley. This is particularly true of chenopod, which was not recovered from the two upland sites, Stanfield-Worley and Rollins. Wild legumes are similarly more likely to occur at the Tennessee Valley sites, although a single wild legume was recovered from an Early Archaic sample at Rollins. "Other seeds", which include taxa not listed above, seeds identified to family level, and unidentified seeds, also have higher ubiquity values at the sites near the Tennessee Valley. The value for Stanfield-Worley may be underestimated, however, as floatation samples were not available for the site.

Table 6.15. Ubiquity of Plant Materials at the Four Rockshelter Sites.

Taxon	Stanfield-Worley[a] (%)	Rollins Dalton[b] (%)	Rollins Early Archaic[c] (%)	LaGrange Dalton[d] (%)	LaGrange Early Archaic[e] (%)	Dust Cave Late Paleo.[f] (%)	Dust Cave E. Side-Notched[g] (%)	Dust Cave ESN/Kirk Stemmed[h] (%)	Dust Cave Kirk Stemmed[i] (%)
Acorn shell	45	50	94	80	100	39	92	100	100
Acorn meat	60	17	19	0	17	6	8	40	13
Black walnut	85	50	25	80	50	36	0	20	0
Hazel	15	0	0	60	17	19	0	0	25
Hickory	95	100	100	100	100	100	100	100	100
Grape	5	17	13	20	50	3	8	20	25
Hackberry	0	0	0	0	0	75	100	100	100
Persimmon	45	25	13	20	17	0	0	10	38
Sumac	5	17	0	40	17	0	8	0	38
Chenopod	0	0	0	20	33	56	75	20	13
Wild legume	0	0	6	20	50	3	0	10	38
Other seeds	5	17	6	60	33	47	25	40	50

[a] N = 20.
[b] N = 12.
[c] N = 16.
[d] N = 5.
[e] N = 6.
[f] N = 36.
[g] N = 12.
[h] N = 10.
[i] N = 8.

Comparisons of ubiquity, then, suggest that black walnut may have been utilized to a greater degree at upland sites, while hazel seems to be more prevalent at sites near the Tennessee Valley. Weedy seeds, and in particular chenopod, are more likely to be recovered at Tennessee Valley sites, and hackberry is clearly limited to riverine sites. Widely used taxa include hickory, acorn, grape, persimmon, and sumac.

Correspondence Analysis

I further explore differences between site assemblages using correspondence analysis. In this analysis, the two axes explain 96% of the variation among the sites (Tables 6.16 and 6.17). The first axis is heavily influenced by hackberry, separating this taxon from hickory, as well as acorn, black walnut, persimmon, and other fruits (Figure 6.23). The second axis best represents black walnut, setting it apart from hickory and acorn. Hackberry, hazel, and edible seeds, all associated with higher ubiquity at floodplain sites, group together towards the left side of the graph. The generally ubiquitous hickory, acorn, and fruits (namely grape and sumac) cluster near the origin of the graph.

Plotting the various sites along these axes illustrates differences between the sites (Figure 6.24). Several of the assemblages cluster near hickory. These include the Kirk Stemmed component at Dust Cave and both the Dalton and Early Archaic component at Rollins. The assemblages from Stanfield-Worley and LaGrange tend toward the black walnut and persimmon end of the second axis. Reviewing the counts of taxa in the LaGrange samples, the Dalton assemblage from the site is influenced more by black walnut than persimmon, while the opposite holds for the Early Archaic assemblage. The Dust Cave samples separate along the first axis, with the Late Paleoindian and Early Side-Notched assemblages clustering near hackberry and edible seeds. The Late Paleoindian samples also plot slightly higher than the Early Side-Notched, perhaps reflecting the greater recovery of hazel from the earlier component. The mixed Early Side-Notched/Kirk Stemmed assemblage from Dust Cave (Zone Q) plots between these earlier samples and the Kirk Stemmed samples, perhaps indicating the influence of fruit and acorn, or more likely the mixed nature of this component.

Table 6.16. Diagnostic Statistics for Correspondence Analysis of Rockshelter Assemblages.

Factor	Eigenvalue	Percent	Cumulative Percent
1	0.568	68.24	68.24
2	0.232	27.89	96.14
3	0.017	2.05	98.19
4	0.009	1.03	99.22
5	0.004	0.48	99.69
6	0.002	0.23	99.92
7	0.001	0.08	100.00

Table 6.17. Loading of Variables on Factors 1 and 2 for Rockshelter Assemblages.

Type: Variable	Mass	Quality	Inertia	Factor 1	Factor 2	Contribution to Factor 1	Contribution to Factor 2	Squared Correlation to Factor 1	Squared Correlation to Factor 2
Taxon:									
Acorn	0.038	0.180	0.014	0.022	0.256	0.000	0.011	0.001	0.179
Black walnut	0.039	0.997	0.202	0.265	2.267	0.005	0.855	0.013	0.983
Edible seed	0.010	0.690	0.021	-1.198	0.064	0.025	0.000	0.688	0.002
Fruit	0.003	0.068	0.004	0.141	0.273	0.000	0.001	0.014	0.054
Hackberry	0.190	1.000	0.429	-1.503	-0.051	0.756	0.002	0.998	0.001
Hazel	0.003	0.564	0.010	-1.176	0.494	0.008	0.004	0.48	0.085
Hickory	0.713	0.998	0.130	0.403	-0.139	0.204	0.059	0.891	0.106
Persimmon	0.005	0.779	0.022	0.555	1.865	0.002	0.068	0.063	0.716
Site-Component:									
DC-KS[a]	0.234	1.000	0.056	0.426	-0.243	0.075	0.060	0.753	0.246
DC-KS/ESN[a]	0.057	0.691	0.030	-0.605	-0.024	0.037	0.000	0.69	0.001
DC-ESN[a]	0.064	0.962	0.116	-1.317	-0.099	0.195	0.003	0.957	0.005
DC-LP[a]	0.169	0.984	0.281	-1.277	0.019	0.487	0.000	0.984	0.000
LG-EA[b]	0.029	0.646	0.021	0.402	0.555	0.008	0.038	0.222	0.424
LG-D[b]	0.019	0.884	0.027	0.439	1.015	0.007	0.086	0.139	0.745
R-EA[c]	0.273	0.992	0.091	0.516	-0.25	0.128	0.074	0.803	0.189
R-D[c]	0.081	0.923	0.027	0.523	-0.197	0.039	0.014	0.808	0.115
SW[d]	0.072	0.997	0.182	0.433	1.525	0.024	0.725	0.074	0.923

[a] DC = Dust Cave; KS = Kirk Stemmed; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); ESN = Early Side-Notched; LP = Late Paleoindian.

[b] LG = LaGrange; EA = Early Archaic; D = Dalton.

[c] R = Rollins; EA = Early Archaic; D = Dalton.

[d] SW = Stanfield-Worley.

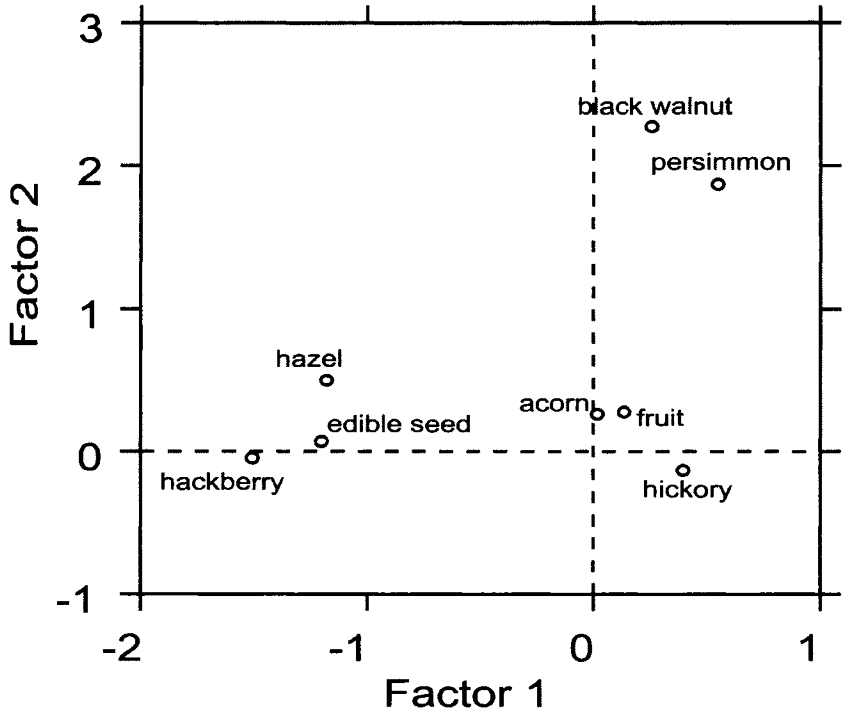


Figure 6.23. Correspondence map of plant taxa in the rockshelter assemblages.

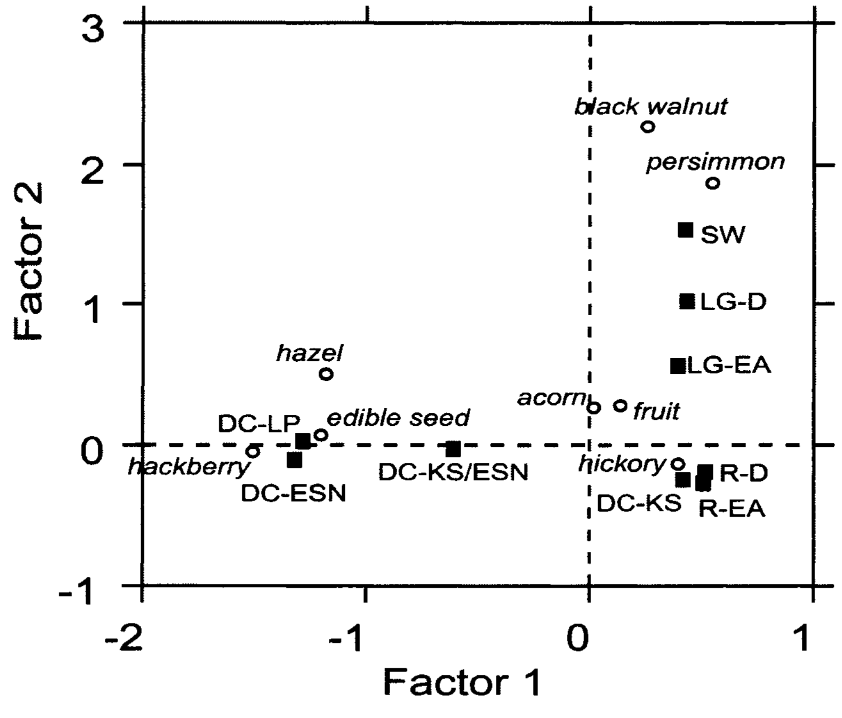


Figure 6.24. Correspondence map of rockshelter assemblages using eight variables. DC = Dust Cave; KS = Kirk Stemmed; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); ESN = Early Side-Notched; LP = Late Paleoindian; LG = LaGrange; EA = Early Archaic; D = Dalton; R = Rollins; EA = Early Archaic; D = Dalton; SW = Stanfield-Worley.

The correspondence analysis does indicate some trends through space. Black walnut is significant in assemblages from sites in or adjacent to the uplands, while hackberry, edible seeds and hazel are of greater influence at a floodplain site. Also of note are the trends through time illustrated by the correspondence plots. Although the boxplots suggested a decrease in hickory and walnut in the Early Archaic component at Rollins, the correspondence analysis demonstrates much similarity between the Dalton and Early Archaic occupations at the site, both heavily influenced by hickory. In contrast, the boxplots indicated no significant shifts through time at LaGrange, although the correspondence analysis suggests a decrease in the importance of black walnut. The differences between the Dust Cave samples are well illustrated by the correspondence analysis, showing the increased use of hickory relative to other plant taxa by the end of the Early Archaic period.

SUMMARY

My analysis of plant remains from the four rockshelter sites not only elucidates several patterns regarding plant use through time and space in the region, but also illustrates differences among various quantitative measures commonly used in archaeobotanical studies. Ubiquity may be simple to apply, but requires assumptions regarding similarity in preservation and sample size that are difficult to make, even within a single site. In addition, it collapses data so much that larger trends cannot be detected; the 100% ubiquity of hickory is a prime example. Relative density is useful for detecting changes in use of taxa through time, but has its own difficulties. Changes in smaller taxa may be overshadowed by increases in denser taxa, such as the increase in hickory at Dust Cave. In addition, items with small counts may be given too much weight, like the possible drop in black walnut demonstrated by relative densities at Rollins that did not show up in the correspondence analysis. Among the various quantitative approaches, correspondence analysis appears to best compare assemblages, both among sites and among different components from single sites.

Among the plant taxa, several stand out in that they are repeatedly recovered. Hickory was present in nearly every sample, illustrating its importance as a resource to early foragers. Acorn also occurred regularly in the samples, suggesting that this nut was also a dietary mainstay, likely underestimated in its importance because of the fragility of its shell. Persimmon, grape, and sumac, although recovered in low numbers, were present at every site in some form. These fruits, which seem to change little in use through time, appear to have been regularly consumed.

There are discernable trends among the data, but they vary considerably from site to site. Occupants of Stanfield-Worley apparently focused on black walnut and acorn as well as hickory, and supplemented these nut resources with various fruits. At Rollins, the dietary mainstay seems to be hickory, while acorn and black walnut play less of a role. Plant use seems to change little through time at the site. At LaGrange, use of black walnut is greater in the Dalton period. In addition to hickory, acorn, and various fruits, edible seeds such as wild legumes and chenopod appear to be regularly used at this site on the boundary between the sandstone hills and Tennessee Valley region. At Dust Cave, hickory and acorn are important nut resources that appear to have been used more intensively by the end of the Early Archaic period. Use of chenopod, and perhaps hazel, seems to decrease, however, although wild legumes may take chenopod's place as an important edible seed in the diet of the site's occupants. There may be some trends across space, with black walnut a greater constituent of upland assemblages and edible seeds more frequently recovered at sites with access to the Tennessee Valley. In general, though, the patterns seem to be specific to each site. This is particularly true of changes through time: no single trend across sites is apparent.

CHAPTER SEVEN:
GATHERING PLANTS AND IMPLICATIONS

In order to expand interpretations of the plant remains recovered from the four rockshelter sites and understand how early foraging groups may have exploited plants in concert with other resources in the region, it is important to understand the possibilities and constraints of the use of these plant foods. In other words, it is important to know where and when plant resources would have been available on the landscape, their dietary contributions, and their processing requirements in order to understand how people collected and used them. This information can be derived in part from botanical studies that detail the habitat, growth habit, and seasonality of native plants, as well as research that quantifies the nutritional content of plant foods.

Experimental studies and ethnographic descriptions provide avenues for understanding how various plants may have been processed, used, and/or discarded in the past. We cannot simply assume that past groups used similar techniques or prepared similar dishes, although the presence of similar processing tools, for example, is suggestive. However, various plant foods have particular characteristics that present challenges as well as opportunities for their use. Nutshells must be removed, tannins leached, seed coats ground, or inedible seeds disposed. Oil can be extracted from nuts high in fats, while nuts high in carbohydrates can be ground into meal; fruits can be used to flavor meats and soups. By reviewing experimental and ethnographic studies, we can identify some of these challenges and opportunities and how they may have affected use of these plants in the past.

Below I present botanical, nutritional, and ethnobotanical information about the nuts, fruits, edible seeds, greens, and other plant taxa recovered from the four rockshelter sites. Data derived from botanical studies include the habitat and growth habit of the various plants, as well as the seasonality and periodicity of their nuts, fruits, and seeds. These data suggest when and where these plant resources would have been available to gatherers. I briefly discuss the nutritional content of plant foods when available. This includes calories, protein, fats, carbohydrates, and various minerals and vitamins, which suggest the dietary role of the various plant foods. Finally, I describe experimental and ethnographic data regarding the collection, processing, preparation, and consumption of these plant foods. These data highlight properties of plants that people either must address or can exploit in their preparation and cooking. I use these accounts to identify necessary processing steps and possible uses of these plants by Late Paleoindian and Early Archaic peoples. By combining these three threads of information, we can gain a better understanding of the decisions and activities involved in gathering and using plant foods in the Middle Tennessee Valley.

NUTS

Nut taxa recovered from the four rockshelter sites include acorn, black walnut, hazelnut, and hickory, as well as several fragments assigned to the Beech Family. These fragments may have been acorn, beechnut, or chestnut, but I could not further identify them. On the whole, nuts are available in autumn, provide fat as well as protein, and require significant processing, particularly removal of shells. These are discussed in further detail below.

Habitat, Seasonality, and Periodicity

Among the nut taxa, acorn and hickory stand out in terms of habitat, growing in nearly every possible setting, from swamps to dry, rocky slopes (Table 7.1). This is no doubt due to the numerous oak and hickory species native to the Southeast, which occupy lowlands and slopes as well as upland areas. The National Wildlife Federation lists some 28 species of oak and eight species of hickory that grow in the state of Alabama (National Wildlife Federation 2005). Harper (1942) identified 16 oak species and five hickory species within the various physiographic regions of the Middle Tennessee Valley. The remaining taxa are somewhat more limited in their range. Harper (1942:70) notes that

Table 7.1. Habitat, Growth Habit, Seasonality, and Periodicity of Yield of Nut-Bearing Taxa.

	Habitat	Growth Habit	Seasonality of Nuts	Periodicity of Yield
Acorn (oak)[a]	Dry or rich forests; poor or rich soils; rocky ridges and bluffs; river bottoms; low grounds; hills and dry rocky slopes	Stands and isolated	Sept-Nov.	Every 2-10 yrs
Beechnut[b]	Rich, damp woods; upland forests	Stands	Sept-Nov	Every 2-3 yrs
Black walnut[c]	Rich, well-drained soil; deciduous woods	Isolated	Oct-Nov	Every 2-3 yrs
Chestnut[d]	Well-drained forest; rich woods	NA	Late Aug-Oct.	NA
Hazelnut[e]	Rich woods; thickets; valleys; uplands; forest margins; along streams	Thicket	July-Sept	Every 2-3 yrs
Hickory[f]	Rich soils; river bottoms; upland slopes; dry to moist upland woods; low woods; swamps	Stands	Sept-Nov	Every 2-5 yrs

[a] Belanger 1990; McQuilkin 1990; Peterson 1977:204; Radford et al. 1964:373-85; Rogers 1990; Sander 1990; Schopmeyer 1974:692-703.

[b] Coladonato 1991a; Little 1995:380-381; Peterson 1977:202; Radford et al. 1964:370; Schopmeyer 1974:401-402.

[c] Coladonato 1991b; Peterson 1977:188; Radford et al. 1964:362; Williams 1990; Schopmeyer 1974:454-9.

[d] Peterson 1977:202, Radford et al. 1964:372; Schopmeyer 1974:273-5.

[e] Coladonato 1993; Foote and Jones 1989:55; Kindscher 1987:99-100; Kurz 1997:94; Peterson 1977:200; Radford et al. 1964:367; Schopmeyer 1974:343-5.

[f] Peterson 1977:190; Radford et al. 1964:363-66; Smith 1990a, 1990b; Schopmeyer 1974:229-72.

beech, which has a very low tolerance for fire (Coladonato 1991a), occurs on slopes and in river bottoms, where it is protected from fire. Furthermore, it prefers soils derived from limestone, and is most abundant in the karstic uplands north of the Tennessee River (Harper 1942:70). Chestnut, on the other hand, preferred less calcareous soils. While common north of the river, chestnut apparently was more frequent in the Little Mountain region (Harper 1942:70). Black walnut appears to have been scattered throughout the region, preferring rich, well-drained soils and limestone slopes (Harper 1942:69; Radford et al. 1964:362). Additionally, black walnut does not grow in stands; it secretes juglone, a toxin that discourages the growth of other black walnuts and some other species in its near vicinity (Williams 1990). This may also have been the case for chestnuts; a chemical found in their leaves may also inhibit the growth of competitor species. However, because of the devastation of chestnuts due to blight in the early 1900s (Schopmeyer 1974:273), such observations are difficult to make. Hazel stands apart from the other nut taxa, growing as a shrub rather than a tree. With its weedy tendencies, hazel colonizes margins and disturbed grounds, forming thickets along stream banks and forest edges.

The seasonality of the various nuts is quite similar, ripening generally from September through November. Black walnuts ripen slightly later, beginning in October, while chestnuts mature as early as August in the South (Schopmeyer 1974:273). Again hazelnuts stand out, ripening from late July through September. While maturation may span several months, the nuts themselves are available for harvest for a much shorter period of time. Wildlife and molds compete for fallen nuts as well (Table 7.2), leaving a window of only several weeks, rather than months, for gathering. This is particularly true of the less bitter species of acorn and hickory, some of which become scarce less than two weeks after the peak of harvest (Gardner 1997; Petruso and Wickens 1984; Talalay et al. 1984).

The periodicity of these yields is more variable, not only between taxa but within genera as well. Different species of hickory, for example, have different cycles: mockernuts have good crops every two to three years, while bitternut hickories have high yields only every three to five years (Smith 1990a, 1990b). Trees within a grove tend to follow the same yield cycle, so that gatherers would have to visit different patches from year to year (Scarry 2003). There is a range of variation among individual trees as well. For example, among white oaks, particular trees consistently yield poor or good crops (Rogers 1990). In addition, trees with the largest crowns tend to produce the greatest yield. In order to create open conditions that promote the growth of larger crowns, early groups may have girdled and felled competitors growing near favored trees (Munson 1986). Northwestern groups also encouraged hazelnut production through the use of controlled burns (Kuhnlein and Turner 1991:140).

Cumulatively, this information regarding nut-bearing species is important to gatherers. The most salient attributes include the location of stands and/or individual trees that consistently produce high yields, and the likelihood that those trees will bear a bumper crop in a given year. This requires

Table 7.2. Animals Competing for Mast Resources.

	Mammals	Birds
Acorn (oak)[a]	Squirrels, chipmunk, raccoon, voles, mice, deer	Bluejay, crow, red-headed woodpecker, ducks, quail, turkey
Beechnut[b]	Squirrels, raccoon, black bear, mice, chipmunk, deer, foxes	Ruffed grouse, ducks, bluejay, game birds
Black walnut[c]	Rodents, squirrels	Variety of birds
Chestnut[d]	Various wildlife	
Hazelnut[e]	Squirrels, small mammals, deer	Northern bobwhite, ruffed grouse, bluejay
Hickory[f]	Squirrels, chipmunk, foxes, rabbits, beaver, mice, black bear, deer	Quail, turkey, ducks

[a] McQuilkin 1990; Rogers 1990; Sander 1990; Schopmeyer 1974.
[b] Burns and Honkala 1990; Coladonato 1991a; Little 1995:380-381.
[c] Coladonato 1991b; Little 1995:359.
[d] Schopmeyer 1974:273.
[e] Coladonato 1993; Foote and Jones 1989:55; Kindscher 1987:99-100; Kurz 1997: 94; Schopmeyer 1974:343.
[f] Smith 1990a, 1990b.

familiarity with the landscape and with the tendencies of various species, as well as monitoring individuals and stands to judge their progress throughout the season. Such monitoring, which could be easily embedded in the course of other subsistence forays, would enable gatherers to schedule their harvest of nuts to be competitive with other wildlife. In addition, gatherers may have encouraged the growth and productivity of nut-bearing trees and shrubs by creating and maintaining forest openings and margins.

Nutrition

On the whole, nuts provide significant quantities of calories, proteins, and fats (Table 7.3), particularly when compared to fruits and greens (Tables 7.7 and 7.13). Among the various nut taxa, chestnuts provide significantly fewer calories, proteins, and fats per 100 g of dried nutmeats. Indeed, nuts in the Beech family (Fagaceae; acorns, beechnuts, and chestnuts) tend to supply comparatively fewer quantities of proteins and fats, but greater quantities of carbohydrates. Black walnut, hickory nuts, and hazelnuts demonstrate the opposite, providing more calories, fats, and proteins, and fewer

Table 7.3. Nutrients Found in Nut Taxa (USDA NDL 2004).

	Acorn	Acorn Flour	Black Walnut	Chestnut, European	Chestnut spp.	Hazelnut	Hickory
Calories (kcal)	509	501	618	369	213	628	657
Water (g)	5.06	6	4.56	9	48	5.31	2.65
Protein (g)	8.10	7.49	24.06	5.01	2.40	14.95	12.72
Fat (g)	31.41	30.17	59.00	3.91	2.30	60.75	64.37
Carbohydrate (g)	53.66	54.65	9.91	78.43	45.50	16.70	18.25
Ash (g)	1.78	1.69	2.47	3.64	1.10	2.29	2.00
Fiber (g)			6.8		1.7	9.7	6.4
Sugar (g)			1.10			4.34	
Starch (g)			0.24			0.48	
Calcium (mg)	54	43	61	64	27	114	61
Iron (mg)	1.04	1.21	3.12	2.39	1.7	4.7	2.12
Magnesium (mg)	82	110	201	74	32	163	173
Phosphorus (mg)	103	103	513	137	93	290	336
Potassium (mg)	709	712	523	991	518	680	436
Sodium (mg)			2	37	6		1
Zinc (mg)	0.67	0.64	3.37	0.35	0.5	2.45	4.31
Copper (mg)	0.818	0.611	1.36	0.653	0.5	1.725	0.738
Manganese (mg)	1.363	1.743	3.896	1.183	1	6.175	4.61
Selenium (mg)			17			4	8.1
Vitamin C (mg)			1.7	15.1	43	6.3	2
Thiamin (mg)	0.149	0.146	0.057	0.354	0.24	0.643	0.867
Riboflavin (mg)	0.154	0.154	0.13	0.054	0.17	0.113	0.131
Niacin (mg)	2.406	2.382	0.47	0.854	1.2	1.8	0.907
Pantothenic Acid (mg)	0.94	0.931	1.66	0.901		0.918	1.746
Vitamin B-6 (mg)	0.695	0.688	0.583	0.666		0.563	0.192
Folate (mcg)	115	114	31	110		113	40
Vitamin A (IU)		51	40			40	131
Vitamin A (mgRAE)		3	2			2	7
Vitamin E (mgATE)			4.691			15.188	5.21

carbohydrates. These nutritional differences are related to differences in how the nuts are processed and used as a foodstuff, discussed in further detail below. Those that are high in fats are primarily processed into an oil or butter, while those that are high in carbohydrates are ground and used as a flour. In addition to essential nutrients, nuts are relatively rich in vitamins and minerals, particularly the B-vitamins, iron, and amino acids (Kuhnlein and Turner 1991:11-12).

Collection and Processing

The collection of nuts requires few implements other than baskets or bags to carry loads back to camp, but may demand a significant labor investment, particularly for groups whose diets include considerable quantities of nuts. This is certainly true for native groups in California, for whom acorns were a staple food. "[A]ll competent family members, male and female, and adult and child" (Jackson 1991:303-304) participated in collecting acorns, primarily to harvest as many as possible before birds and animals did. Among the Cherokee of western North Carolina, entire towns headed into "the mountains gathering chesnuts [sic] upon which many of them depend principally for a subsistence" (Benjamin F. Currey to Elbert Herring, letter, National Archives 1831:11:7:1). In the Northwest, Kuhnlein and Turner (1991:200) note that women and children were the primary gatherers of nuts, including acorns.

In addition to simply collecting nuts off the ground, people facilitated harvests by climbing trees and beating nuts off branches with long poles (Bettinger et al. 1997:894). This is true of the Neeshenams of California, who harvested acorns in this manner. Among those who helped collect the fallen nuts in large conical baskets were elderly men (Powers 1873-74:374). Beechnuts and chestnuts similarly may have been beaten from branches once the burs that surround the nuts had been forced open by frost (Schopmeyer 1974). Northwestern groups harvested hazelnuts early in the season and stored them until completely ripe (Kuhnlein and Turner 1991:140), thus beating their wildlife competitors to the bounty.

Gatherers are more likely to have brought collected nuts back to camp rather than having processed them in the field. Field-processing would allow gatherers to bring larger quantities of nutmeats and lesser quantities of low-utility nutshell back to camp. However, the time required to process nuts in the field prohibits this (Metcalfe and Barlow 1992). Bettinger and colleagues (1997) estimate that gatherers would have to travel one-way distances of roughly 50 km to make field-processing of acorns worthwhile. Nutshell, particularly of hickories and black walnuts, may also have held some utility as a fuel source. They burn well because of their relatively high oil content (Lopinot 1984); gatherers may have processed them at camp in part to obtain the nutshells for fuel.

While collection of nuts is relatively straightforward, nutshells impart significant processing costs (Table 7.4). Nuts from the Beech family and hazelnuts have relatively large meats encased in thin shells that are easily cracked, one at a time, by striking them with a heavy object (Petruso and Wickens 1984) or between "a pair of rounded stones with a pitted center" (Kuhnlein and Turner 1991:200). Hickory nuts and black walnuts have more substantial and convoluted shells, such that pieces of nutmeat must generally be picked from the shell after being cracked open. This picking is time-consuming, and can be circumvented for hickory by crushing the nuts, both shell and meat, into small pieces and throwing the mixture into boiling water, which may be contained in a lined pit in the absence of cooking pots. The shells sink to the bottom while the meats rise and can be skimmed from the top. Some of the meats dissolve in the boiling water, making a rich oil or milk (Fritz et al. 2001; Gardner 1997; Talalay et al. 1984). Black walnuts are not amenable to this process because, unlike hickory nuts, the bitter hull adheres to the shell. If thrown in water, tannins released from the hull would make the meats unpalatable (Gardner 1997; Talalay et al. 1984).

Acorns require additional processing to leach tannins. While some species of acorns, particularly of white oak, may be eaten raw (Kavasch 1977:2; Kuhnlein and Turner 1991:200; Palmer 1871:409), most are quite bitter due to the tannin content and must be leached first. For less bitter species, this may be accomplished by parching, which also prevents germination and infestation by insects and molds. However, it also hardens the meats, making them more difficult to grind (Petruso and Wickens 1984:368). Tannins may also be leached by boiling the meats – either ground or whole – in several changes of water, often including lye of wood ashes in the water to facilitate the leaching (Carr 1895:172; Gilmore 1932:189; Kavasch 1977:2; Kuhnlein and Turner 1991:200; Peterson 1977:204; Petruso and Wickens 1984:368; Yanovksy 1936:18-19). Alternatively, the meats may be placed in baskets or other containers and submerged in water to remove tannins (Bettinger et al. 1997:894; Petruso and Wickens 1984:362). Acorns, as well as beechnuts, chestnuts, and hazelnuts,

Table 7.4. Processing Costs of the Nut Taxa.

	Meat/Total Nut Weight (%)	Collect and Hull (min)	Crack & Pick (min)	Crush & Boil (min)	Clean, Pound, Leach (min)	Meat/Hr (g)	Kcal/100 g	Kcal/Hr
Acorn, not leached[a]		14.3g/hr	126 nuts/hr			489	505	2469
Acorn, leached[b]	31.4	84.6	547.6		1019.8	182	505	917
Shagbark hickory[c]	37.2	1	59			30	657	197
		9		51		264	657	1734
		16		44		496	657	3259
Mockernut hickory[c]	42.6	1	59			21	657	138
		14		46		301	657	1978
		24		36		515	657	3384
Bitternut hickory[c]	45.0	1	59			19	657	125
		15		45		300	657	1971
		25		35		469	657	3081
Black walnut[c]	19.4	3	57			95	618	587
Hazelnut[c]	33.6	17	43			87	628	546

[a] Values used are averages of those given in Petruso and Wickens 1984: Table 2.

[b] Bettinger et al. 1997: Table 1.

[c] Talalay et al. 1084: Tables 1 and 3.

also have a bitter, papery coating that may or may not be removed prior to eating, as it is time-consuming to do so (Bettinger et al. 1997:894).

In ethnographic accounts, all family members were enlisted to collect nuts, but processing fell primarily to women (Jackson 1991) and in some instances to children (Hawkes et al. 1995). Processing primarily involved pounding the nuts in a mortar and/or pestle (Carr 1895:171; Powers 1873-74:374; Swanton 1946:243) or cracking them open with rounded stones with pitted centers (Kuhnlein and Turner 1991:209; Swanton 1946:365). Two flat stones were used when out traveling or hunting (Carr 1895:174). Nutting stones and mortars, used to crack open and grind nuts, were made and owned by women in native Californian groups. These include bedrock mortars, manufactured at three depths to grind acorn meal to different levels of fineness (Jackson 1991; Powers 1873-74:374). Bedrock mortars are also noted near villages of groups living south of the Ohio River (Carr 1895:175). As fixed production loci, these bedrock mortars certainly figured prominently in mental maps of the landscape, as stands of highly productive trees likely did (Jackson 1991).

Preparation and Consumption

Nuts were an important food for historic Native American groups, often used in conjunction with or in place of the major staple of corn. Newberry (1887:46) states that nuts, including chestnuts, hickory nuts, black walnuts and butternuts, were collected "abundantly"; and indeed, they seem to have been put to abundant uses. They were eaten fresh, or ground into a flour to make bread, mix with hominy, or thicken a stew (Carr 1895; Swanton 1946:287). Oil, butters and pastes were prepared from them (Kavasch 1977; Kuhnlein and Turner 1991; Swanton 1946:287, 288), as well as beverages (Carr 1895:182-3). Nuts were especially key in the winter diets of some groups; among the Natchez, the twelfth moon (the latter part of January) is named "Chestnuts" and the thirteenth (February) is the "moon of the Nuts," even though they had been collected earlier (Swanton

1946:261, citing du Pratz 1758, vol 2:354-383). Common preparations of nuts observed among historic and ethnographic Native American groups are described below.

Acorn. Once gathered in the fall, acorns could be eaten immediately or stored for use in the winter or spring (Swanton 1946:259). The collected nuts may be roasted in ashes and eaten (Densmore 1974:320; Peterson 1977:204); once leached and boiled, acorns can also be "eaten like a vegetable" (Densmore 1974:320; Kuhnlein and Turner 1991:200) or dried and ground into a meal. Acorn meal was used to make bread (Carr 1895:172; Palmer 1871:409-410; Peterson 1977:204) on its own or with the addition of cornmeal (Kavasch 1977:2); to make into a mash with grease (Densmore 1974:320; Kuhnlein and Turner 1991:200-1) or without grease (Powers 1873-74:374); to make broth or soup or to thicken stews (Carr 1895:172; Kavasch 1977:2; Kuhnlein and Turner 1991:200-1; Niethammer 1974:35; Swanton 1946:260; 366); to season potherbs (Kavasch 1977:2); or to render oil by boiling them and skimming the resulting oil from the top (Carr 1895:172; Kavasch 1977:2; Swanton 1946:260, 265, 279, 366). In the Southwest, Newberry (1887:38) describes the making of a paste by adding water to acorn meal; the paste is then poured into a depression in the sand, a fire is built over top, with the resulting cake being "half-steamed, half-baked." Powers (1873-74:374) also mentions acorn bread being baked "underground" by the Neeshenams of California.

Acorns were often stored for winter (Jackson 1991; Newberry 1887:38; Palmer 1871:410; Swanton 1946:259), primarily while still in the shell to discourage mold, insects and germination (Bettinger et al. 1997:894). Among the Chippewa, storage involved burying the nuts for use in winter or spring (Densmore 1974:320). In the West, acorns might be stored all winter in baskets buried in mud or under water, which aided in eliminating tannins (Bettinger et al. 1997:894; Kuhnlein and Turner 1991:201), or buried in earth and grasses to keep out moisture (Palmer 1871:409-410). Niethammer (1974:35) suggests sprinkling the nuts with wood ash to protect them from worms.

Beechnut. Similar to acorns, beechnuts were eaten fresh or stored for winter use (King 1984:111; Yanovsky 1936). The nuts can be roasted and eaten, or ground into a meal (Kavasch 1977:1; Peterson 1977:202). Once ground, the meal could be made into a bread, or mixed with cornmeal and beans or berries to make into a bread. Beechnut meal was also used to thicken soups and added to hominy or corn pudding (Moerman 2004). High in fat, crushed beechnuts were boiled to extract the oil, which was added to soups and puddings or drunk as a liquid (Kavasch 1977:1; Moerman 2004; Peterson 1977:202).

Black Walnut. Black walnuts are given more cursory treatment in the literature than other nuts, often simply described as having been used similar to hickory nuts and butternuts (Kuhnlein and Turner 1991:210). The nutmeats may be eaten plain or cooked into soup (Peterson 1977:188; Swanton 1946:273; Yanosky 1936:17); pounded into butter or a meal for flour to make bread (Kavasch 1977:4; Peterson 1977:188; Swanton 1946:291); or rendered for oil by boiling (Peterson 1977:188; Swanton 1946:273), "similar to hickory and acorn" (Carr 1895:172).

Chestnut. Chestnuts could be eaten raw or cooked, or dried and then ground into flour to make bread (Kuhnlein and Turner 1991:199; Swanton 1946:256, 272-3, 288). They were used in soups and cooked with potatoes; the nuts were also roasted like coffee beans to make a beverage (Kuhnlein and Turner 1991:199). Yanovksy (1936:17) states that the nuts were prepared, apparently similar to beechnuts and hickory nuts, by boiling the crushed nuts to extract the oil, which was then skimmed off and used separately. However, as noted above, chestnuts are relatively low in fat, so this method of use seems unlikely.

Hazelnut. Hazelnuts were widely used for food, eaten raw, roasted, or ground into a flour to make a bread or pudding (Densmore 1974:289; Gilmore 1932:127; Kavasch 1977:4; Kindscher 1987:99-100; Kuhnlein and Turner 1991:140; Peterson 1977:200). They were also boiled in soups

(Kindscher 1987:99-100; Kuhnlein and Turner 1991:140; Yanovsky 1936:17), mixed with mashed potatoes, and rendered for oil (Kuhnlein and Turner 1991:140). Some groups in the Northwest mixed the kernels with bear oil or grease, or berries or cooked roots, and formed them into cakes that were then dried and used as a relish (Kuhnlein and Turner 1991:141). Hazelnuts were also dried and stored for winter (Gilmore 1932:127; Kuhnlein and Turner 1991:140; Yanovsky 1936:17).

Hickory. Hickory nuts were widely eaten (Yanovsky 1936:16-17), often in significant quantities (Palmer 1871:411). They were eaten either raw and whole, or crushed and mixed with cornmeal and perhaps berries to make a bread, or to flavor potatoes, hominy, or soups (Kuhnlein and Turner 1991:209; Swanton 1946:354). Oil and a milk were also prepared from the nuts (Carr 1895:171, 182-3; Kavasch 1977:2; Kuhnlein and Turner 1991:209; Swanton 1946:265). Carr (1895:171-2), quoting Bartram's "Florida" (Dublin, 1793:38), describes the production of hickory milk: "[They] pound the nuts to pieces upon a stone thick and hollowed for the purpose ... cast them into boiling water, which, after passing through fine strainers preserves the most oily part of the liquid. It is used as an ingredient in most of their cooking, especially hominy and corn cakes." Swanton (1946:354) recounts a description of the production of hickory milk, in which dried hickory nuts were cracked, and kernels and shells were placed into a sack. Water was then poured over the sack, and the resulting milky fluid was kept for cooking. The milk was also drunk as a beverage or added to soups (Carr 1895:172; Kuhnlein and Turner 1991:209; Swanton 1946:365), while the oil was used as a gravy with bread, potatoes, pumpkin and squash (Kuhnlein and Turner 1991:209; Swanton 1946:365), or to flavor soups (Carr 1895:172).

Summary

Nuts were an important food item for historic Native American groups, whether roasted, boiled, or ground into meal. Although processing costs are significant, nuts are rich in calories, proteins and fats. The autumn collection of nuts is relatively straightforward, although stiff competition from wildlife for ripened mast necessitates concerted collecting efforts that often involve men in addition to women, children, and the elderly, particularly among groups that rely upon mast. Monitoring of stands and individual trees would facilitate the timing of collection, as well as concentrate efforts among trees with higher yields. This timing is key, given the short window of time in which nuts can be gathered from the ground before wildlife eat them or molds ruin them. Such monitoring, which requires a sophisticated mental map of the landscape, would likely be embedded in the course of other foraging tasks.

FRUITS

Fruits recovered from the four rockshelter sites include possible black gum, grape, hackberry, possible honey locust, possible maypop, mulberry, persimmon, and sumac. Nightshade, which was also tentatively identified, may also be considered a fruit; although toxic when fresh, the berries of nightshade are apparently edible when heated (Kavasch 1977:10). As a group, the fruits provide relatively few calories but are rich in vitamins and require little processing. Eaten fresh in the summer and dried for winter storage, fruits were commonly used by Native American groups to flavor various dishes and thus supplement the diet.

Habitat, Seasonality, and Periodicity

The various fruit taxa grow in a range of ecological settings (Table 7.5). The tree species, which are rarely found in pure stands but instead are members of mixed communities, grow in various woodland habitats. Within the Tennessee Valley region, black gum may favor moist locales, although Harper (1942:76) notes that they are common in dry woods in the Little Mountain physiographic region and in the karstic uplands north of the Tennessee River. Hackberry prefers calcareous soils along rivers and creeks, and is noticeably absent from the Little Mountain region (Harper 1942:72). Honey locust, mulberry, and persimmon can be found in rich woods, but as weedy species are more frequently found along forest edges and in disturbed areas (Harper 1942:72, 77).

Table 7.5. Seasonality, Periodicity of Yields, Habitat and Growth Habit of Fruit Taxa.

	Habitat	Growth Habit	Seasonality of Fruits	Periodicity of Yield
Black gum[a]	Upland and low woods, alluvial bottoms, dry woods	Mixed stands	Aug-Oct	Highly variable
Grape[b]	Swamps, wet lake margins, riversides, rich bottomlands, open thickets, upland and low woods, rocky and sandy soils	Vine	July-Oct	Yearly under good conditions
Hackberry[c]	Rich moist soils, limestone soils, woods, rocky uplands, slopes, bluffs, along rivers	Mixed stands	Aug-Nov	Almost yearly
Honey locust[d]	Rich woods, upland woods, fields, borders, alluvial bottoms and rich slopes, old fields	Mixed stands	July-Feb	Every 1-2 years
Maypop[e]	Sandy soil, fields, disturbed ground, thickets, rocky ground	Vine	July-Oct	Yearly
Mulberry[f]	Rich soil, open woods, floodplains, alluvial woods and lower slopes, disturbed ground	Mixed stands	May-Aug	Every 2-3 yrs
Nightshade[g]	Open and disturbed habitats, pastures, riverbanks, floodplains, prairie hillsides and ravines, open woods, woodland borders	Weedy stands	June-Oct	Almost yearly
Persimmon[h]	Old fields, hardwood forests, pinelands, thickets, rocky hillsides, along streams, rich bottomlands	Mixed stands	Late Aug-Nov	Every 2 yrs
Sumac[i]	Disturbed ground, thickets, meadows, upland prairies, borders, sandy or rocky or open woods, along ledges and streams	Thicket	June-Oct	Almost yearly

[a] Harper 1942:76; McGee 1990; Radford et al. 1964:790; Schopmeyer 1974:554-7.

[b] Foote and Jones 1989:93-4; Harper 1944:151; Kurz 1997:364-74; Peterson 1977:198; Radford et al. 1964:695-97; Schopmeyer 1974:853-4.

[c] Harper 1942: 72; Kindscher 1987:242; Krajicek and Williams 1990; Kurz 1997: 74; Radford et al. 1964:389; Schopmeyer 1974:298-300.

[d] Burns and Honkala 1990; Harper 1942:74; Peterson 1977:184; Radford et al. 1964:578; Schopmeyer 1974:431; Sullivan 1994; USDA NRCS 2004.

[e] Peterson 1977:94; Radford et al. 1964:734; USDA NRCS 2004.

[f] Harper 1942:72; Peterson 1977:210; Radford et al. 1964:391; Schopmeyer 1974:544-46; Sullivan 1993b.

[g] Bare 1979:332-4; Harper 1944:187-8; Peterson 1977:50; Radford et al. 1964:930-3.

[h] Harper 1944:174-5; Foote and Jones 1989:118; Halls 1990; Peterson 1977:194; Radford et al. 1964:826; Schopmeyer 1974:373-5.

[i] Foote and Jones 1989:56; Harper 1942: 75, 1944:147-8; Johnson 2000; Kindscher 1987:191-93; Kurz 1997:200-204; Peterson 1997:186; Radford et al. 1964:677-8; Schopmeyer 1974:715-9.

Mulberry is particularly common near streams (Harper 1942:72). Sumac also thrives in rich soils and disturbed ground, preferring open or edge situations. While it primarily grows as a shrub, Harper (1942:75) notes that in rich woods near streams sumac can grow large enough to be considered a tree. Nightshade also prefers open and disturbed areas, and can grow as a forb or shrub (United States Department of Agriculture Natural Resources Conservation Service [USDA NCRS] 2004). Maypop prefers disturbed areas as well, while the various species of grape can be found in a range of habitats.

The seasonality of the various fruits is similar, with most ripening in late summer through autumn. Mulberries may ripen significantly earlier, beginning in May, and nightshade and sumac berries in June. Many of the fruits persist through the winter, including black gum, hackberries, nightshade berries, persimmons, and sumac berries (Bare 1979:332-4; Carey 1994; Krajicek and William 1990; Peterson 1977:194; Radford et al. 1964:930-3; Schopmeyer 1974:298, 554, 716). Most of the taxa produce sizeable yields on a yearly basis, given favorable growing conditions, such as appropriate sunlight for some species of grape (Carey 1994). The tree species tend to be more variable. Honey locust yields good crops every one to two years (Burns and Honkala 1990; Schopmeyer 1974:431), while persimmon and mulberry produce sizeable fruit crops only every other year (Halls 1990; Schopmeyer 1974:431). Yields of black gum are highly variable (McGee 1990).

Similar to nut taxa, humans must compete with birds and animals for ripened fruits (Table 7.6). Mulberries are particularly favored by birds and small animals, and are often eaten before they fully mature (Burns and Honkala 1990). There seems to be relatively little competition for nightshade berries and maypops, however. As mentioned above, nightshade is considered poisonous, although various birds and some wildlife appear to eat them and disperse the seeds (North Dakota State University [NDSU] ProCrop 2004). The flowers of maypop attract butterflies (USDA NCRS 2004), but apparently few wildlife consume the fruits. Songbirds may eat small quantities of the seeds (Sparks 2004).

On the whole, fruits occur in a variety of settings, but generally prefer disturbed grounds, including floodplains and riverbanks, as well as forest margins. This is particularly true of species that are weedy in nature, including honey locust, persimmon, mulberry, sumac, maypop, and nightshade. Gatherers might encourage such species by creating or maintaining edge situations, for example through burning. Burning also would have encouraged production of shrubby species (Kuhnlein and Turner 1991:18). The various fruit taxa produce sizeable crops at least every other year, with the exception of mulberry and black gum. While birds and mammals consume the

Table 7.6. Animals Competing for Ripened Fruits.

	Mammals	Birds
Black gum[a]	Various animals	Various birds
Grape[b]	Black bear, raccoon, foxes, skunk, various small mammals	Songbirds, ruffed grouse, wild turkey, ring-necked pheasant, northern bobwhite
Hackberry[c]	Squirrels, raccoons, various other small mammals	Wild turkey, ring-necked pheasant, quail, ruffed and sharp-tailed grouse, prairie chicken, cedar waxwing, yellow-bellied sapsucker, mockingbird, robin, bobwhite
Honey locust[d]	Cottontail, fox squirrel, gray squirrel, opossum, white-tailed deer	Northern bobwhite, quail, crow
Maypop[e]		Seeds eaten by songbirds
Mulberry[f]	Opossum, raccoon, fox squirrel, gray squirrel	Wood duck, bluebirds, indigo bunting, gray catbird, eastern kingbird, towhee, orchard oriole, brown thrasher, summer tanager, vireo, red-cockaded woodpecker, red-bellied woodpecker, great crested flycatcher, Lewis' woodpecker
Nightshade[g]	Wildlife	Birds
Persimmon[h]	Squirrels, foxes, coyote, raccoon, opossum, skunk, white-tailed deer	Quail, wild turkey, northern bobwhite, crow, songbirds
Sumac[i]	Chipmunks, raccoons, opossum, white-tailed deer	Wild turkey, gray partridge, mourning dove, ruffed and sharp-tailed grouse, songbirds

[a] Coladonato 1992b; McGee 1990.
[b] Carey 1994; Kurz 1997:364-74.
[c] Krajicek and Williams 1990; Kurz 1997:74; Rosario 1988.
[d] Burns and Honkala 1990; Sullivan 1994.
[e] NDSU ProCrop 2004.
[f] Burns and Honkala 1990; Schopmeyer 1974:544-545; Sullivan 1993b.
[g] Sparks 2004.
[h] Coladonato 1992a; Halls 1990.
[i] Coladonato 1992c; Foote and Jones 1987:56; Johnson 2000; Kurz 1997:200-4; Tirmenstein 1987.

fruits, mulberries and grapes are the only taxa for which competition is fierce, eaten as soon as they ripen beginning in May and July, respectively. To take advantage of these fruits before birds and mammals do, gatherers must closely monitor the berries' maturation. In contrast, the remaining taxa, although ripe in early or late summer, often persist through the winter.

Nutrition

Less nutritional information is available for fruits than for the nuts, but the available data indicate that fruits supply significantly fewer calories, protein, fats, and carbohydrates than nuts (Table 7.7). This is likely related to the higher water content of fruits. The fruits tend to be lower in

Table 7.7. Nutrition Values of Fruit Taxa (USDA NDL 2004).

	Black Gum	Grape, American	Hackberry	Persimmon	Smooth Sumac
Calories (kcal)	.	67	.	127	.
Water (g)	90	81.3	17	64.4	66
Protein (g)	0.5	0.63	.	0.8	1.5
Fat (g)	1.7	0.35	2.3	0.4	2.7
Carbohydrate (g)	1.3	17.15	.	33.5	14
Ash (g)	0.5	0.57	24.1	0.9	1.7
Fiber (g)	0.9	1			9.9
Calcium (mg)		14		27	61
Iron (mg)		0.29		2.5	
Magnesium (mg)		5			
Phosphorus (mg)		10		26	54
Potassium (mg)		191		310	
Sodium (mg)		2		1	
Zinc (mg)		0.04			
Copper (mg)		0.04			
Manganese (mg)		0.718			
Selenium (mg)		0.2			
Vitamin C (mg)		4		66	
Thiamin (mg)		0.092			
Riboflavin (mg)		0.057			
Niacin (mg)		0.3			
Pantothenic Acid (mg)		0.024			
Vitamin B-6 (mg)		0.11			
Folate (mcg)		4			
Vitamin A (IU)		100			
Vitamin A (mgRAE)		5			80
Vitamin E (mgATE)		0.34			

minerals, but are not surprisingly high in vitamin C or A. The nutritional data suggest that these wild fruits would have been better dietary supplements than staples. Regardless, berries seem to have been an important component of native diets during the peak of their availability (Newberry 1887:43; Palmer 1871:417).

Collection and Processing

Little is mentioned of collection techniques in ethnographic literature of Native American groups, except that mulberries in particular had to be gathered before wildlife ate them (Schopmeyer 1974:544-545). Interestingly, a number of native groups, including the Creeks, Yuchi Indians, Tuscaroras and Siouan groups, referred to the month of May as "Mulberry," while the Natchez used this fruit to refer to August (Swanton 1946:259-262). The Shawnee and the Creeks also had towns named "Mulberry Place" (Swanton 1946:81, 185). Palmer (1891:417) noted that native groups living in the Great Plains would "travel many miles in search of" mulberries. As one of the first fruits to ripen during the summer and one of the fruits with significant wildlife competition, collection of mulberries appears to have been of particular importance.

While gatherers may have targeted collection of fruits like mulberry and grape that are quickly eaten by wildlife, other fruits that persist into fall and winter may have been gathered using different strategies, given the season, quality and quantity of the fruit remaining. When the fruits were at their peak of availability, gatherers may have focused efforts on collecting them. But much past this peak, the fruits may not be found in quantities that would make targeted collection worth the effort. Instead, people may have simply eaten them as they encountered the fruits during other activities. Persisting fruits may have been a welcome addition to a winter diet perhaps otherwise scant in plant foods.

Similar to nuts, few tools are needed for gathering fruits, other than baskets and bags to carry and store them. Women and children likely performed the majority of gathering (Niethammer 1974:xxii). Unlike nuts, little processing is required for fruits. Seeds may be spit out or simply chewed and eaten. The exceptions are honey locust and maypop, which must be cut open to access the sweet pulp inside. Because they do not demand processing, berries and other fruits are particularly suited to children's foraging efforts (Hawkes et al. 1995).

Fruits may also be dried for future use. This may entail simply spreading the fruits out on a mat in the sun each day, and guarding them from animals that might steal them. Alternatively, fruits may be placed over a heat source to aid in drying (Reidhead 1981).

Preparation and Consumption

While fruits may not have been a staple in terms of their caloric addition to the diet, at least during seasons other than summer (Newberry 1887:43), they likely were indispensable in terms of the flavor they added. Fruits were eaten fresh in the summer, as well as dried for winter (Carr 1895:170; Swanton 1946:258, 277, 378). When dried, they often became ingredients in breads, pemmicans, stews or beverages (Carr 1895:170; Densmore 1974:322; Kavasch 1977:6; Swanton 1946:378). Berries were often prepared by crushing them with a mortar and pestle (Swanton 1946:560). Fruits were often stored, either in containers or underground caches with or without having been dried, or placed in a container with water and then covered with a layer of oil or fat (Kuhnlein and Turner 1991:16). As with other foods, fruits were usually prepared by women (Niethammer 1974:xxii). Various uses and preparation techniques of the individual fruit taxa by Native American groups are presented below.

Black Gum. Black gum is rarely mentioned as a food in the literature. Mooney (1891:372) references the tree not for its fruits, but as a harbinger of birds in the summer that could easily be taken by blowgun and arrow as they ate of the fruits of the tree. However, Swanton (1946:279) gives accounts of its use in soups and mixed with legumes.

Grape. Grapes may be eaten fresh or dried for winter use (Densmore 1974:321; Kuhnlein and Turner 1991:265; Niethammer 1974:68; Palmer 1871:415; Peterson 1977:198; Swanton 1946:265, 281, 287, 378; Yanovsky 1936:42-43), or made into preserves (Peterson 1977:198; Yanovsky 1936:42-43). The spring shoots may also be eaten as greens (Kuhnlein and Turner 1991:265; Peterson 1977:198), and the twigs used to make tea (Yanovsky 1936:42-3).

Hackberry. These small berries can be eaten fresh (Niethammer 1974:72; Peterson 1977:194) or pounded into a meal. This meal can then be shaped into cakes and dried for use in the winter (Niethammer 1974:72), used to flavor meat (Kindscher 1987:242; Kurz 1997:74; Yanovsky 1936:19), or mixed with parched corn and fat (Yanovsky 1936:19).

Honey Locust. The pods of honey locust contain a sweet pulp that may be eaten raw (Moerman 2004; Yanovsky 1936:36) or used to sweeten medicines or children's dispositions (Moerman 2004). The pulp can also be used to make a beverage (Moerman 2004; Ulmer and Beck 1951:58) that may be fermented (Yanovsky 1936:36).

Maypop. Maypops could be eaten raw simply by cutting them open to access the sweet pulp inside (Moerman 2004; Yanovsky 1936:43). A drink could also be made by scooping the pulp and seeds from the fruit and boiling them to obtain a juice that could then be cooked with meal (Ulmer and Beck 1951:48, 58; USDA NCRS 2004).

Mulberry. Mulberries, which apparently were used by groups wherever they were available (King 1984:133), were eaten fresh or dried for future use (Moerman 2004; Palmer 1871:417; Swanton 1946:244; Yanovsky 1936:20). Some groups mashed the berries into cakes before drying and storing them. These cakes were then added to water to make a sauce or mixed with corn meal to make a bread (Moerman 2004). The berries were also used to make a beverage (Burns and Honkala 1990; Moerman 2004; Sullivan 1993b).

Nightshade. Yanovsky (1936:56) reports that berries of *Solanum* sp. were used by groups living in the Southwest. Kavasch (1977:10) likewise states that the berries, although toxic when fresh, were safe to eat when heated. She notes that groups in the Northeast used the berries to flavor their stews (ibid). Kuhnlein and Turner (1991:329) and Moerman (2004) also list use of ripened nightshade berries among western native groups, where they were used as famine foods but also to flavor meat dishes (Moerman 2004).

Persimmon. Ripe persimmon fruits were eaten fresh (Peterson 1977:194; Yanovsky 1936:52), apparently in "large quantities" (Palmer 1871:471), and were kept for winter use by fashioning the pulp into cakes and drying them (Swanton 1946:265, 285, 288, 291, 363, 373). Preserves may also be made for use in winter (Palmer 1871:471). Tea can be made using the summer leaves of the tree (Kavasch 1977:48).

Sumac. Sumac berries may be eaten fresh or dried (Havard 1896:44-5; Kuhnlein and Turner 1991:110-1; Yanovsky 1936:40-1), but they seem to be used most often to make a beverage likened to lemonade or tea (Kavasch 1977:50; Kindscher 1987:191-3; Kuhnlein and Turner 1991:110-1; Kurz 1997:200-4;). To make the drink, the berries might be crushed, bruised, or roasted (Havard 1896:44-5; Peterson 1977:186; Yanovsky 1936:40-1), in part to help abate tannins in the berries (Kindscher 1987:191-3). The berries were also mixed into cornmeal as a flavoring agent (Kindscher 1987:191-3; Kurz 1997:200-4).

Summary

Because of their low caloric content, fruits probably served as important dietary supplements rather than staples, although significant quantities may have been consumed during the peak of their availability. Readily dried and stored, fruits likely imparted flavor to fall and winter meals. Children may have been active exploiters of fruits, as they are easily collected and require little or no processing.

While people may have competed with animals and birds for grapes and mulberries, they apparently could take advantage of some fruits into late fall and winter. Their strategies likely changed, however, given the season and the quality and quantity of fruit remaining. When the fruits were at their peak of availability, gatherers likely targeted the collection of fruits. But much past this peak, the fruits may not have been present in quantities that would make targeted collection worth the effort. Instead, people may have simply eaten the fruits as they encountered them during other activities. Persisting fruits, such as persimmons and hackberries, may have been a welcome addition to a winter diet perhaps otherwise scant in plant foods. Because most of the taxa produce significant yields on a yearly basis, monitoring probably served to determine when fruits would ripen rather than whether the trees, shrubs or vines would be fruiting in a particular year. As with the nuts, gatherers required familiarity with the landscape, and with the habitat and performance of particular trees, shrubs or vines in that landscape, to effectively exploit fruits.

EDIBLE SEEDS

Taxa with edible seeds recovered from the four rockshelter sites include chenopod, chenopod/amaranth, smartweed, possible wild bean, and various wild legumes. A member of the Grass family that could not be further identified was also recovered. Edible seeds are higher in calories than fruits, but they also demand higher processing costs than fruits. Growing in the form of annual or perennial forbs or vines, their availability is also highly predictable.

Habitat and Seasonality

The similarities among the edible seed taxa are striking (Table 7.8). First, they all favor disturbed grounds. These include floodplain areas that are shaped by fluvial activity; clearings and forest edges, such as those that are created and/or maintained by fire; and places that are disturbed by occupation and traffic, whether by animals or humans. Smartweeds prefer damper conditions, and therefore are somewhat more limited in their distribution than the other taxa. The wild beans and legumes, as well as chenopod, are more likely to be found in wooded settings than the other taxa.

As annuals or perennials, these taxa set seed on a yearly basis, such that gatherers do not need to be concerned about periodicity in their yields, unlike the nuts and some fruit taxa. More important is whether local conditions, such as moisture, shade and competition, favor the growth of particular species. They also tend to grow in stands, allowing gatherers to collect seeds from several plants during a visit to a single patch. The taxa vary in their seasonality, however. Smartweeds may mature

Table 7.8. Habitat, Growth Habit, and Seasonality of Edible Seed Taxa.

	Habitat	Growth Habit	Seasonality
Amaranth[a]	Old fields, disturbed grounds, stream valleys	Annual weedy stands	Fall-early winter
Chenopod[b]	Creek banks, disturbed grounds, old fields, moist woods and thickets, dry lake margins, sandy floodplains, woodlands	Annual weedy stands	July-Nov
Smartweed[c]	Damp soils, alluvial fields, river banks, thickets, disturbed ground	Annual/perennial weedy stands	June-fall
Wild bean[d]	Dry woods, sandy thickets, open woods, clearings, river banks, disturbed grounds	Annual/perennial vine	Aug-Oct
Wild legume[e]	Open woods, clearings, woodland borders, thickets, old fields, disturbed grounds	Annual/perennial forb/shrub	July-Nov

[a] Kindscher 1987:19; Peterson 1977:154; Radford et al. 1964:423-427; Walsh 1993.

[b] Bare 1979:88-91; Harper 1944:96; Kindscher 1987:80-2; Peterson 1977:152; Radford et al. 1964:418-20.

[c] Kindscher 1987:248; Peterson 1977:116; Radford et al. 1964:409-410; Snyder 1992; USDA NRCS 2004.

[d] *Phaseolus polystachios:* Peterson 1977:124; Radford et al. 1964:639; *Strophostyles* sp.: Radford et al. 1964:640; USDA NRCS 2004.

[e] *Crotolaria* sp.: Radford et al. 1964:584-586; *Lespedea* sp.: Radford et al. 1964:614-618.

early in the growing season, although for this taxon I was only able to locate information about flowering dates, rather than seed maturation dates. The remaining taxa set seed in late summer and fall. The pods of wild legumes tend to split open and disperse the seeds, suggesting that these taxa would have been collected relatively early in the season. The other seeds, however, may be most efficiently gathered after the first or second killing frost of the season, once the seed heads have dried. The seed heads of some taxa, particularly amaranths, shatter and drop seeds to the ground several weeks after the first frost, limiting the time during which the seeds may be harvested (Munson 1984; Peterson and Munson 1984).

While information about wildlife use was sparse, the available data suggest that gatherers would compete with animals, particularly birds and rodents, for edible seeds (Table 7.9). Small mammals, including raccoons and squirrels, also appear to use the seeds. The literature commonly mentions that white-tailed deer, as well as rabbits and turkeys, browse on the leaves of the various taxa (Munger 2004; Snyder 1992; Sullivan 1993a; Tesky 1992; Walsh 1993). As some seeds persist into early winter, this competition appears not to affect availability to gatherers to the degree that it

Table 7.9. Animals Competing for Edible Seeds.

	Mammals	Birds
Amaranth[a]		Quail
Smartweed[b]	Mice, muskrat, raccoon, fox squirrel	Ducks, geese, bobwhite, ring-necked pheasants, rails, songbirds
Wild bean[c]		Bobwhite, quails, turkey
Wild legume[d]	Rodents	Bobwhite, upland game birds, mallards, mourning doves

[a] Walsh 1993.
[b] Snyder 1992; USDA NRCS 2004.
[c] USDA NRCS 2004.
[d] Only information for exotic *Lespedea* spp. were available, but indicate possible wildlife usage. Munger 2004; Sullivan 1993a; Tesky 1992.

affects nut or fruit availability. Gatherers may monitor stands of these taxa, however, to gauge both seed maturity and the impact of animals.

Nutrition

Although nutritional data are not available for all taxa discussed here, those that are available allows for useful comparisons to other plant foods (Table 7.10). The seeds are relatively high in caloric content and compare favorably to chestnut. They are more similar to the nut taxa than the fruits in protein; amaranth and chenopod seeds have particularly high protein contents. While significantly lower in fat than nuts other than chestnuts, the seeds do provide more fat than fruits. The edible seeds are also high in minerals, particularly iron; they provide the greatest amount of iron per 100 mg of all plant foods considered here.

Collection and Processing

Several methods have been used to collect seeds from herbaceous plants. The first, practiced by the Chippewa Indians collecting wild rice, is by beating ripened seeds from the plants and collecting them in a basket or "drop cloth" of sorts, made of hide or perhaps woven fibers. By selectively beating only those seed heads that had matured, immature seeds could be left to ripen and collected later (Murray and Sheehan 1984:285; Peterson and Munson 1984:322). Similarly, the

Table 7.10. Nutrients Found in Seed Taxa (USDA NDL 2004).

	Chenopodium album	*Amaranth* spp.
Calories (kcal)	414	374
Water (g)	10	9.84
Protein (g)	16.6	14.45
Fat (g)	4.2	6.51
Carbohydrate (g)	49.6	66.17
Ash (g)	8.6	3.04
Fiber (g)	12.5	15.2
Calcium (mg)	1017	153
Iron (mg)	62.9	7.59
Magnesium (mg)	675	266
Phosphorus (mg)		455
Potassium (mg_	1656	366
Sodium (mg)	8	21
Zinc (mg)		3.18
Copper (mg)	2.1	0.777
Manganese (mg)	5.2	2.26
Vitamin C (mg)		4.2
Thiamin (mg)		0.08
Riboflavin (mg)		0.208
Niacin (mg)		1.286
Pantothenic Acid (mg)		1.047
Vitamin B-6 (mg)		0.223
Folate (mcg)		49

Neeshenams of California collected seeds of California buttercup (*Ranunculus californicus)* by sweeping long-handled baskets or gourds through the ripened seed heads (Powers 1873-74:377). This method is most effective for plants whose seeds easily shatter from the seed head. A second method is to strip the seeds from the seed head by pulling the stalk through one's thumb and forefinger, collecting the seeds in a container (Murray and Sheehan 1984:285; Niethammer 1974:118-119; Peterson and Munson 1984:322; Seeman and Wilson 1984:305). The third method is to cut the mature seed heads from the plant using a sharp edge, and then either strip the seeds from the seed head or beat them into a container (Murray and Sheehan 1984:288; Peterson and Munson 1984:322-

323; Seeman and Wilson 1984:305). The Yuman tribes apparently tied amaranth seed heads together before they matured to protect them from shattering before they could be collected. Once killed by frost, they broke the seed heads off the plants and carried them home to be further processed (Niethammer 1974:118-119). Gatherers probably collected wild beans and legumes by pulling up the entire plant, transporting it to camp to be threshed and winnowed.

Of these methods, cutting appears to be most efficient, although it requires additional processing (Table 7.11; Murray and Sheehan 1984:292-293; Peterson and Munson 1984:324; Seeman and Wilson 1984:308, Table 4). This processing includes threshing the seeds from the seed heads, and winnowing or sieving the materials to separate chaff from the seed. Threshing may be performed by beating the seed heads with sticks (Niethammer 1974:118-119; Peterson and Munson 1984:323), trampling the seed heads underfoot, or rubbing the seed heads by hand (Peterson and Munson 1984:323). Similar to nuts, it is unlikely that these steps were performed in the field rather than at base camp unless gatherers traveled significant distances to exploit these plants. The dried stalks and bracts are relatively light, comprising some 40-50% of the total weight (Murray and Sheehan 1984:293; Peterson and Munson 1984:323), and are easily transported. In addition, the time required to thresh and winnow is relatively long, ranging between two and nearly six hours per kilogram of seed produced (Murray and Sheehan 1984:293; Peterson and Munson 1984:323-324). The cutting method and delayed threshing rather than field processing are evidenced at archaeological sites dating to approximately 3000 radiocarbon years ago. Indeed, "sheaves of seed heads" were recovered from the Ozark Bluff-Dweller sites (Fritz 1997; Gilmore 1931:97 in Peterson and Munson 1984:323) and bundles of maygrass from Newt Kash Shelter in Kentucky (Gremillion 1997).

Once threshed from the seed heads, the perianth, or papery covering, must be removed from those seeds to which it clings tightly, including chenopod and smartweed seeds. The seeds are first dried or parched, and then abraded to remove the perianth (Murray and Sheehan 1984:Table 6; Seeman and Wilson 1984:306). The seeds are then winnowed again to separate the cleaned seed from the resulting chaff (Seeman and Wilson 1984:306).

Table 7.11. Processing Costs of Seed Taxa.

	Gather	Thresh (min)	Winnow (min)	Grams/Hr	Kcal/100 g	Kcal/Hr
Amaranth[a]						
Strip	241g/20 min			361.5	374	1352
Cut	372g/10 min	20	20	446.4	374	1670
Chenopod[b]						
Strip				233	414	965
Cut				304	414	1259

[a] Peterson and Munson 1984:322-324.

[b] Highest values from Seeman and Wilson 1984: Table 4.

Preparation and Consumption

Once collected, processed and cleaned, seeds could be eaten raw, boiled into a porridge, or ground into a flour to make mush or bread. They could also be dried and stored for future use (Kuhnlein and Turner 1991; Moerman 2004). Dishes made using the various edible seeds are discussed in further detail below.

Amaranth. Used widely by native groups living in western North America and Central America (Kuhnlein and Turner 1991:110; Moerman 2004), amaranth seeds were eaten raw, cooked and eaten whole, or ground into a meal (Moerman 2004; Walsh 1993). Niethammer (1974:118-119) notes that Yuman tribes parched amaranth seeds with coals to pop the seed coats, and then ground the toasted seeds into a flour that was used to make bread or mush. Moerman (2004) also lists porridge, soup, and dumplings among the other foods made from amaranth flour. The Navajo, and likely other groups as well, stored amaranth seeds for use in winter (Moerman 2004).

Chenopod. Similar to amaranth, chenopod seeds were eaten raw, as a garnish of sorts, but seems primarily to have been parched and ground into flour. This resulting flour was used to made porridge, dumplings or bread (Bare 1979:88-91; Kavasch 1977:21; Kindscher 1987:80-2; Kuhnlein and Turner 1991:152; Moerman 2004; Niethammer 1974:112; Palmer 1871:419; Peterson 1977:152; Yanovsky 1936:22). Northern Californian groups formed cakes from parched and ground chenopod seeds that were eaten without cooking (Moerman 2004). The seeds could also be stored for winter use (Moerman 2004). A nearly 3,000-year-old cache of three bags of chenopod seeds, and two additional bags that also held sunflower, sumpweed, and cucurbit seeds, was found at Marble Bluff Shelter in Arkansas, providing evidence of seed storage well into prehistory (Fritz 1997).

Smartweed. While little mention is made of smartweed seeds, native groups in the western United States used various knotweed seeds, which belong to the same genus. These seeds were also parched, ground into a meal, and apparently eaten dry or made into a porridge (Moerman 2004; Yanovsky 1936:20). Smartweed seeds may have similarly been used.

Wild Bean. Yanovsky (1936:38) notes that native groups in Louisiana boiled and mashed wild bean roots, but no mention is made of seed use. Presumably seeds of wild bean could also be eaten raw, dried, ground into a meal, and stored, as cultivated beans were used by Native Americans throughout the New World (Kuhnlein and Turner 1991:195-196; Moerman 2004).

Summary

Although use of seeds entails significant processing costs, they provide relatively high amounts of calories, protein, and fat. They can also be eaten raw or readily stored, either whole or ground. The seasonal availability of the seed taxa is somewhat varied: wild legumes ripen in late summer and early autumn, while the remaining taxa are best collected after the first killing frosts of the cold season. The latter group may overlap considerably with peak collection times for nut taxa. Gatherers may prioritize nut collection instead, and harvest only the wild seed taxa that persist into early winter, such as chenopod and smartweed (Peterson and Munson 1984:327). A possible scheduling conflict may have been alleviated to some extent by cutting the seed heads and storing them until time became available to thresh and further process them. Use of edible seed taxa likely required little monitoring other than to evaluate ripening and competition from birds and small mammals. Perhaps more important to the exploitation of edible seeds are the location, size, and recurrence of disturbance regimes favored by these weedy taxa. Gatherers may have encouraged the growth of these plants, purposefully or not, by creating and maintaining forest edges and openings through use of fire, treading paths, clearing vegetation for camp sites, and perhaps even scattering useful seeds near these camps.

GREENS

Leafy greens themselves do not appear in the archaeological record. Comprised primarily of water and fiber, leaves quickly decay if discarded or are rapidly consumed by fire and turned to ash. However, the leaves of a number of the species recovered from the four rockshelter sites can be eaten as greens and certainly may have been used by the sites' occupants, whether at these sites or others along their seasonal rounds. It is important to note that gatherers likely used various parts of certain plants, during different seasons of the year, and for various purposes.

Habitat and Seasonality

The taxa providing edible greens are primarily weedy species, thriving in disturbed and/or open habitats (Table 7.12). These include old fields, clearings, forest edges, open woodlands, stream banks and alluvial forests. As noted above, smartweeds prefer damp settings and are therefore more limited in their distribution than the other taxa. Sumac may form thickets, but the remaining herbaceous taxa generally grow in mixed weedy communities.

In marked contrast to the other plant foods discussed, leafy greens are primarily available in the early spring, as plants send forth tender, palatable shoots. As the season progresses into summer, these leaves become more fibrous and woody and generally inedible. In the case of pokeweed and

Table 7.12. Habitat, Growth Habit, and Seasonality of Taxa with Edible Greens.

	Habitat	Growth Habit	Seasonality
Amaranth[a]	Old fields, disturbed grounds, stream valleys	Annual weedy stands	Spring shoots
Bedstraw[b]	Rich and open and low woods, thickets, prairie ravines, meadows, clearings, disturbed ground, moist and rocky soils, marshes, ditches, stream banks	Perennial weedy stands	Spring shoots
Chenopod[c]	Creek banks, disturbed grounds, pastures, moist woods and thickets, dry lake margins, sandy floodplains, woodlands	Annual weedy stands	Spring shoots, summer tips
Maypop[d]	Sandy soil, fields, disturbed ground, thickets, rocky ground	Vine	Spring shoots
Nightshade[e]	Open and disturbed habitats, pastures, riverbanks, floodplains, prairie hillsides and ravines, open woods, woodland borders	Weedy stands	Unspecified
Pokeweed[f]	Rich moist soils, creek banks, pond margins, disturbed grounds, pastures	Annual, often isolated	Spring shoots
Purslane[g]	Rich sandy soils, disturbed grounds	Annual weedy stands	Spring and summer leaves
Smartweed[h]	Damp soils, alluvial fields, river banks, thickets, disturbed ground	Annual/perennial weedy stands	Spring shoots
Sumac[i]	Disturbed ground, thickets, meadows, upland prairies, borders, sandy or rocky or open woods, along ledges and streams	Shrub, thickets	Spring shoots

[a] Kindscher 1987:19; Peterson 1977:154; Radford et al. 1964:423-427; Walsh 1993.
[b] Foote and Jones 1989:362-4; Harper 1944:210; Peterson 1977:50; Radford et al. 1964: 984-88.
[c] Bare 1979:88-91; Harper 1944:96; Kindscher 1987:80-2; Peterson 1977:152; Radford et al. 1964:418-20.
[d] Peterson 1977:94; Radford et al. 1964:734; USDA NRCS 2004.
[e] Bare 1979:332-4; Harper 1944:187-8; Peterson 1977:50; Radford et al. 1964:930-3.
[f] Foote and Jones 1989:100; Harper 1944:99; Peterson 1977:46; Radford et al. 1964:429.
[g] Kindscher 1987:233; Radford et al. 1964:434.
[h] Kindscher 1987:248; Peterson 1977:116; Radford et al. 1964:409-410; Snyder 1992; USDA NRCS 2004.
[i] Foote and Jones 1989:56; Harper 1942: 75, 1944:147-8; Kindscher 1987:191-93; Kurz 1997:200-204; Peterson 1997:186; Radford et al. 1964:677-8; Schopmeyer 1974:715-9.

perhaps nightshade, leaves and stems also become poisonous. Chenopod and purslane are notable exceptions; their leaves, especially the tips, can be used into summer. Spring leaves are also prized browse and forage, especially for white-tailed deer (Snyder 1992; Sullivan 1993b; Walsh 1993). Waterfowl may also eat smartweed leaves (Snyder 1992). Given the wide availability of new leaves and shoots from the extensive leafy vegetation in the Southeast, gatherers' most significant competition may be time rather than animals. Use of taxa with edible greens demands little monitoring, other than an awareness of the start of the growing season, but does require knowledge of the habitats in which these taxa flourish.

Nutrition

Edible greens are more similar to fruits in their nutritional content than they are to nuts and edible seeds (Table 7.13). Their caloric content is lower than fruits, as are their carbohydrates, likely due in large part to the greater amount of sugar in fruits. The greens are generally higher in protein, however. They are also either comparable to, or higher than, fruits in minerals and vitamins. The greens are particularly high in calcium, vitamin C, and vitamin A. Thus although greens may not provide significant amounts of caloric energy, they probably supplemented dietary staples with important vitamins and minerals, particularly at the end of a lean winter diet.

Collection and Processing

Greens demand little in the way of specialized tools or techniques for collection. Young shoots, leaves, and stems can be largely torn by hand, although a sharp edge for cutting is useful. Once collected, greens may be transported in baskets, bags, or mats. Gatherers may have targeted specific patches where a variety of greens were available rather than particular species. Powers (1873-74:373) described a generalized foray of a Neeshenam woman of California: "She will go out in the spring with nothing but a fire-hardened stick, and in an hour she will pick a breakfast of green stuff, into which there may enter fifteen or twenty ingredients." Later in the season, gatherers may have focused their efforts on the particular species that remain palatable. Alternatively, they may have gathered few greens, opting for resources with higher return rates, such as ripe fruits.

Similar to fruits, greens require no additional processing prior to consumption. Easily collected and simply eaten, greens are also highly suited to children's foraging efforts. It is possible, then, that along with fruits, children collected significant quantities of greens for their own use. One wonders, however, whether greens would attract children's interest as much as sweeter fruits.

Table 7.13. Nutrients Found in Leafy Greens (USDA NDL 2004).

	Chenopod Raw	Chenopod Cooked	Poke Raw	Poke Cooked	Purslane Raw	Purslane Cooked	Amaranth Raw	Amaranth Cooked
Calories (kcal)	43	32	23	20	16	18	23	21
Water (g)	84.3	88.9	91.6	92.9	93.92	93.52	91.69	91.49
Protein (g)	4.2	3.2	2.6	2.3	1.3	1.49	2.46	2.11
Fat (g)	0.8	0.7	0.4	0.4	0.1	0.19	0.33	0.18
Carbohydrate (g)	7.3	5	3.7	3.1	3.43	3.55	4.02	4.11
Ash (g)	3.4	2.2	1.7	1.3	1.25	1.25	1.5	2.11
Fiber (g)	4	2.1	1.7	1.5				
Sugar (g)				1.6				
Calcium (mg)	309	258	53	53	65	78	215	209
Iron (mg)	1.2	0.7	1.7	1.2	1.99	0.77	2.32	2.26
Magnesium (mg)	34	23	18	14	68	67	55	55
Phosphorus (mg)	72	45	44	33	44	37	50	72
Potassium (mg)	452	288	242	184	494	488	611	641
Sodium (mg)	43	29	23	18	45	44	20	21
Zinc (mg)	0.44	0.3	0.24	0.19	0.17	0.17	0.9	0.88
Copper (mg)	0.293	0.197	0.157	0.126	0.113	0.114	0.162	0.158
Manganese (mg)	0.782	0.525	0.418	0.336	0.303	0.307	0.885	0.861
Selenium (mg)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Vitamin C (mg)	80	37	136	82	21	10.5	43.3	41.1
Thiamin (mg)	0.16	0.1	0.8	0.07	0.047	0.031	0.027	0.02
Riboflavin (mg)	0.44	0.26	0.33	0.25	0.112	0.09	0.158	0.134
Niacin (mg)	1.2	0.9	1.2	1.1	0.48	0.46	0.658	0.559
Pantothenic Acid (mg)	0.092	0.062	0.049	0.039	0.036	0.036	0.064	0.062
Vitamin B-6 (mg)	0.274	0.174	0.146	0.111	0.073	0.07	0.192	0.177
Folate (mcg)	30	14	16	9	12	9	85	57
Vitamin A (IU)	11600	9700	8700	8700	1320	1852		2770
Vitamin A (mgRAE)	580	485	435	435	66	93		139
Vitamin E (mgATE)		1.34		0.85				
Vitamin K (mcg)				108				

Preparation and Consumption

Leafy greens can be eaten raw, as a salad, or alternatively boiled as potherbs. They may additionally be seasoned with grease, spices, or other flavorings. Once cooked, greens could also be dried and stored for future use.

Amaranth. The young leaves of amaranth, before they become too fibrous, can be used as salad greens or potherb (Walsh 1993; Yanovksy 1936:23). Among western native groups, the leaves were eaten raw, boiled with or without meat and eaten, and also boiled and dried for winter use (Moerman 2004).

Bedstraw. While the young shoots may be used for greens (Kuhlein and Turner 1991:292; Peterson 1977:50), the most popular uses for the various species of bedstraw appear to be medicinal or personal. The stems and leaves have been used in topical remedies for rheumatism (Powers 1873-74:376), rashes, or other skin problems (Gilmore 1932:141), or in herbal concoctions to combat vitamin C deficiency, kidney disorders and dropsy (Bare 1979:362-4). Leaves of fragrant bedstraw (*Galium triflorum*) were also applied to the hair and tucked into girdles for their pleasant fragrance, and also was used as a love medicine by various native groups (Moerman 2004).

Chenopod. While Harper (1944:96) does not give resounding praise to lamb's quarter – "chickens are very fond of it, and it has been recommended for human food when cooked" – the young shoots are widely used for salads and as potherbs (Bare 1979:88-91; Hunt 1992:158; Kindscher 1987:80-2; Kuhnlein and Turner 1991:152; Niethammer 1974:112; Palmer 1871:419; Peterson 1977:152; Yanovsky 1936:22). The leaves apparently may be gathered through autumn for use as potherbs (Kavasch 1977:21). Due to their high moisture content, the leaves can also be used to wrap foods baked in earth ovens (Niethammer 1974:112).

Maypop. The eastern Cherokees, along with other native groups of the eastern United States, boiled young shoots and leaves of maypop vines. They often cooked them with grease and other greens (Moerman 2004; USDA NCRS 2004).

Nightshade. In addition to a wide range of medicinal purposes, native groups used leaves of the various *Solanum* species as greens, boiling them as potherbs (Moerman 2004; Yanovsky 1936:56). Gatherers may have sought young leaves in particular (Moerman 2004).

Pokeweed. While the plant becomes increasingly toxic throughout the growing season, young poke shoots can be eaten as greens (Bare 1979:100; Harper 1944:99; Kavasch 1977:61; Kuhnlein and Turner 1991:219; Peterson 1977:46; Radford et al. 1964:429; Yanovsky 1936:23). The roots and berries are poisonous, but Kavasch (1977:61) mentions that the berries were boiled into a tea to treat rheumatism by groups living in Virginia, and that concoctions prepared with poke root were applied externally to treat skin problems and parasites.

Purslane. Native groups throughout North American ate the leaves of purslane raw or boiled them as potherbs (Hunt 1992:159; Kavasch 1977:22; Kuhnlein and Turner 1991:228; Niethammer 1974; Palmer 1871:422; Yanovsky 1936:24). Southwestern groups are also noted to have boiled them with meat. The Isleta Indians dried the leaves, apparently without boiling them first, for winter use (Moerman 2004).

Smartweed. Native groups ate the young shoots of smartweed, cooking them as potherbs and also apparently enjoying them as a relish (Kindscher 1987:248; Kuhnlein and Turner 1991:313; Moerman 2004).

Sumac. In addition to its berries, native groups used the young sprouts of sumac, which can be peeled and eaten raw as salad greens (Johnson 2000; Kindscher 1987:192; Kuhnlein and Turner 1991:111). Fresh sumac roots were also peeled and eaten raw (Kindscher 1987:191-3; Yanovsky 1936:40-1).

Summary

As the first plant food items available in spring, greens were likely an essential seasonal item of the diets of early hunter-gatherers. Providing little energy but rich in minerals and vitamins, greens likely were not dietary staples, but instead important supplements, particularly after a winter diet presumably high in lean meat and stored nuts and seeds. Greens are easily collected, require no processing, and may be eaten raw or cooked, making them suitable for children's foraging efforts, along with fruits. With relatively little competition from wildlife, few scheduling conflicts with other plant resources, and little need for monitoring, gatherers may have been most concerned with visiting, and perhaps creating and maintaining, locales that favor the growth of the weedy species used as greens.

MISCELLANEOUS PLANTS

Several plant taxa recovered from the four rockshelter sites are not likely to have been used as food, but may provide information regarding seasonality of site use and habitats visited by site's occupants. These taxa include cane and yellow stargrass, as well as possible specimens of morning-glory, pine nut, squash rind, and seeds of the Composite and Mustard families. As the latter two could not be identified to the genus level, I do not discuss them further. Below I present information about the availability and possible use of the remaining taxa.

Habitat and Seasonality

In part because they vary considerably in their growth habit, the miscellaneous taxa favor a variety of habitats (Table 7.14). Cane thrives in damp environments, including low woods, riverbanks, and bogs, although it also grows in dry woods and savannahs. Its absence from rich, mesic forests may reflect its dependence on fire to remove understory taxa with which it competes (Walkup 1991). Morning-glory, squash, and yellow stargrass are generally weedy species, prefering

Table 7.14. Habitat, Growth Habit, and Seasonality of Miscellaneous Taxa.

	Habitat	Growth Habit	Seasonality
Cane[a]	Low woodlands, river and stream banks, sloughs, moist soils, savannahs, dry woods, bogs	Perennial mixed or pure stands	Foliage April-winter
Morning-glory[b]	Old fields, thickets, woodland borders, disturbed grounds	Perennial vine	July-Sept.
Pine[c]	Floodplains, low woods, old fields, uplands, rocky soils	Mixed stands	Sept-Jan
Squash[d]	Disturbed grounds	Annual/perennial vine	Fruit Aug-Oct
Yellow stargrass[e]	Savannahs, clearings, woodlands, alluvial woods, swamp forests, disturbed grounds	Perennial	May-Nov

[a] Radford et al. 1964:60; Walkup 1991.

[b] Radford et al. 1964:866-868; Zouhar 2004.

[c] Burns and Honkala 1990; Carey 1992a, 1992b; Harper 1942:68; Radford et al. 1964: 36-38; Schopmeyer 1974:608-609; Sullivan 1993c.

[d] Radford et al. 1964:998-999.

[e] Bare 1979:62; Radford et al. 1964:322.

disturbed grounds. Morning-glory can also be found along forest margins and thickets, and yellow stargrass in clearings and savannahs as well as alluvial or swampy forests.

Three species of pine (shortleaf – *Pinus echinata*; loblolly – *P. taeda*; and Virginia – *P. virginiana*) are common to the research area. These are found in floodplains, old fields, rocky soils, and upland settings. Loblollies appear to grow in the widest variety of habitats, shortleaf pines in dry non-calcareous soils, and Virginia pine in rocky soils protected from fire (Harper 1942:68).

The miscellaneous taxa differ somewhat in their seasonal availability, with yellow stargrass apparently setting seed as early as May and the pine species dispersing nuts from autumn through January. Although their foliage is only present from mid-spring through winter, cane stalks are available throughout the year. The miscellaneous species do overlap in early autumn, however.

Usage

Although not necessarily used for food by people, the miscellaneous taxa may be eaten by wildlife or used by people for other purposes. The exception may be yellow stargrass. While this wildflower may serve as browse and its seeds may be eaten by birds, humans do not appear to have used it. I discuss possible uses of the remaining taxa below.

Cane. While cane shoots may be eaten by grazing mammals and bears (Kurz 1997:56; Walkup 1991), native groups appear to have used cane for medicinal and other non-food purposes (Moerman 2004). The stems were used to make blowguns, arrow shafts, and the edges sharpened into piercing or cutting instruments. Fibers for weaving baskets and mats were prepared from cane; the stems were also woven between posts to form a support for wattle-and-daub houses. Cane stalks were also used as fuel, notably for torches (Moerman 2004). Burnt torches lie discarded in caves visited by prehistoric Native American groups, and stoke marks line the caves' ceilings (Kennedy and Watson 1997). Suitable for a number of purposes, cane is a highly useful resource.

Morning-glory. White-tailed deer eat the leaves of morning-glories (Zouhar 2004), but a number of species within this genera also produce large, edible roots. Native groups of the Great Plains ate the roots of *Ipomoea leptophylla* (Kindscher 1987:135-136; Moerman 2004), and the eastern Cherokees ate the roots of *I. pandurata* (Moerman 2004). These roots are available throughout the year, but are highest in starch content during August and September, and in sugar content during October. This content declines through May, just before the plants send out blooms (Zouhar 2004). Morning-glory roots may thus be most nutritious during the autumn and winter months.

Pine. Although pine nuts are important food items in the southwestern United States, the southern pines do not produce nuts eaten by people. However, a wide variety of small mammals and birds feast on the nuts of shortleaf, loblolly, and Virginia pines (Carey 1992a, 1992b; Sullivan 1993c).

Squash. The fleshy rind and seeds of squash were certainly important food items for historic and later prehistoric Native Americans (Moerman 2004). However, the domesticated squash with which we are familiar is distinctly different from wild cucurbits. These smaller gourds not only have smaller seeds but also significantly thinner rinds. Native southeastern peoples began to cultivate squashes approximately 4500 radiocarbon years ago (Yarnell 1993:23), variously selecting for thicker rinds and larger seeds (Cowan 1997). Researchers have postulated that wild cucurbits may have been used as containers and rattles (Prentice 1986), or perhaps as floats for fishing nets (Fritz 2000:227). Cowan (1997:70-72) argues that Late Archaic peoples used wild cucurbits for their seeds, as their rinds were too thin to serve as containers. Although only a fragment of what may be squash rind was recovered from the early levels of Rollins Bluff Shelter, it is possible that Late Paleoindian and Early Archaic peoples also used wild cucurbit seeds for food.

Summary

Taxa within the miscellaneous category provide valuable clues, including information about habitat use, seasonality, and additional uses of plant resources. Items that are not likely to be purposefully gathered or stored, such as morning-glory and yellow stargrass seeds, are particularly useful for suggesting nearby habitats and seasonal site use.

Perhaps more importantly, the miscellaneous taxa hint at additional uses of plant resources, both for food and material culture. As suggested by morning-glory, early hunter-gatherers may have used roots for food as well. Indeed, ethnographic accounts indicate that native groups ate the roots of wild legumes (Moerman 2004; Yanovsky 1936:38), as well as nightshade tubers (Yanovsky 1936:56). Roots and tubers were used extensively, probably more often that just during winter months or other periods of food shortage (Kuhnlein and Turner 1991; Moerman 2004; Yanovsky 1936). These food items are not easily recovered archaeologically, as they form amorphous, starchy masses that are difficult to identify when carbonized. Which brings to mind other plant food items that do not preserve well, including flowers, leaves, bark, sap, and cambium from trees, that likely were consumed, or used for a myriad of medicinal purposes, but for which little archaeological evidence of their use exists.

The presence of cane highlights use of plant resources beyond subsistence, as part of material culture. Cane may be used as fuel or for torches, but also as construction material, for baskets, mats, shelters, and tools. Wild cucurbits may also have served as part of the toolkit, possibly as fishing floats. These taxa serve as reminders that the vast majority of the material culture of hunter-gatherers is made from plant and animal materials rather than stone. While these organic items, as well as certain plant foods, are seldom recovered, they must be kept in mind when discussing the role of plant resources within hunter-gatherer lifeways.

GATHERING IMPLICATIONS

The plant taxa recovered from the four rockshelter sites provide information not only about the diets of the sites' occupants, but also about the range of habitats these groups exploited and the seasons during which they visited the sites. Ethnographic descriptions of plant use by Native Americans suggest the strategies and technologies required to gather, process, and consume these taxa. Nutritional data indicate the roles the various taxa played within early foragers' diets.

The sites' occupants apparently exploited a variety of habitats, from swampy floodplains to dry upland forests, and the ecotones that connect them. Numerous weedy taxa, including fruits, edible seeds, and taxa that may have been used for greens, suggest the importance of disturbed settings for providing diverse foodstuffs. Established forests were also key zones for gatherers, as indicated by the nut taxa. Forest margins supplied a variety of resources, including hazelnuts, sumac, honey locust, nightshade, and morning-glory. Few of the taxa are strictly limited in their distribution, but hackberry and smartweed are particularly indicative of moist habitats.

Although nearly all of the plant foods discussed could be stored, thus making determinations of seasonality of site use using only plant remains rather problematic, the availability of the food items does provide information about seasons of gathering activities to take advantage of seasonal availability (Table 7.15; please note that many of the taxa are only available for short periods within these general windows). Early spring activities likely centered on leafy greens and shoots, which would have been particularly tender and palatable. Flowers and buds were probably eaten as well. Mulberries ripen toward the end of spring and beginning of summer. Additional fruits become available during summer, including maypops, sumac, nightshade berries, honey locust, and grapes. By late summer, greens were probably no longer gathered, although the mature seeds of wild legumes and perhaps smartweed could now be collected. Black gum fruits, hackberries, persimmons, and hazelnuts are also ripe by the end of summer. Autumn activities likely included harvesting nuts before the yields were significantly impacted by competition from wildlife, insects, and mold. Edible seeds are also available for gathering during this season. Gatherers may have delayed collecting these seeds until later in autumn, after the height of nut availability and after several killing frosts had dried the seed heads. Alternatively, they may have cut seed heads and transported these bundles back to camp to dry and thresh at a more convenient time. By winter, early peoples may have been living primarily off of stored and/or hunted foods, but could supplement this diet with fruits and seeds, such as hackberries, persimmons, and chenopod, that persist on trees and stalks well into winter months.

When viewed in concert, the seasonality and habitat data suggest movements of gatherers across the landscape, as well as possible scheduling conflicts. Gatherers presumably spent considerable time during the spring and summer in disturbed settings, where weedy taxa that provide greens and fruits are found. These primarily include floodplains, clearings, and forest margins. The latter likely became more important toward the second half of summer, as sumac, grapes, and hazelnuts ripened. During autumn, gatherers likely turned their efforts towards rich woods to collect hickory nuts, acorns, and black walnuts. Nearby communities of weedy taxa that supply edible seeds may also have been visited, but if significantly distant, gatherers may have returned to these open areas after the peak of nut harvesting to collect seed heads.

Table 7.15. Seasonal Availability of Plant Taxa.

Category: Taxon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nuts:												
Acorn									x	x	x	
Beechnut									x	x	x	
Black walnut										x	x	
Chestnut								x	x	x		
Hazelnut							x	x	x			
Hickory									x	x	x	
Fruits:												
Black gum								x	x	x		
Grape							x	x	x	x		
Hackberry*	(x)	(x)						x	x	x	x	(x)
Honey locust*	(x)	(x)					x	x	x	x	x	(x)
Maypop							x	x	x	x		
Mulberry					x	x	x	x				
Nightshade						x	x	x	x	x		
Persimmon								x	x	x	x	
Sumac						x	x	x	x	x		
Edible Seeds:												
Amaranth									x	x	x	x
Chenopod							x	x	x	x	x	
Smartweed						x	x	x	x	x	x	
Wild bean								x	x	x		
Wild legume							x	x	x	x	x	
Leafy Greens:												
Amaranth			x	x	x							
Bedstraw			x	x	x							
Chenopod			x	x	x	x	x					
Maypop			x	x	x							
Pokeweed			x	x	x							
Purslane			x	x	x	x	x					
Smartweed			x	x	x							
Sumac			x	x	x							

* Parentheses denote persisting fruits.

Gatherers' activities likely extended beyond harvesting. They probably monitored the seasonal development of various stands of weeds, fruit trees and shrubs, and nut-bearing trees, in order to gauge not only which stands would be most productive during a given year, but also the timing of peak availability. Monitoring may have required visits to patches that otherwise were not currently being utilized, but these visits may well have been embedded in the course of other tasks, such as acquiring stone for tools, traveling to another patch, moving campsites, or collecting firewood. Gatherers may also have significantly shaped their environment to create favorable settings or encourage the growth of particular species. Such activities include setting controlled fires to clear underbrush and/or create and maintain clearings and forest edges, and girdling trees to produce conditions that favor open growth for nut-bearing taxa. These open and edge habitats would also attract wildlife, including white-tailed deer and game birds.

The plant taxa also suggest technologies required for their exploitation. Long poles may have been used to knock nuts and fruits from tree branches, and digging sticks to access roots and tubers. Harvesting implies the use of baskets or bags for carrying food items back to camp. Threshing may have been performed with a stick, while stones are required to crack open nutshells. Parching and toasting entail the use of hot coals, perhaps within a shallow depression or on top of a prepared surface. Shallow baskets may have been used for winnowing chaff from seeds, and mortars and pestles for grinding seeds and nuts into flour. Leaching tannins from acorns requires several changes of water, and efficient use of hickory nuts demands separation of shells and meats using boiling water. Boiling technology may also have been important for preparing greens and seeds.

Although the processing costs of nuts and seeds are significantly higher than fruits and greens, nuts and seeds are also higher in calories, protein and fats. As such, they are more likely to have served as dietary staples than fruits and greens. The latter two certainly provided important vitamins and minerals, and flavors as well, to hunter-gatherer diets. The low processing costs of fruits and greens also suggest that during their seasons of availability children may have substantially contributed to their own caloric needs by foraging for these foodstuffs.

The plant remains recovered from the sites also suggest uses that are difficult to detect archaeologically. In addition to the use of greens, this includes consumption of roots, tubers, flowers, cambium, bark, and sap. Ethnographic accounts are also replete with medicinal uses of a staggering range of plants. Plant resources also figure prominently in the material culture of hunter-gatherer groups. While we frequently cannot see these in the archaeological record, or the dishes that early peoples prepared, ethnographic and historic accounts remind us of how much we are missing.

The combined information, derived from botanical, nutritional, and ethnographic sources, provide insight into uses of plant resources, as well as the activities and technologies surrounding their use. I apply this insight in my interpretation of the assemblages from the four rockshelter sites in the next chapter. Information regarding the distribution of plant resources in time and space, associated with monitoring and scheduling demands, also figure prominently in my discussion of regional mobility patterns in Chapter 9.

CHAPTER EIGHT:
SITE INTERPRETATIONS

Lists and quantitative comparisons of plant remains recovered from archaeological sites are descriptive, but do not adequately detail plant use in and of themselves. I compiled such lists and quantitative results in Chapter Six. In Chapter Seven, I assembled information about these plants, including botanical information regarding the habitat preferences and seasonal availability of plants and their fruits, seeds, and nuts, as well as ethnographic information about the collection, processing, preparation and consumption of these plant foods. Using this information, I interpret the plant assemblages from the four rockshelter sites in this chapter, describing the activities performed by gatherers at the sites, in addition to the habitats they exploited and the seasons in which they occupied the sites.

Because the groups who lived at the sites used animal and stone tool resources in addition to plants, I consider the results of faunal and stone tool analyses for each of the sites. I use information from the faunal analyses to gain further information about both the habitats exploited by the sites' occupants and the seasons in which they occupied the sites. Stone tool analyses indicate an additional range of activities performed by peoples while at the sites. The raw materials used to manufacture the stone tools further provide information about the distance over which groups routinely traveled to obtain such materials. The various strands of data weave together to suggest the subsistence strategies employed by Late Paleoindian and Early Archaic groups. Below, I examine the activities performed at each site, and then explore the similarities and differences among them to determine how these activities vary through space and time.

STANFIELD-WORLEY BLUFF SHELTER

The plant remains recovered from the Dalton and Early Side-Notched zone at Stanfield-Worley indicate that the site's occupants extensively used nuts and supplemented their diets with fruits, particularly persimmon. Edible and weedy seeds are notably absent from the samples, although this is may be due to sampling error rather than lack of use by site occupants, as none of the samples were processed using floatation. However, two grape seeds and one possible sumac seed were recovered from the "pinch" samples, indicating that recovery of smaller seeds from the samples is not entirely impossible. Cane was also identified in the samples, and likely served utilitarian purposes.

The taxa that are present indicate that the local environment may have been significantly wooded. Oaks, hickories, and particularly black walnut suggest the presence of rich, open forests. The faunal materials at the site, particularly gray squirrel and raccoon, also point to wooded surroundings (Parmalee 1962:112). Forest clearings must also have been located in the region, as suggested by the recovery of northern bobwhite (Parmalee 1962:Table 32). Edge situations are also indicated by the presence of hazel and the possible sumac and honey locust, as well as white-tailed deer, gray fox, and striped skunk (Parmalee 1962:Table 32). These forest margins would have been conducive to growth of weedy taxa, as would the banks of Henson's Creek, located within one kilometer of the site. Parmalee (1962:Table 32) identified snapping turtle within the faunal assemblage as well, suggesting that the occupants of Stanfield-Worley had access to a sizeable stream.

The site's wooded surroundings apparently provided ample opportunity for gathering fruits and nuts. The occupants of Stanfield-Worley likely targeted the autumn collection of nuts, particularly hickory, acorn, and black walnut, as well as ripened persimmons. Other than one sample tentatively assigned to the Dalton zone from which large quantities of acorn meats were recovered, acorn is rather poorly represented relative to hickory and black walnut, although this is most likely due to differences in preservation. The sizeable representation of black walnut bear further mention.

This species occurs in numbers comparable to hickory, unlike the assemblage at Rollins and the two cave sites along the Tennessee River. Because black walnuts grow singly rather than in stands, gatherers generally cannot collect walnuts from multiple trees in a single location. The significant quantities of black walnut recovered suggest that either black walnut trees were more common in the surrounding area, and/or that gatherers visited black walnut trees with particularly high yields. The latter would include trees with large crowns that grew in relatively open conditions. Both possibilities speak to the nature of the local environment.

In comparison, gatherers appear to have collected hazelnuts more opportunistically than the other nut taxa. Fruits may also have been gathered as encountered, but prior to the ripening of nuts, gatherers may well have set out on forays to specifically collect grapes, and possibly sumac and honey locust. These fruits, as well as persimmons later in the fall, may have been collected for immediate consumption as well as to dry for future use.

In addition to gathering nuts, the occupants of Stanfield-Worley appear to have invested some time and energy in processing them. This is suggested by the presence of bedrock mortars at the site, including conical "hominy holes" at the edge of the dripline as well as cup-shaped depressions, or nutting stones, pecked into the bedrock encountered at the base of the Dalton zone. At least one hammerstone and pecked sandstone slab were also recovered from this component (DeJarnette et al. 1962:83-85; Goldman-Finn 1997:8, 10). The recovery of over 200 acorn meats from one sample also speaks to nut processing. These meats may have been accidentally burned while being parched or toasted, perhaps to reduce the tannin content and/or prepare them for storage by preventing germination and contamination by insects, mold and mildew. The presence of what may be prepared surfaces near the bedrock nutting stones is also intriguing (Homsey 2004:269). These surfaces may have been ideal for spreading out nutmeats and coals for parching or toasting.

While nuts may certainly be stored, these processing activities indicate that foraging groups occupied the site during autumn, likely during the peak of nut availability. Persimmons, sumac, grapes, and honey locust may have been brought to the site from previous locations as they can be dried and stored as well, but they are also available in late summer and early autumn. This certainly does not preclude use of the site during other seasons. The occupants may have parched and stored nuts such as acorns within the rockshelter, planning to return in winter. No features suggesting underground storage were encountered, but this does not preclude use of above-ground storage in baskets or bags.

Hunting and hide preparation also appear to be important activities performed by the site's occupants. White-tailed deer appear to be a particular focus of hunting efforts, as it comprises the majority of identified bone from the Dalton zone. Squirrel is also well represented, as are turkey and turtles. Meat cutting and hide preparation is indicated in part by the range of tools, which include bifaces, uniface blades, and scrapers, as well as awls made both from stone and bone. Microwear analysis of polish found on several bifaces, scrapers, a chisel-like tool and flake tools also speaks to butchering and hide preparation (Goldman-Finn 1997).

The site occupants also worked wood, as evidenced by wood polish on what seems to have been a hafted "scraper" and a blocky chert flake, apparently used to plane and/or saw wood (Goldman-Finn 1997:26). Tool manufacture, however, is poorly represented at the site. The stone tool assemblage is characterized by resharpened and heavily reworked items and is notably lacking in early-stage bifaces (Goldman-Finn 1997:15; Randall 2002:100). In addition, the majority of tools are made from blue-gray Fort Payne chert, which outcrops along the Tennessee River some ten kilometers from the site, rather than locally available materials. This leads Goldman-Finn (1997:29) and Randall (2002:103-105) to suggest that the occupants of Stanfield-Worley prepared their toolkits prior to visiting the site, quite likely at locales within the river valley nearer chert outcrops.

Randall (2002:103-105) further proposes that the occupants at Stanfield-Worley did not manufacture tools at the site because it was not convenient for them to do so. Instead, the site's occupants invested their time in hunting, particularly of white-tailed deer, and collecting and processing nuts. Both of these activities have temporal and, to some extent, spatial limits. Ripened acorns, black walnuts, and hickory nuts are available in quantity for only several weeks during autumn. Deer and turkeys vied for these mast resources as well. Both are particularly attractive prey in the fall, in part because they carry extra fat for the upcoming winter. They are also bolder in their movements and therefore easier to hunt: deer are in the midst of mating season, and turkeys travel in larger flocks in autumn. Early groups may well have headed to the uplands near the site to take advantage of both nuts and the wildlife attracted to them.

The botanical evidence presented here supports such an interpretation. The collection and processing of hickory nuts, black walnuts, and acorns appears to have been an important activity at the site, supported not only by the plant remains but also by the presence of bedrock mortars, as well as a hammerstone and sandstone slab that may have been used to crack nuts. Prepared surfaces near the bedrock mortars may also have been manufactured for and used to prepare the nuts for consumption or storage. The occupants supplemented hunted food and nuts with fruits, including persimmons, grapes, and sumac. This interpretation contrasts markedly with DeJarnette and colleagues' (1962:85-88) original conclusions that the Dalton peoples relied all but exclusively on hunting for their subsistence during their stays at Stanfield-Worley.

ROLLINS BLUFF SHELTER

Similar to Stanfield-Worley, nut and fruit taxa characterize the botanical assemblage at Rollins Bluff Shelter. Hickory nuts and acorn appear to have been particularly important in the occupants' diets. Given the lower numbers of black walnuts recovered, occupants seem to have used them in much smaller quantities and/or less frequently. Fruits supplementing the diet include grape, persimmon, and sumac. Use of edible seeds is suggested by a single wild legume. A fragment of what may be squash rind was also recovered. Edible seeds are thus poorly represented, while weedy taxa are entirely absent. The paucity of these taxa could well be related to sampling issues; although the samples were processed using floatation, they appear to be rather small in size and were passed through ¼-inch mesh before being processed. Thus the small size of samples may have precluded significant recovery of such seeds, which are relatively infrequent to begin with, and/or the initial screening may have damaged small seeds, making them unidentifiable. However, eleven grape seeds and two sumac seeds were recovered, which suggests that if edible and weedy seeds were used or encountered regularly, they likely would have been recovered in the samples.

The rarity of edible and weedy seeds in the Rollins samples may be related to the local setting rather than sampling issues. Creeks and streams cut steep valleys into the sandstone hills of the uplands in the Fall Line hills, creating relatively narrow zones of disturbance appropriate for the growth of weedy taxa. Significant stands of weedy taxa may have been lacking. The nut taxa suggest the presence of forest communities near the site. Black walnuts were recovered in low numbers at Rollins, particularly in comparison to Stanfield-Worley. Perhaps the woods near Rollins were not as rich or as open as those near Stanfield-Worley, resulting in fewer black walnut trees or trees that produced fewer nuts. These conditions may have worsened in the Early Archaic, resulting in a decrease in the use of these nuts. Interestingly, the only taxon requiring open or edge conditions recovered from Early Archaic samples is wild legume. No sumac seeds were recovered from these samples, and the ubiquity of persimmon, which also has weedy tendencies, also dropped. Taken together, these may reflect a decrease in the openness of the surrounding forests or in the presence of clearings and forest margins in the Early Archaic period.

The assemblages from the Dalton and Early Archaic components suggest subtle changes in plant sue through time at the site. Plant deposition, related to intensity of site use, may have increased during the Early Archaic, as suggested by the increased ubiquity of acorn shell, despite the fact that use of acorn relative to other taxa does not change significantly. Use of black walnut, however, does decrease significantly, evidenced both by decreases relative to other nuts and all other plant materials. As noted above, this drop may be related to changes in local environment. However, the occupants of Rollins do not appear to have significantly utilized black walnut in either period. This taxon is characterized by low counts, two orders of magnitude lower than hickory nutshell. Assuming that the occupants disposed of both black walnut and hickory nutshell in similar manners, it appears that they gathered them in different quantities. The occupants may have collected black walnuts as the opportunity arose, but did not specifically target these nuts.

In contrast, gatherers appear to have pursued hickory nuts, and likely acorn as well, as both taxa had high ubiquities. Although hickory nutshell was recovered in much greater numbers than acorn, these differences are likely due to preservation. Interestingly, though, the two taxa display different trends through time. Use of acorn remains stable relative to other plants, while hickory use decreases. This suggests that the manner in which site occupants used, processed, and/or disposed of hickory nutshell seems to have changed.

Occupants processed nuts and likely other plant foods at the site, as evidenced by mortars, nutting stones, and mullers/hammerstones (Stowe 1970). One mortar and one nutting stone were recovered from the Dalton component, which increases in the Early Archaic component to two mortars and five mortar fragments, five nutting stones, three muller/hammerstones, one hammerstone and one anvil stone (Stowe 1970:Tables 14-16). The increase in ground stone tools associated with processing plant foods coincides with the increased ubiquity of acorn shell, suggesting an increase in plant use at the site, whether due to more frequent or more intensive site use.

Comparisons of fruit and edible seed taxa between the two components are not possible due to the low numbers recovered. However, both Dalton and Early Archaic occupants supplemented their diets with fruit, which may have been fresh or dried. Fruits may have been targeted for collection prior to nut harvests, gathered for immediate consumption and/or to dry for future use. During the peak of nut gathering, peoples probably gathered fruits opportunistically, with the majority of effort concentrated on collecting acorns and hickory nuts. Edible seeds do not appear to have figured largely in the diets of the site's occupants, particularly during the Dalton period.

Although the various plant taxa may be stored, their availability overlaps in autumn. The fruits and wild legume ripen in summer, and squash in late summer, but are also present through the fall, when nut harvests peak. As mentioned above, the recovery of ground stone tools in the Dalton and Early Archaic components suggests that nut processing was an important activity at the site, further indicating an autumn occupation. Use of the site during other seasons cannot be ruled out, however.

Additional stone artifacts recovered from the site suggest that the site's occupants also hunted and prepared hides. This is suggested by the presence of hafted bifaces, uniface blades, various forms of scrapers, and utilized flake tools. Unfortunately, preservation of bone at Rollins was poor, thus precluding faunal analyses. However, the small amount of bone present appears to be predominantly white-tailed deer (Stowe 1970:124).

In addition to hunting and hide preparation, the site's occupants also manufactured stone tools. This is evidenced by numerous waste flakes, particularly in the Early Archaic deposits. The increase in debitage, as well as in chipped stone tools, in the Early Archaic component may reflect increased intensity of site use. Ground stone tools also increase, as noted above. The stone tool assemblage thus complements the increase in plant use, suggesting that groups used the site more frequently or stayed for longer periods.

The lithic assemblage also demonstrates a decrease in the use of non-local blue-gray Fort Payne chert, out of which a slight majority of the Dalton hafted bifaces are made, in favor of locally available Tuscaloosa gravel. This suggests that Dalton occupants had stronger ties to the Tennessee River, where blue-gray Fort Payne chert outcrops, some 40 km from Rollins Bluff Shelter. They may have traveled to the river valley more often, or traded more extensively with groups in that region. Interestingly, though, the proportion of blue-gray Fort Payne debitage does not change between the two components. Rather than transporting raw materials with them, both Dalton and Early Archaic peoples brought finished blue-gray Fort Payne tools, including hafted bifaces, uniface tools, and utilized flakes, with them to Rollins. They appear instead to be using local chert to make tools on-site, including expedient tools. Indeed, all of the cores from these early components are of Tuscaloosa gravel.

On the whole, the occupants of Rollins Bluff Shelter hunted, prepared hides, manufactured stone tools, and processed nuts, particularly hickory and acorn. The intensity of occupation, whether in terms of longer stays or more frequent visits, appears to have increased in the Early Archaic period. Concomitantly, the occupants' range of mobility seems to have decreased to some extent, as suggested by the decrease in use of non-local blue-gray Fort Payne chert. It is possible that Early Archaic hunter-gatherers adjusted their ranges in response to climatic and subsequent habitat changes, or to increases in population density. Ties with the Tennessee River Valley remained important, however, as occupants continued to use of tools made from blue-gray Fort Payne chert.

Nut processing appears to have been an important activity at the site, as evidenced not only by the plant remains but also by the presence of mortars, nutting stones, and mullers. It is possible that these artifacts were stored at the site, reinforcing use of the site for processing nuts. Gathering activities appear to have remained largely similar between the Dalton and Early Archaic components, focusing on hickory nuts and acorns, and to some extent fruits, particularly persimmons and grapes. Black walnut appears to have decreased in importance, and perhaps sumac as well. This decrease may be related to changes in the local environment, perhaps towards less open woods. The coincidence of a possible decrease in the range of mobility and the decrease in black walnut is also intriguing. It is possible that the Dalton occupants had greater opportunities to collect black walnuts, and perhaps sumac and squash, over the course of their travels, which may have been greater in distance and/or in frequency. Regardless, their travels, as well as those of their Early Archaic successors, brought them back to Rollins Bluff Shelter in autumn to process nuts.

LAGRANGE BLUFF SHELTER

Although few floatation samples were available from LaGrange, those few samples were rich in plant taxa. Gatherers exploited hickory and black walnut, which were most frequently recovered form the samples, as well as acorn, which recurred consistently, although in low numbers. This may reflect preservation differences between acorn and the more robust Juglandaceae nuts. Black walnut is particularly well represented, with quantities more commensurate with hickory than seen in the samples at Rollins. Several hazelnut shells were also recovered. Fruits used by occupants include persimmon, grape, sumac, mulberry, and possibly maypop. Among edible seeds, occupants appear to have gathered chenopod, wild legumes, and possibly wild bean and a member of the Grass family. Weedy seeds include seeds tentatively assigned to the Mustard and Composite families.

The nut taxa suggest that the surrounding environment included rich woods, especially indicated by the black walnut. Similar to Stanfield-Worley, the quantity of black walnut recovered is comparable to hickory nutshell, suggesting either that black walnut trees were relatively common within the region, and/or that these trees grew in a relatively open environment, thus yielding significant nut crops. An open environment could include forest margins. Such edge situations are suggested by the presence of hazel and sumac. The faunal assemblage also includes animals that favor wooded and ecotone habitats. Among the former are opossum, raccoon, squirrel, and box turtle, and the latter include white-tailed deer, striped skunk, and fox (Curren 1976).

The wide range of weedy seed taxa may have grown in clearings, but also may reflect use of disturbed habitats along streams. Dry Creek runs just 2 km to the north of the shelter, and Brush Pond is located five kilometers to the northeast. Both are associated with soils that occasionally flood or pond, providing the best habitat for wetland plants within Colbert County (Bowen 1994). The occupants of LaGrange may have exploited these disturbed settings to obtain edible seeds, and perhaps greens as well.

The occupants of LaGrange likely gathered seed heads of chenopod, but probably not until after hickory nuts, acorns, and black walnuts had been harvested. Similarly, they may have collected wild legumes, which mature as early as July or August, prior to and/or after the peak in nut gathering. If gathered in late summer by pulling up the whole plant, the occupants may have left them to dry before threshing them. The collection of nuts by the occupants of LaGrange appears more similar to that practiced at Stanfield-Worley than at Rollins Bluff Shelter. Black walnut shell was recovered in quantities comparable to hickory nutshell, suggesting that black walnuts were readily available in the surrounding habitats. The high ubiquity of acorn shell is a better reflection of its importance to the site's occupants than quantities recovered, given differences in preservation between acorn and the

Juglandaceae nutshells. Nut processing is also evidenced at the site by the presence of at least one nutting stone, associated with carbonized nutshells, in the Early Archaic deposits.

LaGrange's occupants also consumed a variety of fruits, which were recovered consistently although in low numbers. These fruits, including persimmon, grape, sumac, mulberry, and possibly maypop, can all be dried and stored, so that it is possible that they were brought to the site already dried rather than gathered fresh while the site was occupied. In either case, the site's inhabitants must have gathered them, and the taxa would have been available within the local environment. While they may have gathered fruits opportunistically during the peak of the nut harvest, gatherers may have targeted ripe fruits during late summer. The major exception is mulberry, which ripens as early as May and is available only through August. Because of intense competition with wildlife, gatherers likely concentrated their efforts on these fruits during the peak of their availability, similar to their strategies for collecting nuts.

Assuming that LaGrange's occupants collected mulberries rather than having transported dried berries to the site, then it is likely that these groups visited the site during summer as well as autumn. Although it is difficult to extrapolate from just a few fruit seeds, it is possible that they used the site as a camp during collection and processing of mulberries in summer; sumac, grapes, and perhaps maypops, as well as wild legumes and hazelnuts in late summer and early fall; persimmons, acorns, black walnuts, and hickory nuts in autumn; and chenopod and perhaps wild legumes in late autumn and/or early winter. It is unlikely that they continuously occupied the site from May through November; the artifact density and number of features at the site do not warrant such an interpretation. Instead, groups probably inhabited the site over the course of several days or perhaps weeks, a pattern of use that likely applies to the other four sites as well.

Similar to Rollins Bluff Shelter, the Dalton and Early Archaic occupations at LaGrange are stratigraphically separate, allowing comparisons between the two components. Unfortunately, the small number of samples from the site allows for few quantitative comparisons, particularly among taxa other than nuts. In terms of ubiquity, sumac and hazel may decrease slightly while wild legumes may increase. The three taxa grow in similar habitats, making a change in local environment an insufficient explanation. The remaining nut taxa demonstrate very little change in use between the two components. Black walnut may decrease slightly, as suggested by its ubiquity and by the correspondence analysis. It is possible that black walnuts became less common in the area, or no longer enjoyed relatively open conditions. Ecotone habitats may have decreased in frequency during the Early Archaic, leading to fewer sumac and hazel shrubs, as well as reducing open growth conditions for black walnut. Because wild legumes also favor forest margins and disturbed habitats, their possible increase would then need to be explained by changes in gathering practices. It is also possible that the site's occupants changed the way that they used, processed, and/or disposed of the various nutshells. While such changes are possible, error due to the small sample size seems more likely. In general, then, the plant assemblage suggests more continuity through time than change in gathering practices.

In addition to gathering and processing nuts, fruits, and edible seeds, the occupants of LaGrange also appear to have engaged in hunting, hide preparation, and to some extent tool manufacture. Hunting is suggested by the presence of biface and uniface blades and knives, in addition to hafted bifaces, which may have served as projectile points and/or knives. Although the faunal assemblage is relatively small, it indicates that the site's occupants hunted white-tailed deer, opossum, raccoon, squirrel, and rabbit (Curren 1976). Hide preparation is evidenced by the recovery of bifacial and unifacial scrapers, as well as a bone awl from the Early Archaic component that may have served as a leather punch.

Tool making is suggested by the presence of cores, particularly a cache of nine blue-gray Fort Payne chert cores recovered from Zone C, which is associated with corner-notched Early Archaic hafted bifaces. Few artifacts were recovered from this zone other than the cores, which were associated with a significant concentration of waste flakes towards the rear of the shelter. DeJarnette and Knight (1976) otherwise conclude that the occupants made few stone tools at the site, as preforms are rare and the majority of debitage is less than 10 mm in size. They suggest that the debitage therefore derives from retouch rather than stone tool manufacture. DeJarnette and Knight (1976:29) speculate that a specialized uniface toolkit, comprised of scrapers, flakes and knives, found in the Early Archaic levels of Zone B may have been used for wood, bone, and/or hideworking, so occupants may have focused their efforts on making tools from materials other than stone at the site.

Although quantitative information is not provided, DeJarnette and Knight (1976:49) note that the stone tools and flakes from all components demonstrate "the practically exclusive dominance" of use of blue-gray Fort Payne chert. Indeed, four of the five Dalton hafted bifaces and 14 of the 16 Early Side-Notched hafted bifaces are made from blue-gray Fort Payne. This contrasts with Stanfield-Worley, which apparently included greater quantities of locally available Tuscaloosa gravel, even though the two sites are located similar distances from outcrops of blue-gray Fort Payne chert. The stone tool assemblage at LaGrange further differs from Stanfield-Worley in that Dalton hafted bifaces in particular, and presumably Early Side-Notched hafted bifaces as well, show little evidence of resharpening, suggesting that they are relatively disposable rather than heavily curated. Taken together, this suggests that the occupants of LaGrange made the majority of their stone tools elsewhere, but also had relatively easy access to raw materials, namely blue-gray Fort Payne chert. Located on the escarpment between Little Mountain and the limestone plateau of the Tennessee River Valley, rather than nestled into the mountain ridges as Stanfield-Worley is, LaGrange may simply have offered easier travel to and from the river floodplains. Alternatively, the chert may have been available further up the smaller streams and creeks around LaGrange than Stanfield-Worley, reducing the distance that occupants traveled to obtain it.

Also of interest are numerous pieces of abraded red and yellow ochre recovered from the site. These include five fragments of red ochre from the Dalton deposits, 19 pieces of red ochre and four of yellow ochre in the Early Archaic levels of Zone D, and four red ochre and one yellow ochre fragment from Early Archaic levels of Zone B. DeJarnette and Knight (1976:47) suggest that these artifacts may have held ritual importance. Abraded ochre is notably absent from Zone C, from which few artifacts were recovered in general. However, in this zone excavators encountered a burial of a middle-aged adult, accompanied by four chert flakes, a chert core, and a fragment of limestone. It seems that use of the site changed significantly during this component, which is associated with two corner-notched hafted bifaces. Interestingly, none of the rockshelters investigated here claim significant Early Archaic Kirk Corner-Notched deposits, often in stark contrast to the preceding Early Side-Notched and succeeding Kirk Stemmed and Eva/Morrow Mountain periods. Although an erosional event(s) may have removed evidence of Kirk Corner-Notched occupations from Dust Cave (Sherwood 2001; Sherwood et al. 2004), marked changes in the place of rockshelters in peoples' social landscapes during this period are also possible.

Few features are associated with the Dalton and Early Archaic occupations at LaGrange. These include two small pits – one near the bottom of Zone B and another in Zone D – that may have served as fire basins. A large, hardened surface of dark gray, clayey soil was encountered in Zone D, along with charred plant remains, animal bone, an Early Side-Notched hafted biface, and a nutting stone. DeJarnette and Knight (1976:48) note that this surface showed signs of fire, and refer to it as an "occupational floor." It is possible that this "floor" served purposes similar to the prepared surfaces observed at Dust Cave, for toasting, grilling, and various cooking activities (Homsey 2004; Sherwood 2001; Sherwood et al. 2004). That it is associated with a nutting stone, as the hardened clay surface at Stanfield-Worley is adjacent to a bedrock mortar, is further intriguing and informative of its possible function.

In sum, the assemblages at LaGrange suggest that the site's occupants not only gathered and processed nuts, but also exploited fruits and edible seeds. Use of edible seeds in particular may have entailed trips to the nearby creek and/or pond, with their associated soils prone to flooding and ponding. In addition to gathering, the occupants hunted game and prepared hides, and may have made bone and wood tools, but seem to have primarily maintained rather than manufactured stone tools. Instead, they appear to have made their chipped stone tools elsewhere, perhaps nearer the chert source along the Tennessee River. These groups must have had ready access to blue-gray Fort Payne chert, as the vast majority of their tools derive from this raw material, although it outcrops some ten kilometers from the site. It appears, then, that the occupants of LaGrange frequented the Tennessee River floodplain.

In addition to serving as a temporary shelter for foraging groups, LaGrange may also have held ritual importance. This non-economic dimension is suggested by the recovery of numerous fragments of abraded red and yellow ochre from all components of the site, and more so by the burial of an individual within the shelter's deposits. Such use of the rockshelter reminds us that these sites, as well as open-air sites, figured as important places on a social landscape that intertwined with the economic ones that we readily map.

DUST CAVE

The plant assemblage from Dust Cave is the richest of the four on several levels. More samples were available for study from this site, and these samples derive from both floatation columns and features. As such, they provide both an averaged view of plant use at the site, as well as use that is bounded in time and space. Certainly related, at least in part, to the fact that the sample size is larger, the greatest range of plant taxa was recovered from Dust Cave. Similar to the other sites, the plant assemblage is dominated by nutshell, suggesting that nuts served an important dietary role. Hickory comprises the majority of these nuts, but acorn shell is also consistently recovered, although often in low numbers. Less frequent are black walnut and hazelnut shell, and members of the Fagaceae family, which may include chestnut and beechnut. The occupants at Dust Cave likely supplemented their diet with fruits. These include hackberry, as well as persimmon, grape, sumac, and possibly black gum and nightshade. Plants that may have been used for edible seeds and/or greens at the site include chenopod, wild legumes, cheno-am, bedstraw, poke, purlsane, and smartweed. Additional weedy taxa include stargrass and possible morning-glory.

The nut taxa indicate the presence of woods in the area of the site, likely within the floodplains just to the south as well as the karstic uplands to the north, and along the slopes that connect the two. The relative scarcity of black walnut in the assemblage, especially compared to the materials at Stanfield-Worley and LaGrange, suggests that these trees were comparatively infrequent in the area. Wooded habitats are also indicated in the faunal assemblage by the recovery of passenger pigeon, gray squirrel, raccoon, opossum, eastern woodrat, and box turtle. The presence of beaver, muskrat, swamp rabbit, and barred owl further suggests forested wetlands (Walker 1998:141), likely growing in the low floodplains associated with the river and its backwaters. The recovery of hackberry seeds and possible black gum in the samples is also suggestive of alluvial woods.

Hazel and sumac thrive in edge situations; nightshade, wild legumes, and morning-glory are also common in ecotone habitats. White-tailed deer, red and gray foxes, cottontail rabbit, and grackle, recovered in the faunal assemblage, further indicate the use of ecotone communities by the site's inhabitants (Walker 1998:141). Open habitats are suggested by prairie chicken and northern bobwhite (Walker 1998:141), as well as the various weedy herbaceous taxa among the plant remains. These weedy plants are also likely to have grown along the banks of streams and within the river floodplain, areas disturbed by frequent flooding. Smartweed in particular is indicative of use of damp settings.

The collection and processing of hickory nuts, as well as acorns, appears to have been a major activity of the occupants of Dust Cave. The consistently low numbers of acorn shell recovered is likely related to differences in preservation rather than use. In fact, several features contained significant quantities of acorn shell; of these, all but one included markedly greater quantities of acorn than hickory nutshell. Significant use of acorn at the site must not be overlooked. Black walnut and hazelnuts, however, are poorly represented at the site. Both are recovered infrequently, often in low numbers. Several samples do contain greater quantities, perhaps suggesting years in which bumper crops of these nuts were available. In general, however, it seems that the site's occupants collected these nuts opportunistically, rather than targeting them as they did hickory nuts and acorns.

The occupants also consumed a variety of fruits that likely supplemented their diets. These include hackberry, persimmon, grape, and sumac, and possibly black gum and nightshade berries. Gatherers may have concentrated their efforts towards collecting these fruits in late summer, prior to the height of nut availability, or perhaps picked them opportunistically while collecting nuts. They also may have gathered these fruits, with the exception of grapes, after nut harvesting, as they persist on trees into winter. In addition to eating them fresh, the site's occupants may have dried and stored the fruits for future use.

Edible seeds recur consistently at Dust Cave, identified in over half of the Late Paleoindian and Early Side-Notched samples. While wild legumes were recovered in ten samples, cheno-ams in six, and smartweed in just a single Late Paleoindian sample, chenopod occurs in 42 of the 106 samples from the site. This includes nearly half of the column samples and one-fourth of the features. Smartweed and cheno-ams may have been used occasionally, but gatherers appear to have significantly interacted with chenopod in particular, and perhaps wild legumes. It is likely, then, that the site's occupants specifically targeted chenopod, perhaps cutting dried seed heads after the peak of nut harvesting and returning with them to the site to thresh and prepare the seeds.

A variety of weedy seeds were also identified among the plant assemblage. The spring leaves of several of these, including poke, bedstraw, and purslane, as well as chenopod, smartweed, nightshade, and sumac, may have been used for greens. However, the seeds recovered in the samples, of course, are available in autumn. Some of these weedy seeds are likely commensals, perhaps growing in the immediate vicinity of the site and blown in by wind or tracked in by people or animals. The presence of both commensals and edible weedy seeds suggests that the local surroundings of the site were significantly disturbed, either by recurrent flooding of the creek that flowed within fifty meters of the cave's entrance, or perhaps as a result of frequent human habitation. In either case, it is also possible that chenopod grew in the immediate vicinity of the site.

I reiterate, however, that chenopod does not appear to have been commensal, but rather purposefully collected and used by the site's occupants. The miscellaneous weedy seeds demonstrate a markedly different pattern of recovery. Poke seeds were recovered from eight samples, bedstraw and stargrass from five, purslane from two, and possible morning-glory from one. In addition, they are often represented by single specimens. Chenopod, on the other hand, occurs in over five times as many samples, and includes five or more specimens in twelve of the samples. As such, the site's occupants appear to have used chenopod in significantly different ways.

The nut taxa in particular suggest that groups used the site in autumn. While the fruits ripen as early as midsummer, they are also generally available through fall. Similarly, the weedy seeds may mature in summer but also persist through autumn and in some cases into late winter. The faunal assemblage provides additional information regarding seasonality of site use. The recovery of a white-tailed deer antler still attached to the frontal bone suggests fall or early winter occupation, prior to loss of antlers in late winter and early spring (Walker 1998:152). Passenger pigeons, a migratory species, would have been available in fall and winter (Walker 1998:148). The significant use of waterfowl suggests occupation of the site during the migration of geese and ducks in fall and perhaps spring (Walker 1998:150). A possible spring occupation is further suggested by the recovery of suckers. In spring, these fish leave the main river channel for smaller tributary streams in large numbers to spawn, and would have provided ample fishing for the site's occupants in this season (Walker 1998:152). Occupation in other seasons is also possible; fresh-water mussels, regularly recovered from the samples, would have provided a stable, year-round food source (Parmalee 1994:159).

Although the plant assemblage from all components at the site is generally characterized by nutshell, the quantitative data indicates several shifts in plant use through time. General increases in plant remains recovered suggest more intensive use of the site over time, whether by more frequent visits, longer stays, or increased activity during those stays. In particular, use of nuts as a foodstuff seems to have intensified, namely during the Kirk Stemmed component. Hickory nutshell increases significantly relative to other plant remains. Acorn use may also increase, as suggested by its ubiquity values, but does not appear to keep pace with increases in hickory. Use of black walnut, however, appears to decrease during the Kirk Stemmed component, as did hazelnut. This drop is perhaps related to a decline in open-growth or edge settings, in which these species produce higher yields. This coincides with a decrease in the recovery of edible and weedy seeds. Chenopod in particular drops significantly, from over 50% ubiquity in Late Paleoindian samples to just 11% in Kirk Stemmed samples. The quantity of chenopod seeds recovered also decreases: the Kirk Stemmed samples claim no more than three specimens each, while six of the Late Paleoindian samples contain five or more seeds. Wild legumes, in contrast, may increase in importance, recovered from one-third of Kirk Stemmed samples but only one of fifty Late Paeloindian samples. Compared to the nut taxa, however, use of wild legumes still appears to drop. Use of fruits, however, seems to change little over time, with the exception of hackberries, which decrease significantly in the Kirk Stemmed component.

Given the significant increase in hickory nuts along with the drop in use of resources that prefer open or edge settings, including weedy seed taxa, hazelnut, and perhaps black walnut, the Kirk Stemmed occupants of Dust Cave appear to be targeting forest resources. This shift may be driven by changes in local ecological conditions, cultural practices, or both. Trends in the faunal assemblage also suggest an increase in use of resources from closed habitats. Of species that can be assigned to a particular habitat, 35% represent open habitats in the Late Paleoindian assemblage. This drops to 20% in the Early Side-Notched and only 7% in the Kirk Stemmed component. Ecotonal species remain relatively stable at roughly 20-27%, while closed species increase from 40% of the Late Paleoindian assemblage to 53% of the Early-Side Notched and 73% of the Kirk Stemmed materials. This coincides with an increase in the use of mammals and a decrease in bird species, particularly waterfowl (Walker 1998).

Use of aquatic resources, however, remains fairly consistent. Walker (1998:139-141; Walker et al. 2001:179) notes that over 60% of the faunal remains (comparing the number of individual specimens) from the Late Paleoindian through Kirk Stemmed components derive from aquatic habitats. This dependence on aquatic species is highest in the Early Side-Notched component, comprising some 75% of the total faunal assemblage. This relative stability masks a significant increase in exploitation of fish after the Late Paleoindian, as well as a decrease in use of waterfowl. Reliance on aquatic habitats is also indicated by the recovery of mussels from the deposits, which appears to increase in the Kirk Stemmed component. The various species in the assemblage indicate that occupants of Dust Cave collected shellfish both from the main river channel and its smaller tributaries (Parmalee 1994).

Geoarchaeological analyses of the sediments and feature assemblage demonstrate a significant shift in the Kirk Stemmed component as well. The Kirk Stemmed deposits contain significant quantities of ash, and appear to be primarily anthropogenic (Sherwood 2001). The number and diversity of features increase substantially in these deposits, and their spatial distribution leads Homsey (2004) to suggest that the occupants were conserving space by clustering different activities in particular areas of the site. Notably, Homsey's (2003, 2004) geochemical analyses indicate that certain feature types, namely charcoal pits, contain high levels of strontium, which may reflect burning of hickory nutshell. Although more numerous in the Kirk Stemmed component, it is important to note that charcoal pits, as well as prepared surfaces that may have been used for a variety of cooking tasks, occur in the Late Paleoindian and Early Side-Notched components as well.

Recovery of ground stone tools may also reflect increases in nut processing. While no nutting stones were recovered from the earlier deposits, five derive from the Kirk Stemmed component. It is possible, however, that excavators did not recognize nutting stones as such in earlier deposits, mistaking these limestone slabs for roof fall instead.

In general, the chipped stone tool and bone tool assemblages suggest considerable continuity through time in activities performed at the site. Stone tools include hafted and non-hafted bifaces, scrapers, drills, gravers, and utilized flakes. The Late Paleoindian toolkit also included a suite of uniface tools, including blades, scrapers and gravers. Morphological and microwear analyses of these various tools indicate that they were used in hunting, butchering, and hide preparation, as well as working bone and wood. Bone tools, including awls and needles, further suggest hide preparation (Walker et al. 2001). A bone point from the Early Side-Notched component and a bone fishhook from the Kirk Stemmed component indicate that bone tools were used in obtaining prey as well.

Stone tools with bone and wood polish suggest tool manufacture, as does a cache of 23 goose humeri excavated from the Late Paleoindian component (Walker and Parmalee 2004). Manufacture of chipped stone tools appears to have been an important site activity as well. Middle- and late-stage preforms are regularly recovered from the deposits, and debitage analyses further suggest that the site's occupants were shaping as well as retouching stone tools. Conservation of tools does not appear to have been a major concern, however, likely related to the ready availability of blue-gray Fort Payne chert, which outcrops within a kilometer of the site. This raw material comprises the vast majority of the stone tools, debitage, and cores at the site. Randall (2002) suggests that the occupants refurbished their toolkits while at Dust Cave, gearing up for forays into the uplands.

Although the tools suggest significant continuity in the types of activities performed at the site, the amount of lithic debitage recovered from the floatation and screen samples indicates significant differences through time in the intensity of tool manufacture and maintenance. The density of lithic debitage is highest in the Early Side-Notched deposits, while comparable between the Late Paleoindian and Kirk Stemmed components (Figure 8.1). This is in marked contrast to plant materials (Figure 8.2), recovery of shell (Figure 8.3), and the feature assemblage, which all indicate a significant increase in intensity of site use in the Kirk Stemmed component. The contrast is even more pronounced when the ratios of lithic debitage to plant remains are compared (Figure 8.4). Interestingly, the recovery of bone from floatation samples demonstrates a similar decrease to the lithic debitage (Figure 8.5).

These conflicting trends are intriguing. On one hand, the assemblages at Dust Cave demonstrate continuity in the kinds of activities performed at the site: collection and processing of nuts and edible seeds, general use of fruits, hunting, fishing, butchering, hide preparation, and manufacture of bone and stone tools. On the other, they suggest subtle shifts in use of habitats and intensity of particular activities. Occupants of the site seem to increase their use of closed habitats by the Kirk Stemmed component, suggested by shifts in faunal resources, a significant increase in use of hickory relative to other plants, and an apparent decrease in use of edible seeds such as chenopod.

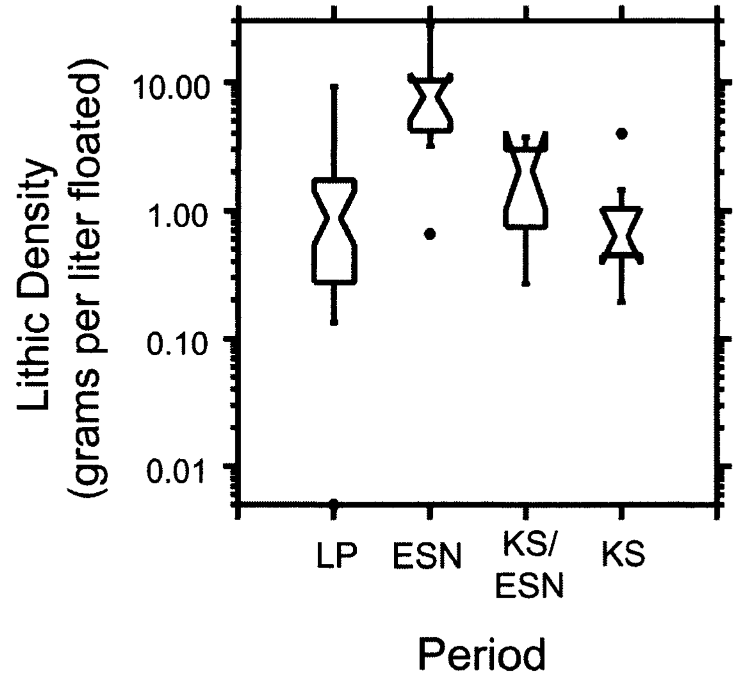


Figure 8.1. Boxplot comparing the ratio of lithic weight (g) to sample volume (L) in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

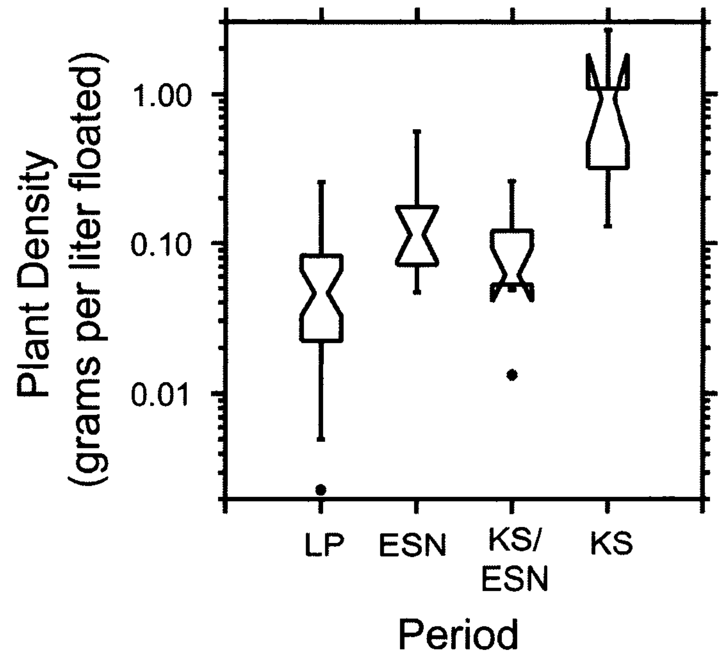


Figure 8.2. Boxplot comparing the ratio of plant weight (g) to sample volume (L) in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

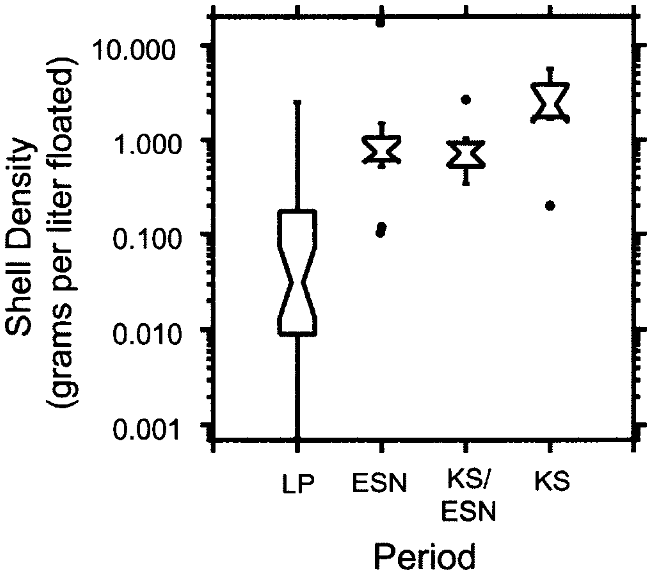


Figure 8.3. Boxplot comparing the ratio of shell weight (g) to sample volume (L) in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

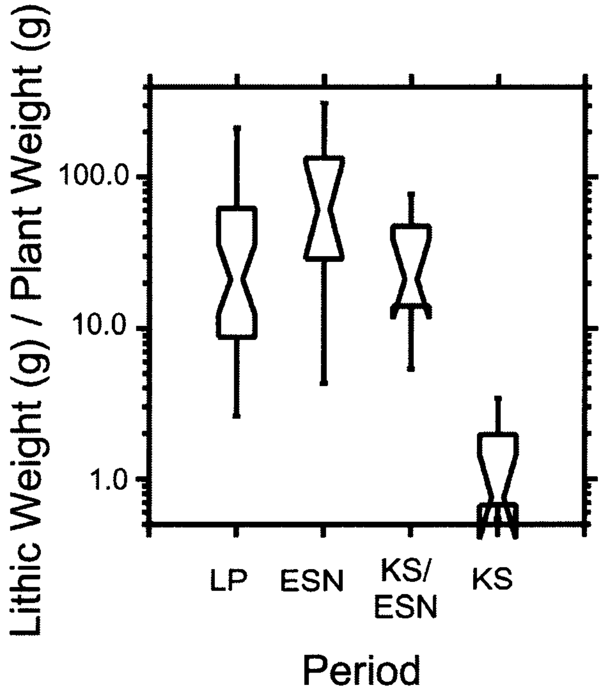


Figure 8.4. Boxplot comparing the ratio of lithic weight (g) to plant weight (g) in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

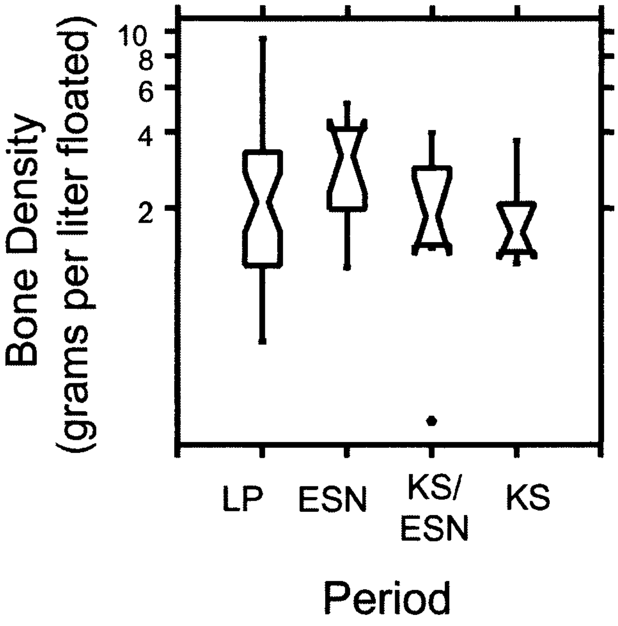


Figure 8.5. Boxplot comparing the ratio of bone weight (g) to sample volume (L) in Dust Cave column samples. Note that the y-axis is scaled logarithmically. LP = Late Paleoindian; ESN = Early Side-Notched; KS/ESN = Kirk Stemmed/Early Side-Notched (Zone Q); KS = Kirk Stemmed.

They also increase their use of fish and mollusks during this period. At the same time, the site's occupants appear to engage less in the manufacture and/or maintenance of stone tools, and perhaps exploit fewer animal resources relative to plants than in previous components.

Taken together, these trends may suggest that the collection and processing of hickory nuts, and maybe acorns, became a more important focus during the Kirk Stemmed occupation of Dust Cave. The question is why. Munson (1986) suggests that increases in hickory nutshell in the Middle Archaic in the Midwest are related to changes in technology, particularly the adoption of stone boiling for processing hickory nuts. As noted in Chapter Seven, however, the costs of processing hickory nuts without boiling are sufficiently high that the nuts are unlikely to have been used extensively. The significant use of hickory nuts relative to other plant foods prior to the Middle Archaic is difficult to explain if these earlier groups did not use the boiling technique as well.

It is also possible that hickories became more prominent in the local landscape at this time, making Dust Cave an attractive site for exploiting hickory nuts. Broad environmental reconstructions suggest that the percentage of hickories within forests remained relatively stable over the Pleistocene/Holocene transition, although they may have decreased slightly around the "8.2 ka event" and rebounded shortly after. In contrast, the percentage of oaks in regional forests appears to have increased dramatically during the Pleistocene/Holocene transition. However, if forests expanded in the area, the number of hickories would increase as well. The faunal remains from the site certainly support an expansion of wooded habitats. Finer-scale environmental reconstructions are required to corroborate this inference.

Another possibility is that the manner in which groups occupied the site changed in the Kirk Stemmed component. Given their more intensive occupation of the site, they may have disposed their stone and bone waste in different manners than previous groups. Staying for longer periods or expecting to return at shorter intervals, they may have cleaned the site to a greater degree. Hickory nuts, being more robust than other plant remains, may have better survived such cleaning. It is important to note, however, that very little cultural material was recovered from excavation units in the talus slope in front of the site. It seems, then, that Kirk Stemmed occupants were not simply throwing their lithic debitage out the front of the cave, unless these materials were washed down slope into the creek.

Of the scenarios, I suspect that the reality of occupation at Dust Cave may have fallen somewhere between them. Intensive occupation certainly affected the final deposition of artifacts and ecofacts, and changes in local environment would have shaped subsistence strategies. In any event, the placement of Dust Cave within hunter-gatherers' economic, and likely social, landscapes changed significantly by the close of the Early Archaic period.

SUMMARY

In a broad sense, the plant assemblages from the four rockshelter sites suggest that the occupants of each undertook a similar range of activities. Nut collection and processing appears to have been key at each, and use of fruits seems relatively stable. In particular, significant quantities of hickory nutshell characterize each of the site assemblages. This likely reflects their dietary importance. It also suggests that the occupants of the sites used stone boiling, which is significantly more efficient than other methods, to process hickory nuts.

The plant assemblages indicate that occupants visited the sites at least during autumn, in part to collect and process nuts. While they may have brought fruits with them to the sites in dried form, they may also have gathered them opportunistically during nut harvests. It is also possible that gatherers visited the sites in late summer and earlier in the fall, not only to collect ripening fruits, such as mulberry, but also to monitor stands of oaks and hickories, as well as black walnuts, to determine where and when sizeable nut harvests would be available. At sites with nearby alluvial or open settings, gatherers may also have collected edible seeds in late autumn and early winter. The faunal assemblage at Dust Cave, which includes migratory waterfowl, fish that spawn in spring, and mollusks available throughout the year, suggests that this site may well have been used during spring and other seasons as well.

These gathering activities were scheduled in concert with other subsistence activities at the sites, including hunting, butchering, and hide preparation. Groups may have targeted mammals and birds attracted to the same habitats and resources that gatherers exploited, including weedy seeds, sumac and hazel thickets along forest margins, and nut mast in forest communities. At Stanfield-Worley in particular, occupants appear to have traveled to the site to hunt deer, turkeys, and squirrels as well as harvest nuts, with little energy expended in the manufacture of stone tools. This contrasts with the other sites, where tool-making appears to have been a common activity.

In spite of these broad similarities, the quantitative details of the plant assemblages suggest important differences at the sites across space and through time. Use of black walnuts seems to have been more important at the two sites in the Little Mountain region, Stanfield-Worley and LaGrange. This may be related to greater availability of the species in this area. Similarly, hackberry was recovered only at the two sites along the Tennessee River, presumably because of its preference for riverbank settings. Occupants at rockshelters near the Tennessee River and/or sizeable streams, namely Dust Cave and LaGrange, appear to have exploited edible seeds to a greater extent than those ensconced in the uplands.

Changes in plant use through time are also particular to each site. Increased intensity of occupation, and of nut exploitation, is suggested at all three of the sites for which diachronic information is available. The recovery of mortars and nutting stones increases at each, and often the ubiquity of plant remains increases as well, suggesting higher rates of plant deposition. Use of black walnut seems to decrease at each of the sites over time, perhaps indicating a decrease in habitats that favor the productivity of this species. Overall, however, the manner in which plants are used changes little between the Late Paleoindian and Early Archaic periods at Rollins, LaGrange, and Dust Cave. Not until the close of the Early Archaic, during the Kirk Stemmed component, does plant use change significantly at Dust Cave, marked by dramatic increases in the recovery of hickory nutshell.

The cultural role of rockshelters may also have changed significantly through time. As permanent fixtures on the landscape, the sites were certainly important locales on the mental maps of hunter-gatherers. Groups cached goose humeri, raw material cores, mortars and nutting stones, pecked mortars into the bedrock of sites, and prepared clay surfaces for cooking and other activities, suggesting not only planned returns to the sites, but perhaps usufruct rights as well. The possible increase in intensity of site use during the Early Archaic period may relate to increases in population density or differences in the time spans associated with the Late Archaic and Early Archaic occupations, but may also indicate a shift in how early groups envisioned rockshelters within their social as well as economic landscapes. The social role of rockshelters is further suggested by the inclusion of burials at the sites, first evidenced by a Kirk Corner-Notched burial at LaGrange. This added dimension of site use continues into the Middle Archaic period, particularly the Eva/Morrow

Mountain component, which includes several burials at Stanfield-Worley and Rollins, and several dozen burials at Dust Cave. These sites certainly served as more than temporary protection from the elements.

In sum, the focus of gathering and other subsistence and social activities, and changes in these activities through time, seem to be unique to each site. While the social importance of the sites can only be speculated, the economic activities appear to depend largely on the availability of resources on the local landscape. I further explore this relationship between local resource distribution and economic site activities in the next chapter, and use the information to expand our understanding of the role that the sites played within early hunter-gatherers' subsistence and mobility strategies.

CHAPTER NINE:
RESOURCE DISTRIBUTION, PROCUREMENT, AND THE LOCAL LANDSCAPE

Just as early groups' use of plants at the four rockshelter sites occurred within the context of other tasks related to food and material culture, so the activities performed at each site occurred within a regional context of landscape use. Late Paleoindian and Early Archaic peoples visited the rockshelter sites in the midst of their food-getting and toolkit-maintaining activities. Over the course of these activities, they traveled to various resource patches and camped at various sites. In this chapter, I articulate the site-level activities discussed in Chapter 8 with the distribution of resources on the regional landscape through time to develop a picture of early foraging peoples' mobility patterns and landscape use.

First, I consider the distribution of plant resources on the local landscape. I approximate the vegetation communities and productivity of various topographic settings using the field notes taken by U.S. General Land Office surveyors in the early 1800s. I then adjust these results using information from broad environmental reconstructions to rank the availability of resources on the local landscape during the Pleistocene/Holocene transition. Second, I evaluate the costs that the regional topography imposes on foragers as they procure these resources and transport them to a base camp. I model these costs conceptually using central place foraging theory, while modeling them graphically with the assistance of a geographic information system (GIS). Third, I explore patterns in the distribution of Late Paleoindian and Early Archaic sites across this landscape through time. I compare these site placements with the distribution of resources across the landscape and the costs of procuring and transporting them, and use this combined information to discuss the mobility decisions of early hunter-gatherer groups living in the region.

RECONSTRUCTING LOCAL PLANT RESOURCES

In order to determine how the distribution of resources in time and space influenced the movements of early foragers across the landscape of northwest Alabama, we must be able to locate resources on the landscape. The location of stone-tool resources is readily available: geological formations do not change significantly over the course of 13,000 years. Animal and plant resources are more difficult to place, especially considering that the global climate changed rapidly between 14,000 and 8,000 years ago. As discussed in Chapter Three, analyses of pollen cores and of faunal remains provide regional reconstructions of plant and animal communities. However, these reconstructions are too broad to indicate the distribution of local resources.

Lacking analyses of local pollen cores, or of other ecofacts that might provide microenvironmental clues, I have turned to the field notes of early surveyors who parceled northwest Alabama into one-mile squares for the U.S. government in the early 1800s. These surveyors of the General Land Office (GLO) recorded and marked four witness trees at every corner of the one-mile square sections. They also noted the quality of the soil, the immediate topography, and the nature of the local vegetation, not only at each corner but also whenever they encountered a significant change in landscape, vegetation, or whenever they crossed a creek (Bourdo 1956:758). As such, the GLO surveyors' field notes provide a fine-scale description of plant communities within the project area prior to significant impact by Euro-American settlers.

Of course, these early 19th-century plant communities do not correspond to those that covered the area during the Pleistocene/Holocene transition. In addition to significant climate changes, human interaction with and impact on landscapes also changed markedly over the past 14,000 years. Inasmuch as the relative productivity of these historic plant communities is related to differences in local topography and geology, however, the GLO field notes may be used to rank the various topographic and physiographic settings within the project area for their likelihood to support particular vegetation. This ranking can then be fine-tuned as further information from analyses of pollen and other microbotanical and microfaunal remains becomes available.

General Land Office Survey Data

In the late 1700s, the US Congress ordered the surveying of all public lands. The instructions for partitioning lands into townships evolved through 1805, when the system still in use today was established. Under this system, each township measures six miles by six miles, divided into 36 one-mile-square sections (Bourdo 1956:757). At each section corner, the surveyors marked four "bearing" or "witness" trees, one in each section, and measured the angle and distance to that tree from the corner. The surveyors also noted the general plant community at the section corners, as well as at stream crossings. Through 1855, instructions for conducting surveys continued to change, as surveyors were eventually required to estimate the diameter of the witness trees at breast height, as well as mark two witness trees at the quarter section posts (Bourdo 1956:757-758).

Although the GLO surveys were not undertaken with the purpose of documenting vegetation communities, the field notes can be used to reconstruct these communities (H. Delcourt 1975, 1976; H. Delcourt and P. Delcourt 1974). Hazel Delcourt (1975:10-11) outlines the steps for developing such a reconstruction. After choosing an area for study, one must ascertain that the surveyors were not significantly biased in selecting witness trees. Although instructed to choose the nearest tree of sufficient girth, surveyors often selected trees that were easier to mark (or "blaze"), or those that were more resistant to decay (Bourdo 1956). Others may have selectively blazed trees that they could easily identify (H. Delcourt 1975:3). In order to determine whether surveyor bias significantly affects the witness tree data, Delcourt and Delcourt (1974:640; H. Delcourt 1975, 1976) suggest the use of analysis of variance (ANOVA). If the average distance of a particular tree species is significantly different from the remaining species, the surveyor's bias presumably shapes the data, and the data should not be used for reconstructing plant communities.

Once the suitability of a surveyor's notes is determined and the witness trees are noted for each corner, the corners are assigned to and grouped by environment. Environmental variables may include physiographic district, topographic setting, and soil type. Topographic settings can be determined by consulting topographic maps, and soil types from soil maps (H. Delcourt 1975:11). Once grouped by environment, the witness tree data can be used to determine the relative frequency, relative density, and frequency-density index of each species within each environment. These are calculated using the following equations (H. Delcourt 1976:127-128):

$$\text{Relative Frequency} = \frac{\text{(number of surveyed corners at which a species occurs)}}{\text{(total number of surveyed corners)}} * 100$$

$$\text{Relative Density} = \frac{\text{(number of individuals of a species recorded)}}{\text{(total number of individuals of all species recorded)}} * 100$$

$$\text{Frequency -Density Index} = \text{Relative Frequency} + \text{Relative Density}$$

The Frequency-Density (FD) Index has a maximum value of 200. Additionally, the mean area (MA) per tree can be calculated for corners at which four trees were recorded using the following equation (H. Delcourt 1976:128):

$$\text{MA} = [(Q_1 + Q_2 + Q_3 + Q_4) / 4]^2$$

where Q_1 is the distance, in "links", to the closest tree in the first quadrant, Q_2 to the closest tree in the second quadrant, etc. Mean area is thus expressed in square links. Surveyors used chains with 100 links for their measurements, where 80 chains = one mile, and 10 square chains = one acre. As such, the density of trees per acre can be derived as follows (H. Delcourt 1976:128):

$$\text{Density of trees per acre} = 100{,}000 \text{ links}^2 / \text{MA}$$

These various descriptive measures can then be used to characterize and compare the plant communities in different environments.

Reconstructing and Comparing Plant Communities in Northwest Alabama

To reconstruct the plant communities in the project area prior to significant Euro-American settlement, I chose 355 sections, represented by some 657 section corners (Figure 9.1). These include all sections within a five-kilometer radius of the four rockshelter sites; the sections are located in Lawrence and Marion counties, as well as Lauderdale, Colbert, and Franklin counties. I also chose additional sections located in physiographic regions and soil types not included in the five-kilometer site radii to widen the variety of local environments represented. By superimposing images of the section grids over a digital elevation map of the project area using ArcView GIS software, I assigned each corner to a physiographic region, as well as to one of three topographic settings: river/creek bottoms, slopes, or uplands. I then transcribed the witness tree data for each of the section corners from digital images of the GLO field notes, available on the internet through the website of the Land and Trademarks Division of the Alabama Secretary of State (2005). Table 9.1 lists the various species recorded by surveyors in the project area.

The majority of the townships and sections within the project area were surveyed between 1817 and 1820 by some 28 surveyors (Table 9.2). Several of the townships within Colbert, Franklin and neighboring Marion counties were surveyed in 1833 and 1834 by five different surveyors. The large number of surveyors removes some degree of continuity from the field notes, as each surveyor has his own style of description. However, it also precludes any one surveyor's bias from significantly shaping the overall results.

As recommended by Delcourt and Delcourt (1974:640), I performed a one-way (tree by distance) ANOVA to determine if any of the surveyors exercised significant bias in designating witness trees. I collapsed species that were recorded fewer than five times into a miscellaneous category to remove the variance introduced by rare taxa. I further compared the ANOVA results by physiographic region for each surveyor, because the density of trees, and therefore the distance to the nearest tree, may be significantly different in each region, and could introduce additional error. As

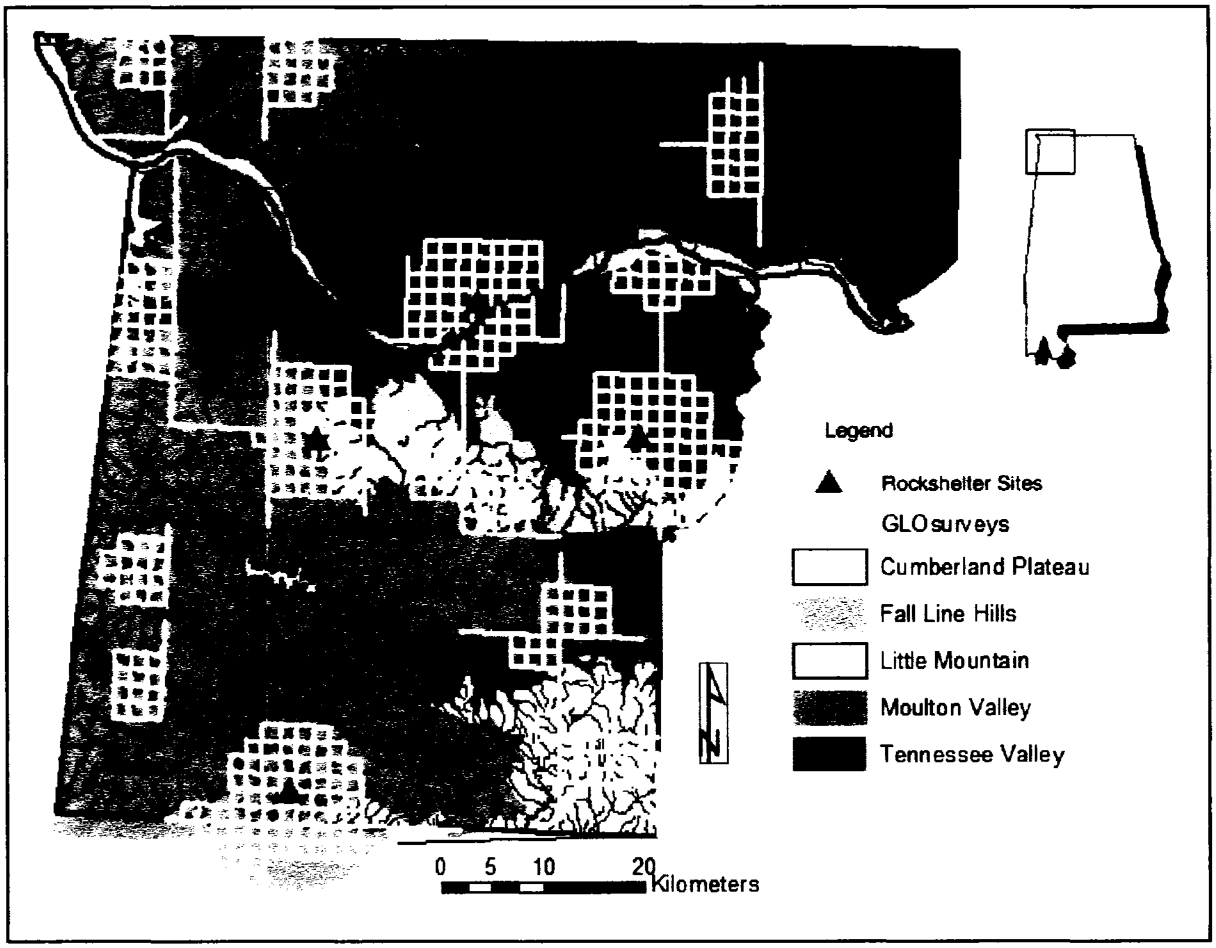


Figure 9.1. Map of project area showing township sections for which GLO survey data was obtained. Insert shows relation of project area to the state of Alabama.

seen in Table 9.3, four of the surveyors demonstrated significant bias ($p < 0.05$)[1] towards a particular species, often within one physiographic region. Subsequently, I did not use the notes of these surveyors in quantitative descriptions of the plant communities.

I consider the 1817-1820 and 1833-1834 field notes separately for two reasons. First, significant changes in plant communities may have occurred during the fifteen years that separate the

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[1] In other words, the chance that the preferred species would randomly occur at its average distance relative to the average distance of the other species is less than 1 in 20. I debated whether to discard the data from surveyors with a significance value (p) of less than 0.10. However, I have compared the quantitative results of including and excluding their data, and do not find significant differences between the two. This is likely due to the fact that there are so many surveyors; any one person's biases are not likely to dominate the data as a whole.

Table 9.1. Tree Species in Northwest Alabama Identified by GLO Surveyors.

Common Name	Scientific Name	Common Name	Scientific Name
Ash	*Fraxinus* spp.	Nay tree	Unkown
Beech	*Fagus grandifolia*	Oak	*Quercus* spp.
Black gum	*Nyssa sylvatica*	Persimmon	*Diospyros virginiana*
Black jack	*Quercus marilandica*	Pine	*Pinus* spp.
Black locust	*Robinia pseudo-acacia*	Pin oak	*Quercus palustris*
Black oak	*Quercus velutina*	Plumb tree	*Prunus* spp.
Box elder	*Acer negundo*	Poplar	*Liriodendron tulipifera* or *Populus* spp.
Brush	Unknown	Post oak	*Quercus stellata*
Cedar	*Juniperus virginiana*	Red bud	*Cercis canadensis*
Chestnut oak	*Quercus prinus*	Red elm	*Ulmus rubra*
Cucumber tree	*Magnolia acuminata*	Red oak	*Quercus rubra* or *Q. shumardii*
Cypress	*Taxodium distichum*	Sassafras	*Sassafras albidum*
Dogwood	*Cornus florida*	Sour oak	Sourwood?
Elm	*Ulmus americana* or *U. alata*	Sourwood	*Oxydendrum arboreum*
Gum	Black gum or Sweet gum	Spanish oak	*Quercus falcata*
Hackberry	*Celtis* spp.	Sugar tree	*Acer saccharum*
Hickory	*Carya* spp.	Sumac	*Rhus copallina* or *R. glabra*
Holly	*Ilex opaca*	Swamp oak	*Quercus michauxii* or *Q. bicolor*
Honey locust	*Gleditsia triacanthos*	Sweet gum	*Liquidambar styraciflua*
Hornbeam	*Carpinus caroliniana*	Sycamore	*Platanus occidentalis*
Ironwood	*Ostrya virginiana*	Walnut	*Juglans nigra*
Locust	Black locust or Honey locust	Water oak	*Quercus nigra*
Lynn	*Tilia americana*	White oak	*Quercus alba*
Maple	*Acer rubrum* or *A. saccharum*	Willow	*Salix* spp.
Mulberry	*Morus rubra*	Willow oak	*Quercus phellos*

two, with the increased settlement of the area by Euro-Americans. Second, the instructions for recording witness trees changed by the 1833-1834 surveys, requiring surveyors to estimate the diameter of witness trees at breast height and to record two witness trees at the quarter-section posts. I include the quarter-section witness trees in calculations of Relative Density because of the additional information that they provide. However, I do not include them in calculations of Relative Frequency because they do not compare well with the section corners, where four trees were recorded.

Table 9.2. GLO Surveyors Whose Notes Were Consulted for This Study.

Surveyor	Year	County	Number of Corners Surveyed	Number of Trees Surveyed
Samuel Bell	1818	Colbert		44
James Blakemore	1817	Lauderdale	30	120
Anderson Bright	1817	Lauderdale	7	14
Ben Clements	1818	Colbert,	7	60
		Franklin,	3	
		Marion	6	
Richard Coffee	1833	Colbert	37	264
J.W. Coffee	1820	Lauderdale	1	2
Thomas Coffee	1833	Colbert	34	254
James W. Ecum	1817	Lauderdale	6	22
Daniel Gilchrist	1818	Colbert	29	116
Malcolm Gilchrist	1818	Franklin	5	20
Ralph Graves	1817	Lauderdale	6	24
Thomas Hardeman	1818	Franklin	3	12
Benjamin Harris	1818	Colbert	24	114
Robert D. Harris	1818	Colbert,	16	299
		Franklin,	31	
		Marion	8	
Simpson Harris	1820	Marion	10	82
David Hubbert	1818	Colbert	12	40
Stewart Jackson	1833-1834	Colbert	44	276
H.M. Johnson	1817	Lauderdale	2	6
LeRoy May	1818	Franklin	40	162
Robert McCombs	1817	Lauderdale	20	80
John P. McCutcham	1820	Marion	5	32
James McGregor	1820	Marion	6	42
Richard McMahon	1818	Colbert	5	22
David Mitchell	1818	Colbert	41	149
George Perry	1818	Colbert	25	92
John Ralston	1818	Colbert,	9	146
		Franklin	23	
Benjamin Smith	1818	Franklin	9	36
Lewis Tucker	1833-1834	Franklin	30	236
James Vauly	1817	Lauderdale	32	115
James W. Waggatt	1817	Lauderdale	19	74
Da. H. Weakley	1817	Lauderdale	12	48
Miles Woodfier	1818	Colbert	14	56

Table 9.3. One-Way ANOVA (Tree by Distance) for GLO Surveyors to Detect Bias in Species Recorded. Asterisk (*) Designates Significance Values Less Than 0.05.

Surveyor	Physiographic Region	Source	Sum of Squares	Deg. of Freedom	Mean Square	F-Ratio	Signif. (P)
Bell		Between	2342.898	5	468.580	0.871	0.510
		Within	20448.079	38	538.107		
Blakemore		Between	1615.733	6	269.289	0.679	0.667
		Within	44842.234	113	396.834		
Bright		Between	2067.254	4	516.813	0.305	0.867
		Within	15239.550	9	169.283		
Clements	All	Between	4791.760	8	598.970	0.816	0.592
		Within	37418.424	51	733.695		
	Fall Line Hills	Between	2492.439	7	356.063	0.957	0.481
		Within	10419.200	28	372.114		
	Tenn. Valley	Between	855.571	3	285.190	0.232	0.873
		Within	24535.762	20	1226.788		
R. Coffee	All	Between	21628.249	15	1441.883	1.022	0.433
		Within	350041.070	248	1411.456		
	Fall Line Hills	Between	13361.045	11	1214.640	0.778	0.662
		Within	274725.822	176	1560.942		
	Tenn. Valley	Between	12195.238	8	1524.405	1.441	0.196
		Within	70895.749	67	1058.146		
T. Coffee	All	Between	8216.616	15	547.774	1.391	0.152
		Within	93741.640	238	393.872		
	Fall Line Hills	Between	6684.219	15	445.615	0.988	0.470
		Within	76679.227	170	451.054		
	Little Mountain	Between	4337.319	7	619.617	2.612	0.020*
		Within	14234.917	60	237.249		
Ecum		Between	2023.823	4	505.956	0.629	0.648
		Within	13676.950	17	804.526		
D. Gilchrist	All	Between	13946.688	9	1549.632	2.355	0.018*
		Within	69743.112	106	657.954		
	Little Mountain	Between	758.722	5	151.744	0.226	0.948
		Within	17449.997	26	671.154		
	Tenn. Valley	Between	14913.990	5	2982.798	4.242	0.003*
		Within	37971.756	54	703.181		
	Warrior Basin	Between	2904.158	3	968.053	2.110	0.131
		Within	9175.800	20	458.790		
M. Gilchrist		Between	2028.800	2	1014.400	0.593	0.564
		Within	29093.000	17	1711.353		
Graves		Between	717.958	4	179.490	0.532	0.714
		Within	6409.375	19	337.336		
Hardeman		Between	1059.750	2	529.875	1.517	0.271
		Within	3144.500	9	349.389		
B. Harris	All	Between	11776.625	8	1472.078	2.225	0.031*
		Within	68804.473	104	661.581		
	Little Mountain	Between	2607.613	5	521.523	0.909	0.485
		Within	21801.114	38	573.714		
	Tenn. Valley	Between	1387.240	4	346.810	0.389	0.815
		Within	20527.724	23	892.510		
	Fall Line Hills	Between	1584.331	4	396.083	0.761	0.558
		Within	18735.767	36	520.438		
R. Harris	All	Between	256215.793	15	17081.053	6.016	0.000*
		Within	803495.302	283	2839.206		

Table 9.3 (continued). One-way ANOVA (tree by distance) for GLO surveyors to detect bias in species recorded. Asterisk (*) Designates Significance Values Less Than 0.05.

Surveyor	Physiographic Region	Source	Sum of Squares	Deg. of Freedom	Mean Square	F-Ratio	Signif. (P)
	Fall Line Hills	Between	8977.160	13	690.551	1.800	0.047*
		Within	61770.555	161	383.668		
	Tenn. Valley	Between	118952.244	5	23790.449	2.001	0.092
		Within	689666.193	58	11890.796		
	Warrior Basin	Between	1286.726	5	257.345	0.609	0.694
		Within	22833.319	54	422.839		
S. Harris		Between	1746.002	4	436.500	1.644	0.172
		Within	20450.193	77	265.587		
Hubbert		Between	996.431	5	199.286	0.475	0.792
		Within	14272.544	34	419.781		
Jackson	All	Between	33789.901	17	1987.641	1.307	0.188
		Within	392314.802	258	1520.600		
	Fall Line Hills	Between	9209.262	14	657.804	0.954	0.504
		Within	95843.861	139	689.524		
	Little Mountain	Between	115.800	3	38.600	0.104	0.957
		Within	11908.200	32	372.131		
	Tenn. Valley	Between	9369.521	4	2342.380	0.677	0.610
		Within	280192.200	81	3459.163		
May	All	Between	3142.956	8	392.870	0.586	0.789
		Within	102618.038	153	670.706		
	Fall Line Hills	Between	2223.407	3	741.136	1.697	0.197
		Within	9609.708	22	436.805		
	Moulton Valley	Between	1761.558	4	440.390	0.490	0.743
		Within	63839.218	71	899.144		
	Warrior Basin	Between	906.682	6	151.114	0.324	0.922
		Within	24738.302	53	466.760		
McCombs		Between	4408.015	6	734.669	1.240	0.296
		Within	43264.185	73	592.660		
McCutcham		Between	3305.785	3	1101.928	2.254	0.104
		Within	13686.683	28	488.810		
McGregor		Between	1508.936	5	301.787	0.962	0.454
		Within	11299.183	36	313.866		
McMahon		Between	4232.575	2	2116.288	2.642	0.097
		Within	15219.243	19	801.013		
Mitchell		Between	27946.617	6	4657.770	4.837	0.000*
		Within	136748.739	142	963.019		
Perry	All	Between	5038.385	8	629.798	1.980	0.059
		Within	26400.232	83	318.075		
	Fall Line Hills	Between	15.238	1	15.238	0.093	0.767
		Within	1641.429	10	164.143		
	Little Mountain	Between	2555.011	6	425.835	1.937	0.092
		Within	11649.201	53	219.796		
	Tenn. Valley	Between	470.400	1	470.400	0.588	0.453
		Within	14398.800	18	799.933		
Ralston	All	Between	5112.948	9	568.105	1.219	0.288
		Within	63369.787	136	465.954		
	Fall Line Hills	Between	4921.869	7	703.124	1.954	0.070
		Within	33827.121	94	359.863		
	Little Mountain	Between	1593.720	4	398.430	0.575	0.683
		Within	21475.190	31	692.748		

Table 9.3 (continued). One-way ANOVA (tree by distance) for GLO surveyors to detect bias in species recorded. Asterisk (*) Designates Significance Values Less Than 0.05.

Surveyor	Physiographic Region	Source	Sum of Squares	Deg. of Freedom	Mean Square	F-Ratio	Signif. (P)
Smith		Between	2252.313	4	563.078	0.601	0.665
		Within	29054.687	31	937.248		
Tucker		Between	7189.596	11	653.600	1.503	0.131
		Within	96512.288	222	434.740		
Vauly		Between	14010.624	7	2001.518	1.851	0.085
		Within	114633.560	106	1081.449		
Waggatt	All	Between	12952.521	7	1227.948	1.507	0.181
		Within	77360.718	63			
	Tenn. Valley	Between	15882.218	3	5294.073	2.286	0.107
		Within	50959.667	22	2316.348		
	Fall Line Hills	Between	1816.283	5	363.257	0.676	0.644
		Within	20948.917	39	537.152		
Weakley	All	Between	1340.488	4	335.122	0.441	0.778
		Within	32691.179	43	760.260		
	Fall Line Hills	Between	948.265	4	237.066	0.425	0.790
		Within	21748.917	39	557.665		
Woodfier	All	Between	1994.057	5	398.811	1.545	0.193
		Within	12907.438	50	258.149		
	Little Mountain	Between	1690.001	5	338.000	1.272	0.294
		Within	11163.827	42	265.805		

Forest Communities in the Tennessee Valley Region. The Tennessee Valley region is well represented in the GLO data that I have compiled. Of the 1817-1820 data, 152 section corners and 574 individual trees are assigned to this region; the 1833-1834 data include 25 corners and 161 trees. Both sets of data indicate that the bottom communities are the richest in terms of the number of species represented (Table 9.4). Exclusive to bottomland forests are species that thrive in rich deciduous forests, including box elder, black walnut, hornbeam, ironwood, and American basswood (which the surveyors referred to as "lynn"). Also recorded only in the creek bottoms are a number of species that prefer moist soils, such as hackberry and cypress, as well as fruit trees such as honey locust and mulberry.

As indicated by the 1817-1820 field notes, slope communities are notably dominated by various oak species and hickory; chestnut and poplar are also relatively well represented. Additional species present in smaller quantities include ash, black gum and sweet gum, beech, elm, and pine.

Table 9.4. Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Tennessee Valley Region.

1817-1820:	River/Creek					Slopes					Upland				
Taxon	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Ash	5	0.06	5	0.14	0.21	2	0.01	2	0.05	0.07	2	0.01	1	0.01	0.02
Beech	1	0.01	1	0.03	0.04	1	0.01	1	0.03	0.03					
Black gum	3	0.04	3	0.08	0.11	2	0.01	2	0.05	0.07					
Black jack						4	0.03	2	0.05	0.08	16	0.10	18	0.23	0.34
Black locust	1	0.01	1	0.03	0.04										
Black oak	7	0.09	5	0.14	0.20	27	0.18	18	0.49	0.67	38	0.23	34	0.43	0.69
Box elder			1	0.03	0.04										
Brush	2	0.02	2	0.06	0.07										
Chestnut	1	0.01	1	0.03	0.04	12	0.08	9	0.24	0.32	6	0.04	4	0.05	0.07
Chestnut oak	2	0.02	1	0.03	0.05	1	0.01	1	0.03	0.03					
Cypress			1	0.03	0.04										
Dogwood	1	0.01	1	0.03	0.04						1	0.01	1	0.01	0.02
Elm	3	0.04	7	0.19	0.26	1	0.01	1	0.03	0.03			1	0.01	0.01
Hackberry	3	0.04	4	0.11	0.15										
Hickory	14	0.17	16	0.44	0.63	17	0.12	15	0.41	0.52	23	0.14	31	0.39	0.56
Honey locust	1	0.01	1	0.03	0.04										
Hornbeam	1	0.01	1	0.03	0.04										
Ironwood	1	0.01	2	0.06	0.07										
Maple	2	0.02	1	0.03	0.05										
Oak	1	0.01	1	0.03	0.04										
Pine	4	0.05	2	0.06	0.09	4	0.03	2	0.05	0.08					
Plumb tree	1	0.01	1	0.03	0.04										
Poplar	2	0.02	3	0.08	0.12	9	0.06	8	0.22	0.28	2	0.01	1	0.01	0.02
Post oak	2	0.02	1	0.03	0.05	19	0.13	12	0.32	0.45	42	0.25	39	0.49	0.73
Red oak	4	0.05	4	0.11	0.15	15	0.10	10	0.27	0.37	11	0.07	15	0.19	0.26
Spanish oak	1	0.01	2	0.06	0.07	2	0.01	2	0.05	0.07	3	0.02	1	0.01	0.02
Sugar tree	3	0.04	3	0.08	0.11										
Swamp oak											1	0.01	1	0.01	0.02
Sweet gum	2	0.02	5	0.14	0.20	1	0.01	1	0.03	0.03	3	0.02	3	0.04	0.05
Walnut	1	0.01	1	0.03	0.04										
White oak	12	0.15	13	0.36	0.51	30	0.20	19	0.51	0.72	21	0.13	14	0.18	0.25

Table 9.4 (continued). Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Tennessee Valley Region.

	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Willow oak										1	0.01	1	0.01	0.02	
Total	81		36 corners			147		37 corners			170		79 corners		
1833-1834:															
Ash	8	0.12	2	0.20	0.32						1	0.02			0.02
Beech	3	0.04	1	0.10	0.14										
Black gum	3	0.04	2	0.20	0.24										
Black jack											2	0.03	2	0.20	0.23
Black oak	1	0.01			0.01	4	0.13	3	0.60	0.73	20	0.33	7	0.70	1.03
Box elder	2	0.03			0.03										
Chestnut oak						1	0.03			0.03					
Cypress	2	0.03			0.03										
Dogwood	4	0.06	2	0.20	0.26										
Elm						1	0.03	1	0.20	0.23	1	0.02			0.02
Hickory	12	0.18	2	0.20	0.38	3	0.09	2	0.40	0.49	7	0.11	7	0.70	0.81
Hornbeam	1	0.01			0.01						1	0.02			0.02
Ironwood	1	0.01	1	0.10	0.11										
Lynn	1	0.01	1	0.10	0.11										
Maple	2	0.03	1	0.10	0.13										
Mulberry	1	0.01	1	0.10	0.11										
Pine	3	0.04	2	0.20	0.24	4	0.13	1	0.20	0.33	2	0.03			0.03
Poplar						1	0.03	1	0.20	0.23	1	0.02	1	0.10	0.12
Post oak	1	0.01	1	0.10	0.11	9	0.28	2	0.40	0.68	15	0.25	4	0.40	0.65
Red elm	3	0.04			0.04										
Red oak	4	0.06	1	0.10	0.16	4	0.13	1	0.20	0.33					
Sassafras						1	0.03	1	0.20	0.23					
Sourwood						1	0.03	1	0.20	0.23					
Spanish oak	3	0.04	1	0.10	0.14										
Sugar tree	1	0.01	1	0.10	0.11						2	0.03	1	0.10	0.13
Sweet gum	7	0.10	3	0.30	0.40						3	0.05	1	0.10	0.15
Sycamore	1	0.01	1	0.10	0.11						1	0.02			0.02

Table 9.4 (continued). Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Tennessee Valley Region.

	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
White oak	4	0.06	1	0.10	0.16	3	0.09	2	0.40	0.49	5	0.08	2	0.20	0.28
Total	68		10 corners			32		5			61		10 corners		

Oaks and hickories are even more dominant in upland communities. Chestnuts and poplars are poorly represented, along with sweet gum, ash, poplar, dogwood, and elm. The 1833-1834 field notes also reflect these differences. Pine, elm, poplar, sassafras, and sourwood are much better represented among the oaks and hickories of the Tennessee Valley slopes than they are in the uplands. Interestingly, chestnut is absent from the 1833-1834 records, while pine has a notably higher Frequency-Density Index. This is also true of pine in the creek bottoms. These differences between the 1817-1820 and 1833-1834 are related in part to the location of the surveys. The 1833-1834 surveys include areas of the Tennessee Valley region within Colbert County that are adjacent to the Fall Line Hills and Little Mountain. The higher frequency of pine in particular thus likely represents mixing between these communities and the forests of the Tennessee Valley. Alternatively, the increase in pine might reflect the impact of Euro-American settlers, with pine rapidly succeeding cleared hardwood forests. However, the surveyors make no mention of privately-owned property in this area.

The density of trees per acre is not significantly different among the three topographic zones in either the 1817-1820 or 1833-1834 data (Figure 9.2). However, the uplands have a slightly lower density of trees per acre than the other two zones (note that the wider spread in values for slopes in the 1833-1834 notes is related to the smaller number of corners surveyed). This suggests that the forests of the Tennessee Valley uplands, characterized by oaks and hickories, may have been more open than the more diverse slope communities and remarkably rich bottomlands. Fire, more readily swept by wind across the level uplands than along either the slopes of protected valleys or moist bottom communities, might have created such a pattern.

Forest Communities in the Little Mountain Region. The Little Mountain region is not as well represented among the field notes as the Tennessee Valley region. The 1817-1820 notes record 238 trees at 60 corners, while the 1833-1834 notes include only four corners and 36 trees (Table 9.5). Among the three topographic zones, creek bottoms are poorly represented, with only five corners and

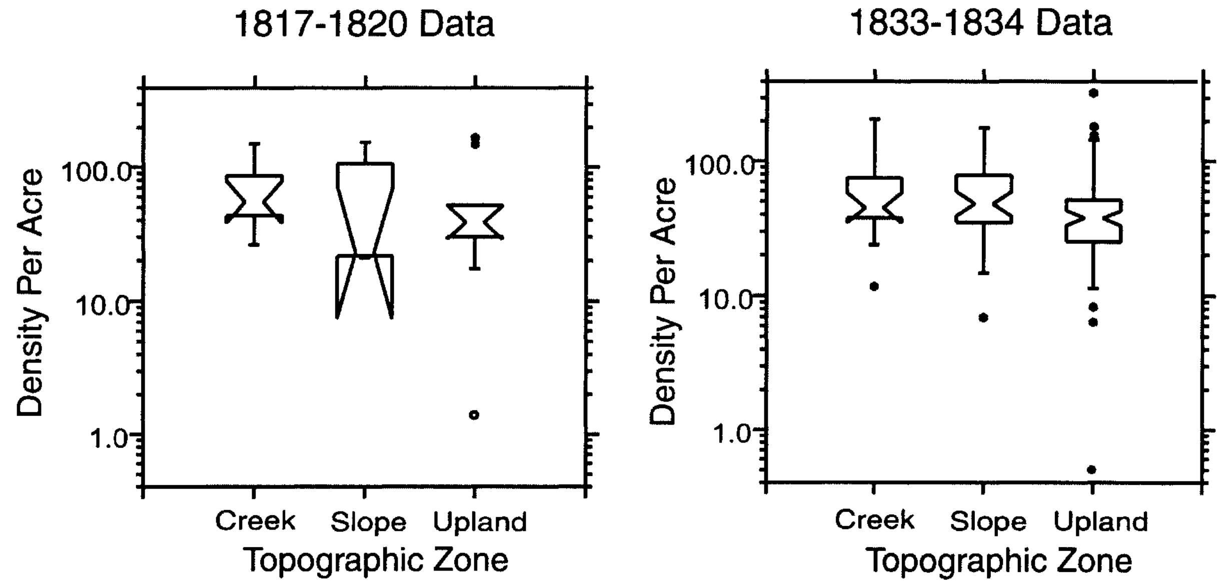

Figure 9.2. Boxplots comparing the density per acre of recorded trees by topographic zone in the Tennessee Valley region.

20 trees. Because of the small sample size, these data should be cautiously interpreted. Hickories and oaks appear to dominate these bottom communities, while ash, dogwood, mulberry, poplar, and sugar tree are present in smaller quantities.

In comparison, slopes and uplands are much better represented. The 1817-1820 notes indicate that slope communities are dominated by oak, pine, and hickory. Chestnut is also a significant component of these forests. Present in smaller numbers are ash, elm, black gum, ironwood, sassafras and sourwood. The 1833-1834 field notes suggest a similar dominance of oak, followed by hickory and pine, although the sample is small. Oaks comprise a greater proportion of upland forests, while hickory, chestnut and black gums have similar Frequency-Density Index values. Pine is notably lower in the uplands than in the slopes. Sourwood, maple, sweet gum, persimmon, elm and poplar are also recorded among the upland communities. Comparison of the density of trees per acre among the three topographic zones demonstrates no significant differences (Figure 9.3).

The broad picture suggested by the field notes for the Little Mountain region, then, is of creek bottom communities of hickory and oak in which pine appears to have been rare, if present at all. In

Table 9.5. Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Little Mountain Region.

1817-1820:	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Ash	2	0.12	1	0.20	0.30	3	0.03	3	0.11	0.13					
Black gum						1	0.01	1	0.04	0.04	4	0.05	7	0.26	0.35
Black jack						2	0.02	2	0.07	0.10					
Black oak	3	0.18	2	0.40	0.55	8	0.09	9	0.32	0.43	14	0.19	12	0.44	0.62
Chestnut						7	0.08	7	0.25	0.33	5	0.07	7	0.26	0.34
Chestnut oak								1	0.04	0.04	1	0.01	3	0.11	0.14
Dogwood	1	0.06	1	0.20	0.25										
Elm						2	0.02	2	0.07	0.09	1	0.01	1	0.04	0.05
Hickory	4	0.24	4	0.80	1.10	13	0.14	9	0.32	0.44	7	0.09	6	0.22	0.31
Ironwood						1	0.01	1	0.04	0.04					
Maple											1	0.01	2	0.07	0.10
Mulberry	1	0.06	1	0.20	0.25										
Persimmon											1	0.01	1	0.04	0.05
Pine						14	0.16	10	0.36	0.52	3	0.04	4	0.15	0.20
Pin oak						2	0.02	1	0.04	0.05					
Poplar			1	0.20	0.25								1	0.04	0.05
Post oak						10	0.11	7	0.25	0.37	19	0.26	10	0.37	0.55
Red oak						1	0.01	1	0.04	0.04	1	0.01	1	0.04	0.05
Sassafras						1	0.01	1	0.04	0.04					
Sourwood						1	0.01	1	0.04	0.04	3	0.04	2	0.07	0.11
Spanish oak						2	0.02	3	0.11	0.13	2	0.03	2	0.07	0.09
Sugar tree	1	0.06	1	0.20	0.25										
Sweet gum											1	0.01	2	0.07	0.09
White oak	5	0.29	3	0.60	0.85	22	0.24	16	0.57	0.81	11	0.15	18	0.67	0.82
Total	17		5 corners			90		28 corners			74		27 corners		

Table 9.5 (continued). Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Little Mountain Region.

1833-1834:	All Zones*		Slope				
	RD Count	RD	RD Count	RD	RF Count	RF	FDI
Black gum	5	0.14	5	0.14	1	0.25	0.39
Black oak	5	0.14	5	0.14	1	0.25	0.39
Chestnut	2	0.06	2	0.06			0.06
Chestnut oak	6	0.17	6	0.17	2	0.5	0.67
Hickory	2	0.06	2	0.06	1	0.25	0.31
Hornbeam	1	0.03	1	0.03			0.03
Ironwood	1	0.03	1	0.03	1	0.25	0.28
Pine	1	0.03	1	0.03	1	0.25	0.28
Poplar	1	0.03	1	0.03			0.03
Post oak	3	0.08	3	0.08			0.08
Sourwood	2	0.06	2	0.06			0.06
Spanish oak	2	0.06	2	0.06	1	0.25	0.31
Sugar tree	1	0.03	1	0.03			0.03
Sweet gum	1	0.03	1	0.03	1	0.25	0.28
White oak	3	0.08	3	0.08	1	0.25	0.33
Total	36		36		4 corners		

* No section corners were available for river/creek and upland zones; however, the available data was combined to calculate Relative Densities of tree species for all zones.

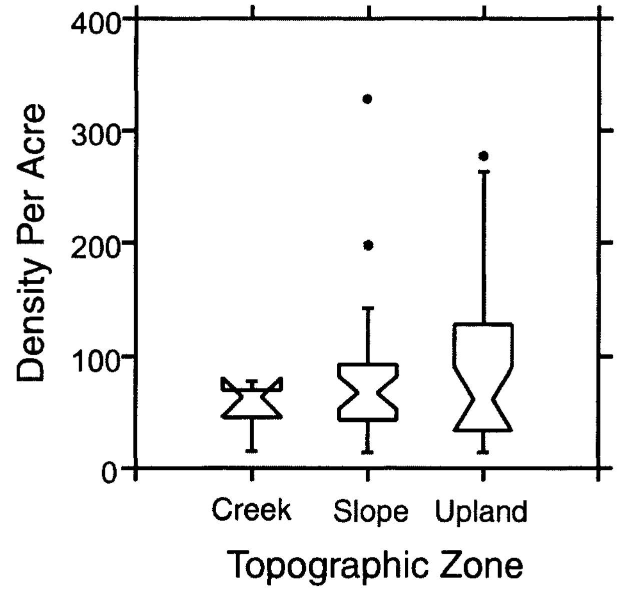

Figure 9.3. Boxplot comparing the density per acre of recorded trees by topographic zone in the Little Mountain region.

contrast, pine is well represented in forests along slopes, with a Frequency-Density Index value twice that of the upland zone. If pine is used as a proxy for forest richness and productivity, then creek bottoms appear to be the richest and slopes the poorest of the three zones. Hickory is particularly well represented in creek bottoms, although its importance may well be exaggerated due to the small sample size. Oaks, on the other hand, dominate upland communities. Chestnut and hickory appear to be subdominates of forests both along slopes and in the uplands.

Forest Communities in the Fall Line Hills Region. The Fall Line Hills region is well represented by 99 corners and 515 trees in the 1817-1820 surveys, and by 101 corners and 728 trees in the 1833-1834 surveys (Table 9.6). The large majority of these are assigned to slopes, which is not surprising given the highly dissected nature of this physiographic region. Creek bottoms and uplands claim much less area and are thus represented by many fewer section corners and quarter-section posts.

Table 9.6. Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Fall Line Hills Region.

1817-1820:	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Black gum						2	0.01	2	0.03	0.03	2	0.02	1	0.04	0.06
Black jack						2	0.01								
Black oak	2	0.11	3	0.50	0.63	51	0.18	32	0.46	0.63	26	0.22	14	0.61	0.84
Chestnut	4	0.21	2	0.33	0.47	39	0.14	25	0.36	0.51	23	0.19	11	0.48	0.66
Chestnut oak						8	0.03	7	0.10	0.13					
Cucumber tree						1	0.00			0.00					
Dogwood	1	0.05			0.03	7	0.02	6	0.09	0.11	5	0.04	3	0.13	0.17
Gum	1	0.05	1	0.17	0.20	2	0.01	2	0.03	0.03	1	0.01	1	0.04	0.05
Hickory	1	0.05	1	0.17	0.20	18	0.06	15	0.21	0.27	6	0.05	4	0.17	0.22
Maple	2	0.11	1	0.17	0.23	3	0.01	4	0.06	0.07					
Nay tree	1	0.05	1	0.17	0.20										
Oak						2	0.01	1	0.01	0.02					
Persimmon						1	0.00	1	0.01	0.02					
Pine	1	0.05	1	0.17	0.20	45	0.16	20	0.29	0.46	14	0.12	5	0.22	0.33
Poplar			1	0.17	0.20	2	0.01	1	0.01	0.02			1	0.04	0.05
Post oak	1	0.05	1	0.17	0.20	26	0.09	11	0.16	0.24	29	0.24	14	0.61	0.84
Red oak						20	0.07	15	0.21	0.29	7	0.06	2	0.09	0.14
Sassafras						1	0.00			0.00					
Sourwood	1	0.05			0.03	6	0.02	5	0.07	0.10	1	0.01	1	0.04	0.05
Spanish oak						3	0.01	3	0.04	0.05	1	0.01	1	0.04	0.05
Sweet gum			1	0.17	0.20	1	0.00	1	0.01	0.02					
Water oak						2	0.01	1	0.01	0.02					
White oak	4	0.21	2	0.33	0.50	41	0.14	30	0.43	0.59	5	0.04	2	0.09	0.14
Total	19		6 corners			283		70 corners			120		23 corners		
1833-1834:															
Ash	8	0.06	3	0.18	0.23	6	0.01	3	0.04	0.05	1	0.02			0.02
Beech	19	0.14	5	0.29	0.43	4	0.01	2	0.03	0.03					
Black gum	8	0.06	3	0.18	0.23	15	0.03	9	0.12	0.14					
Black jack						19	0.04	6	0.08	0.11					

Table 9.6 (continued). Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Fall Line Hills Region.

	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Black oak	3	0.02	2	0.12	0.14	48	0.09	24	0.31	0.40	10	0.21	3	0.43	0.64
Cedar	1	0.01			0.01										
Chestnut	1	0.01			0.01	38	0.07	19	0.25	0.32	2	0.04	1	0.14	0.18
Chestnut oak								13	0.17	0.17	1	0.02			0.02
Cypress	1	0.01	1	0.06	0.07										
Dogwood	5	0.04	1	0.06	0.09	11	0.02	3	0.04	0.06					
Elm	1	0.01			0.01	3	0.01			0.01	1	0.02	1	0.14	0.16
Hickory	7	0.05	3	0.18	0.23	59	0.11	18	0.23	0.34	7	0.15	3	0.43	0.57
Holly	7	0.05	2	0.12	0.17										
Hornbeam	2	0.01			0.01										
Ironwood	2	0.01	1	0.06	0.07										
Lynn	2	0.01	1	0.06	0.07	2	0.00	1	0.01	0.02					
Maple	1	0.01	1	0.06	0.07										
Persimmon						1	0.00								
Pine	11	0.08	4	0.24	0.31	108	0.20	32	0.42	0.62	6	0.13	1	0.14	0.27
Poplar	2	0.01	1	0.06	0.07	6	0.01	4	0.05	0.06	1	0.02	1	0.14	0.16
Post oak	2	0.01	1	0.06	0.07	52	0.10	23	0.30	0.39	7	0.15	3	0.43	0.57
Red bud	1	0.01	1	0.06	0.07										
Red oak	9	0.06	3	0.18	0.24	76	0.14	27	0.35	0.49	7	0.15	3	0.43	0.57
Sassafras	4	0.03	2	0.12	0.15	4	0.01			0.01					
Sumac	2	0.01			0.01										
Sour oak						1	0.00	1	0.01	0.01					
Sourwood	2	0.01	1	0.06	0.07	13	0.02	3	0.04	0.06					
Spanish oak	2	0.01	1	0.06	0.07	10	0.02	4	0.05	0.07					
Sugar tree	5	0.04	3	0.18	0.21	1	0.00								
Sweet gum	1	0.01	1	0.06	0.07	2	0.00	1	0.01	0.02	2	0.04	2	0.29	0.33
Walnut	1	0.01			0.01										
White oak	22	0.16	7	0.41	0.57	62	0.11	21	0.27	0.39	3	0.06	2	0.29	0.35
Willow	3	0.02	1	0.06	0.08										
Willow oak	4	0.03			0.03										

Of the three topographic zones, creek bottoms appear to be the richest. The 1833-1834 field notes include 17 corners and 139 trees representing 30 species. Of 1817-1820 survey data, the thirty trees recorded in creek bottoms comprise fourteen species. These include species that prefer moist grounds, such as cypress and willow, as well as trees that favor rich soils, like walnut, hornbeam, ironwood, and beech. White oak and beech are the predominant species, although pine is also relatively well represented.

Pine is a much larger constituent of slope communities, however, particularly as recorded in the 1833-1834 field notes. Oaks are prominent in both sets of field notes, although more so in the earlier surveys. Chestnut is also a larger constituent of earlier forested slopes. Hickory, on the other hand, remains relatively low in both surveys. Upland communities are poorly represented in the 1833-1834 field notes by only seven corners and 48 trees. Both sets of surveys indicate that oak species are predominant. The more sizeable 1817-1820 notes suggest that chestnuts also thrived in the uplands. Pine is relatively well represented, although it appears to be a lesser component of upland forests than of forests on slopes. Hickory and dogwood are also present in somewhat lower quantities.

Comparisons of density of trees per area suggest no differences among the three topographic zones by either the 1817-1820 or the 1833-1834 field notes (Figure 9.4). In general, then, creek bottoms appear to be the richest communities, supporting a wide variety of hardwood species and relatively low percentages of pine. Forests in the uplands appear to be more productive than those found on slopes, as Frequency-Density Index values are lower for pine and higher for chestnut, as well as some of the oak species, in upland communities.

Forest Communities in the Moulton Valley Region. The Moulton Valley region is relatively poorly represented in the 1817-1820 field notes included in this survey. Of the 30 corners studied here, only two were located in creek bottom settings and six along slopes (Table 9.7). As such, quantitative measures are not well suited to the data. Several qualitative statements may be

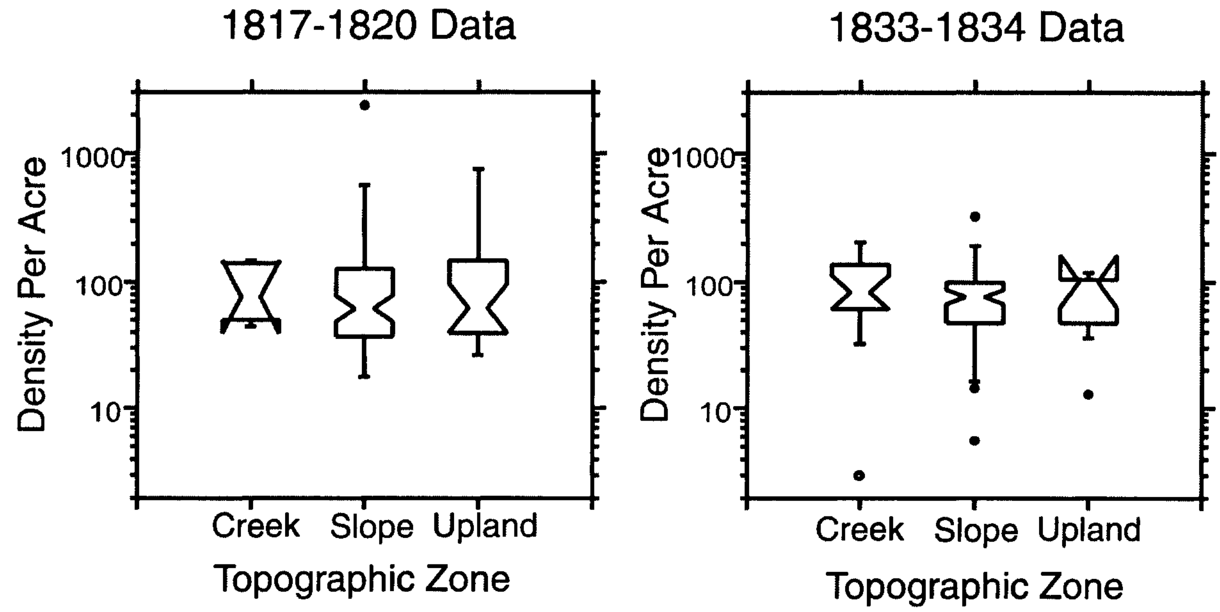

Figure 9.4. Boxplots comparing the density per acre of recorded trees by topographic zone in the Fall Line Hills region.

made, however. Oaks and hickories appear to dominate the forests of the region. The Frequency-Density Index value of hickory in the uplands, a zone represented by 22 corners and 88 trees, is notably high. The forests of the region appear to be relatively rich, as the surveyors recorded very little pine. Furthermore, the upland communities include a range of species that prefer rich soils, including ash, elm, ironwood and mulberry. As such, it is reasonable to classify the forests of the region as highly productive.

Forest Communities in the Cumberland Plateau Region. While the Cumberland Plateau region is relatively well represented, including 42 section corners and 168 trees recorded in the 1817-1820 surveys, only one of these corners occurs in a creek bottom setting and four in the uplands (Table 9.8). Similar to the Fall Line Hills region, this uneven distribution is related to the highly dissected nature of the Plateau. As such, few comparisons between the topographic zones can be made. In general, however, the forests of the region appear to be relatively poor, as pine has notably

Table 9.7. Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Moulton Valley Region.

1817-1820:	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Ash	3	0.38	2	1	1.38	1	0.04	1	0.17	0.21	2	0.02	2	0.09	0.11
Black gum											1	0.01	1	0.05	0.06
Black jack											1	0.01	1	0.05	0.06
Black oak						3	0.13	2	0.33	0.46	9	0.10	5	0.23	0.33
Cedar											1	0.01	1	0.05	0.06
Chestnut oak	1	0.13	1	0.50	0.63										
Dogwood											3	0.03	2	0.09	0.13
Elm											3	0.03	3	0.14	0.17
Gum	1	0.13	1	0.50	0.63										
Hackberry											1	0.01	1	0.05	0.06
Hickory	2	0.25	1	0.50	0.75	3	0.13	2	0.33	0.46	23	0.26	13	0.59	0.85
Ironwood											3	0.03	1	0.05	0.08
Locust											1	0.01	1	0.05	0.06
Mulberry											1	0.01	1	0.05	0.06
Pine											2	0.02	1	0.05	0.07
Post oak						7	0.29	4	0.67	0.96	26	0.30	12	0.55	0.84
Red oak	1	0.13	1	0.50	0.63	5	0.21	2	0.33	0.54	7	0.08	5	0.23	0.31
Sassafras						1	0.04	1	0.17	0.21					
Spanish oak						1	0.04	1	0.17	0.21	1	0.01	1	0.05	0.06
Sweet gum						1	0.04	1	0.17	0.21					
White oak						2	0.08	2	0.33	0.42	3	0.03	3	0.14	0.17
Total	8		2 corners			24		6 corners			88		22 corners		

Table 9.8. Comparison of Relative Density (RD), Relative Frequency (RF), and Frequency-Density Index (FDI) for Tree Species Recorded by Topographic Setting in the Cumberland Plateau Region.

1817-1820:	River/Creek					Slope					Upland				
	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI	RD Count	RD	RF Count	RF	FDI
Black gum						2	0.01	2	0.05	0.07					
Black oak						32	0.22	15	0.41	0.62	1	0.06	1	0.25	0.31
Chestnut	1	0.25	1	1	1.25	22	0.15	15	0.41	0.55	5	0.31	4	1.00	1.31
Chestnut oak						3	0.02	3	0.08	0.10	1	0.06	1	0.25	0.31
Cucumber tree						1	0.01	1	0.03	0.03					
Dogwood						4	0.03	4	0.11	0.14					
Hickory						9	0.06	6	0.16	0.22					
Holly						1	0.01	1	0.03	0.03					
Maple						1	0.01	1	0.03	0.03					
Pine						33	0.22	16	0.43	0.66	3	0.19	2	0.50	0.69
Poplar						1	0.01	1	0.03	0.03					
Post oak						5	0.03	4	0.11	0.14	4	0.25	2	0.50	0.75
Red oak						10	0.07	8	0.22	0.28	1	0.06	1	0.25	0.31
Sourwood						6	0.04	4	0.11	0.15					
White oak	3	0.75	1	1	1.75	18	0.12	14	0.38	0.50	1	0.06	1	0.25	0.31
Total	4		1			148		37			16		4		

high Frequency-Density Index values. As usual, oaks are predominant in the forests, but chestnut is also particularly common. Because of the large quantities of pine noted, however, the forests of the region appear to be relatively low in productivity.

Comparing Plant Communities

The data derived from the GLO field notes can also be used to compare and rank the various physiographic regions in terms of their productivity of food-producing plants. Several measures may suggest productivity. These include the range of species supported by a particular topographic zone or physiographic region. Pine may be used as a proxy as well; this genus generally denotes poorer soils and therefore less productive settings (Harper 1942). The Frequency-Density Index values of various taxa, particularly those that bear nuts, might also be compared to suggest productivity, particularly in terms of mast resources.

Creek bottoms appear to be the richest settings in terms of the number of species present. Surveyors recorded 29 species in the 1817-1820 notes from the Tennessee Valley creek bottoms, and 30 species in the 1833-1834 notes of the Fall Line Hills creek bottoms. The creek bottoms of the Fall Line Hills tend to include more pine than those of the Tennessee Valley, however. Although little data is included here, I suspect that the creek bottoms of the other regions are also richer than slopes and uplands, and that those of the Little Mountain and Cumberland Plateau regions have relatively more pine, similar to the narrow creek bottoms of the Fall Line Hills. The density of trees per acre in creek bottoms is similar among all physiographic zones, suggested both by the 1817-1820 and 1833-1834 data (Figures 9.5 and 9.6).

The distribution of pine further indicate differences between the two valley regions, underlain by limestone, and the highly dissected sandstone hills of the Fall Line Hills, Little Mountain, and Cumberland Plateau. The slopes of the latter three regions claim particularly high Frequency-Density Index values for pine among the 1817-1820 field notes. The slopes are followed by the uplands of the Fall Line Hills and Little Mountain, which have more intermediate values. A similar pattern in seen

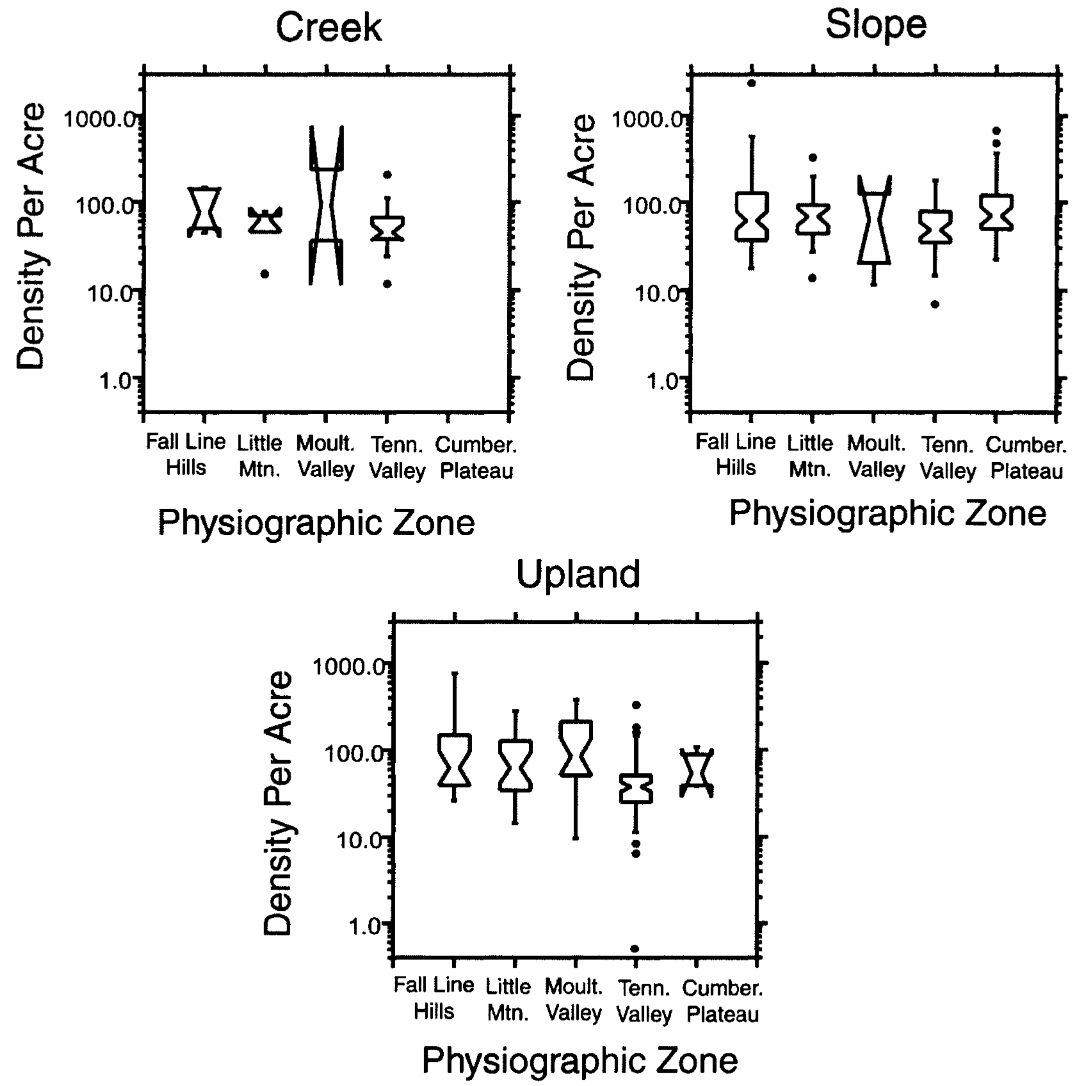

Figure 9.5. Boxplots comparing the density per acre of trees recorded in the 1817-1820 GLO surveys by topographic and physiographic zone.

in the 1833-1834 data, although here the Tennessee Valley region includes more pine than previously, as discussed above. A map of all section corners and quarter section posts at which surveyors recorded pine also demonstrates the distribution of pine in the study area (Figure 9.7). Pine is present in much lower numbers in the creeks, slopes, and uplands of the Tennessee Valley and Moulton

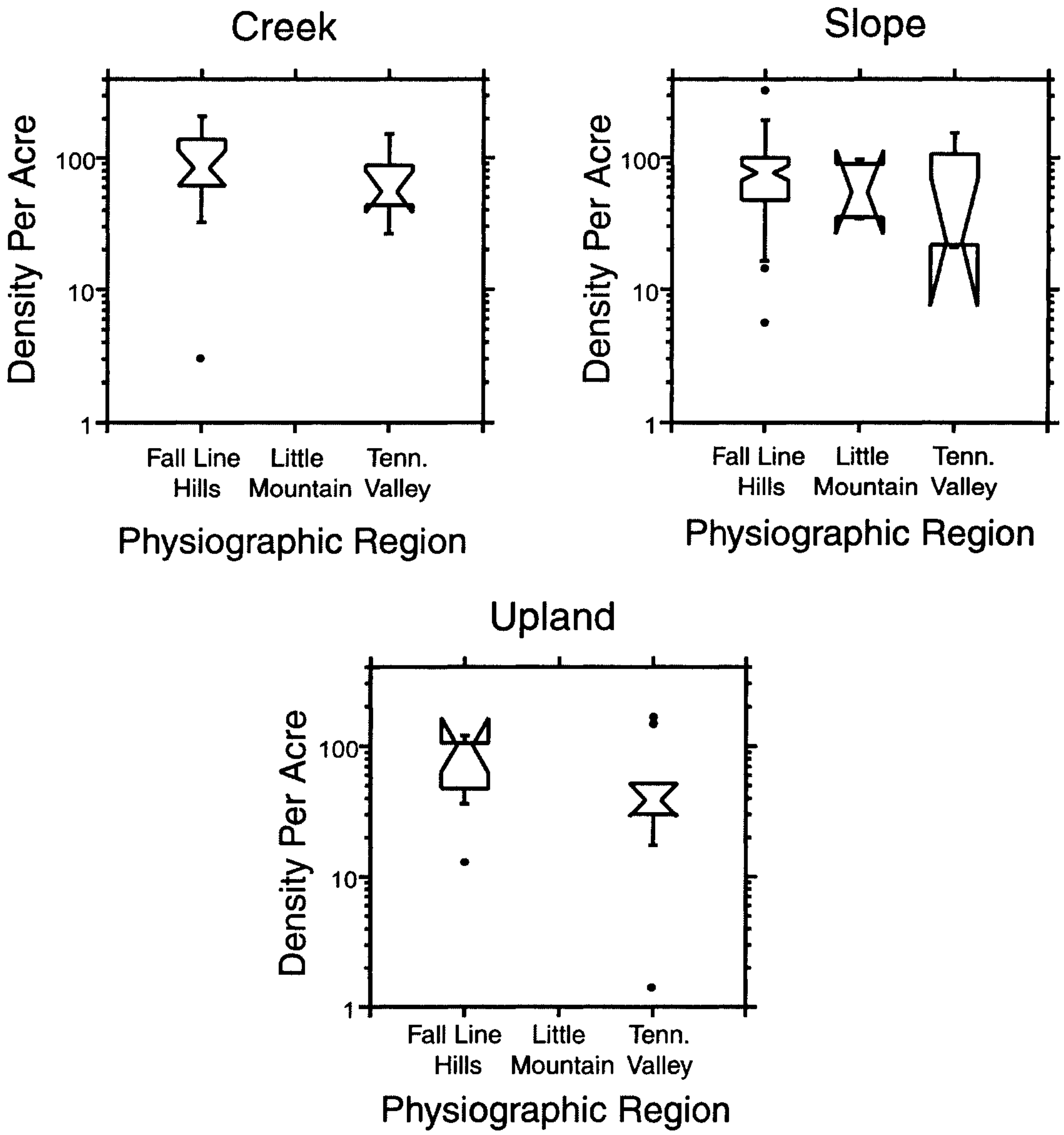

Figure 9.6. Boxplots comparing the density per acre of trees recorded in the 1833-1834 GLO surveys by topographic and physiographic zone.

Valley, suggesting that these topographic zones and regions are more productive than those of other regions.

Using this information, I rank the productivity of the various physiographic regions as given in Table 9.9. I suggest that this rank refers primarily to productivity of herbaceous weedy taxa and fruit taxa. The weedy taxa in particular thrive in disturbed bottom settings, and are thus more likely

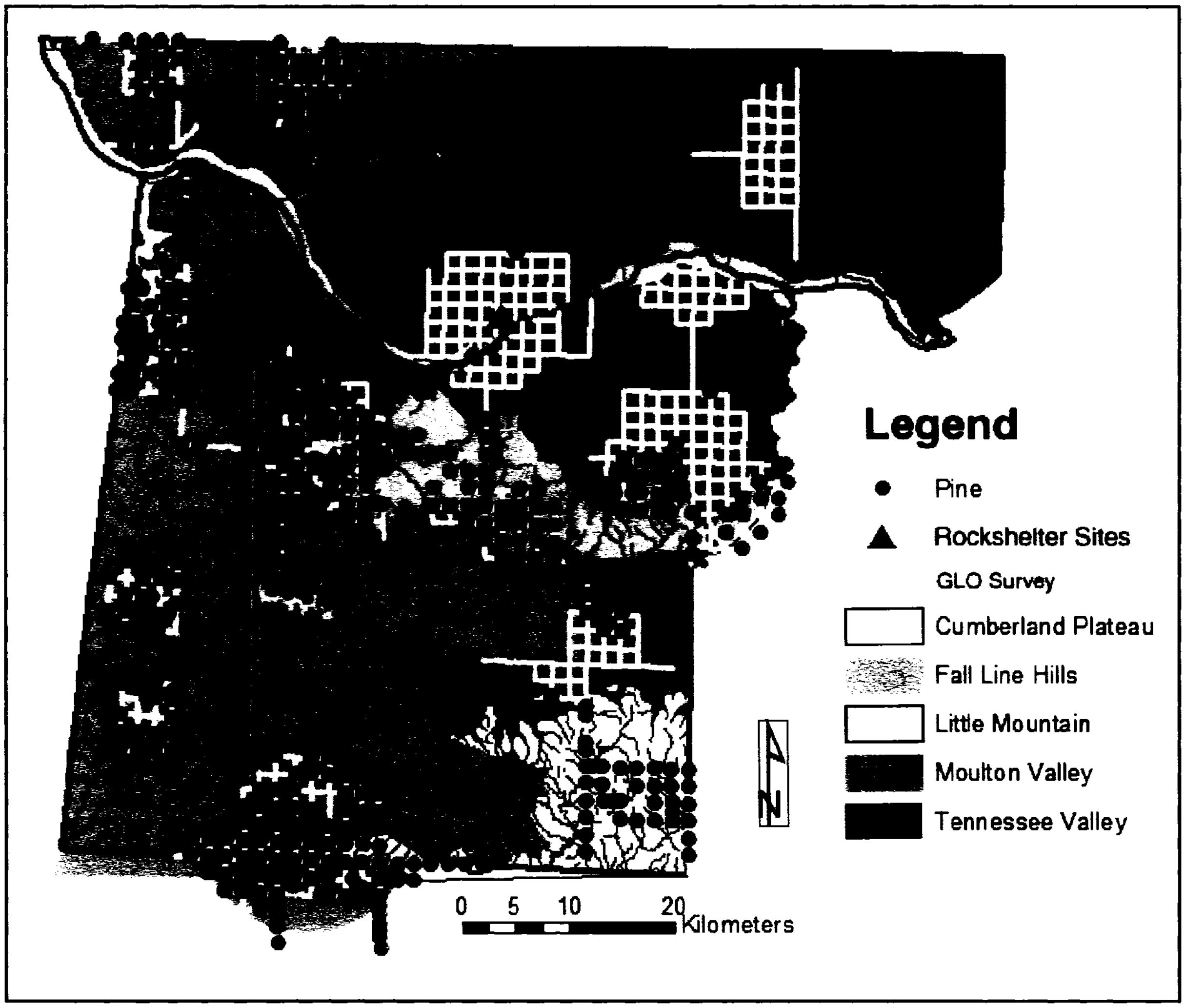

Figure 9.7. Map showing locations where pine trees were recorded by GLO surveyors.

to be found in quantity within the creek bottom zones. Although many of the fruit taxa can be found in a variety of settings, a number prefer moist and/or rich, often alluvial, settings. These include hackberry, mulberry, and honey locust. Further, we might expect to find more fruit taxa in settings with high species diversity. As such, the rankings likely refer to the distribution of fruit taxa as well. Because surveyors recorded both hackberry and mulberry in the uplands of the Moulton Valley region, I gave this zone a higher rank than uplands of other regions.

Table 9.9. Rank of Physiographic Regions and Topographic Zones by Productivity for Weedy and Fruit Taxa.[a]

	1	2	3	4
Number of species present	TV-creek FLH-creek	FLH-slope	LM-slope LM-uplands MV-uplands TV-slope TV-uplands CP-slope	FLH-uplands
Low F-D index for pine	TV-creek TV-uplands MV-uplands	TV-slope FLH-creek	FLH-uplands LM-uplands	CP-slope FLH-slope LM-slope
Overall rank for weedy and fruit taxa	TV-creek MV-creek[b]	FLH-creek LM-creek[b] CP-creek[b] MV-uplands	TV-uplands TV-slope FLH-slope LM-uplands	CP-slope LM-slope FLH-uplands

[a] CP = Cumberland Plateau; FLH = Fall Line Hills; LM = Little Mountain; MV = Moulton Valley; TV=Tennessee Valley.

[b] Those communities for which little data is available.

Productivity of foodstuffs is also suggested by the Frequency-Density Index values of nut-bearing species other than black walnut, which was rarely noted by the GLO surveyors. I rank the mast potential of the various topographic zones and physiographic regions using the Frequency-Density Index values in Table 9.10. When all oak species are considered together, the 1817-1820 field notes indicate that oaks are most abundant in the slopes and uplands of the Tennessee Valley region. The uplands and slopes of the remaining four regions have intermediate index values, while the creek bottoms of the Tennessee Valley and Fall Line Hills claim the lowest value. It appears, then, that oaks are generally less dominant in these rich, hardwood communities.

Hickories are somewhat similar to oaks, thriving particularly in the Moulton Valley uplands, but also along the slopes and uplands of the Tennessee Valley, and to some degree along the slopes of Little Mountain. Unlike the oaks, hickories are relatively abundant in the creek bottoms of the Tennessee Valley. Hickories tend to have lower Frequency-Density Index values in the regions underlain by sandstone, particularly the Fall Line Hills and Cumberland Plateau.

Table 9.10. Ranking of Physiographic Regions and Topographic Zones by Productivity of Nut-Bearing Taxa.[a]

	1	2	3	4
Oaks (all taxa)	TV-slope TV-uplands	MV-uplands CP-slope LM-slope LM-uplands FLH-slope FLH-uplands	TV-creek FLH-creek	
Hickory	MV-uplands	TV-creek TV-uplands TV-slope	LM-slope	LM-uplands FLH-slope FLH-uplands FLH-creek CP-slope
Chestnut	FLH-uplands CP-slope FLH-slope	LM-uplands LM-slope TV-slope	FLH-creek TV-uplands TV-creek	MV-uplands
Pine	CP-slope	FLH-slope LM-slope	FLH-uplands FLH-creek LM-uplands	TV-creek TV-slope MV-uplands TV-uplands

[a] CP = Cumberland Plateau; FLH = Fall Line Hills; LM = Little Mountain; MV = Moulton Valley; TV=Tennessee Valley.

The ranked distribution of chestnut is nearly opposite that of the oaks and hickories, apparently thriving in the sandstone regions. High Frequency-Density Index values were obtained in the uplands and slopes of the Fall Line Hills and Cumberland Plateau, and intermediate values for the Little Mountain region. Chestnuts are relatively rare in the Tennessee and Moulton Valleys, likely related in part to the fact that chestnuts apparently do not thrive in soils derived from limestone (American Chestnut Cooperators' Foundation 2004). Their larger presence along the slopes of the Tennessee Valley may suggest that soils are poorer in this topographic zone. Interestingly, the distribution of chestnut is largely similar to that of pine (Table 9.10).

Comparisons of the density of trees per acre among the various physiographic regions also suggest differences in productivity. The 1817-1820 field note data demonstrate no differences in forest density for creek bottoms or slopes, but do indicate that the upland communities of the

Tennessee Valley were relatively more open than other upland forests (Figure 9.5). This trend is also illustrated by the 1833-1834 data (Figure 9.6). Trees in open-growth settings have larger crowns, and subsequently yield more nuts than those in closed communities. As such, the forests of the Tennessee Valley uplands may have been particularly productive.

Possible Changes through Time

While the information derived from the GLO survey notes are useful in describing the plant communities of the region prior to significant Euro-American settlement, they certainly do not directly suggest the composition of Late Pleistocene or Early Holocene forests. Rapidly changing climatic conditions gave rise to rapid shifts in local vegetation. Over 13,000 years of human interaction with the landscape additionally shaped the composition of local vegetation. In as much as the plant communities are structured by the local geology and topography, however, the ranking in productivity of the various physiographic regions and topographic zones may be applied to past landscapes as well. Here I consider these rankings in tandem with reconstructions of the regional environment developed from pollen analyses. Viewed together, these two sets of information may supply a reasonable estimation of local plant communities until finer-grained environmental reconstructions are available for the project area.

As discussed in Chapter Three, the forests of the project area changed rapidly during the close of the Pleistocene. Approximately 14,000 years ago, spruce woodlands that have no modern analog covered the Highland Rim, while deciduous forests likely characterized the Fall Line Hills. By the close of the cooler Younger Dryas event around 11,600 years ago, communities in both regions are described as mixed hardwood forests. Oak-hickory-pine forests replaced the mixed hardwoods in the Fall Line Hills by roughly 10,000 years ago. These communities appear to persist through 7000 years ago.

Analyses of pollen cores do suggest more detailed changes. Around 13,000 years ago, just prior to the adoption of Quad/Beaver Lake hafted bifaces (12,900-12,000 cal B.P.), trees associated with cooler conditions were in the process of migrating northwards. These include spruce, which at one point comprised nearly 20% of regional forests, as well as birch, fir, hemlock, and alder. Southern pines may have begun to encroach on the area from the south. Oaks constituted some 20-40% of forests, and hickory between 5 and 20%. Other hardwoods, including maple, hackberry, beech, ash, walnut, aspen/cottonwood, tupelo and willow, accounted for less than 5% of forest trees.

By 12,000 years ago, during the Younger Dryas and as peoples began to use Dalton toolkits (12,000-11,200 cal B.P.), spruce comprised less than 20% of regional forests. The presence of sedges at more than 5% of regional assemblages indicates the cooler weather associated with this climatic oscillation. The increase of ash to over 5% may also suggest colder temperatures. However, although annual temperatures were colder, warmer summers continued to push trees that prefer cooler conditions northward.

Just after local peoples began to fashion Early Side-Notched hafted bifaces (11,200-10,500 cal B.P.), forests of the region could be characterized as mixed hardwood communities. By 11,000 years ago, oaks increased to 40-60% of area forests, elms and maples to roughly 10%, and pine to as much as 20%. Spruce and birch, as well as ash, continued to decrease. Hickory, beech, walnut, hackberry, tupelo, and other hardwoods demonstrated little change.

By 10,000 years ago, well into the time that peoples made Kirk Corner-Notched hafted bifaces (10,500-9800 cal B.P.), trees associated with colder climates had little presence in the area. Spruce and alder comprised less than 5% of regional forests, and birch and hemlock less than 1%. By 9,000 years ago, during the time that groups used bifurcate hafted bifaces (9,800-8,600 cal B.P.), these northern trees disappeared from local forests completely. Oaks remained dominant at 40-60%, but hickories may have decreased to around 10% of the trees in area forests. Maple and tupelo increased slightly, but other hardwoods, including ash, hackberry and walnut, demonstrate little change. Southern pines may have been pushed slightly southward, perhaps retreating from the Highland Rim and taking up their position in the Fall Line Hills.

Well into and after the use of Kirk Stemmed hafted bifaces (8,900-7,800 cal B.P.), by at least 7,000 years ago, regional plant communities may reflect drier conditions. Sedges and forbs constitute roughly 5% of regional assemblages, suggesting drier weather. Oaks increased to 60% of area forests, and hickory appears to have rebounded to 10-20%. Pines, ash, beech, hackberry, tupelo, and walnut demonstrate little change.

The question, then, is how these shifts in regional plant communities would have affected the availability of foodstuffs for early hunter-gatherers, as well as ranking of the productivity of various physiographic regions and topographical zones. As acorn-bearing oaks in particular replaced spruces and other cooler climate species, productivity of regional forests – both for people and animals – certainly increased. Other members of mixed hardwood communities, including walnut and hackberry, appear to have changed relatively little over this span. Hickory also demonstrated less of a shift than oak, apparently decreasing around 9,000 years ago before rebounding to 10-20% of regional forests roughly 7,000 years ago, suggesting a possible decrease in productivity during this span.

Relative rankings of the various physiographic and topographic districts presumably changed little over this course. The creek bottoms likely supported rich hardwood communities throughout. Differences between the uplands and slopes of the Tennessee Valley, Little Mountain, and Fall Line Hills regions may have been less distinct in the Late Pleistocene, particularly if spruce woodlands covered the Highland Rim and more productive deciduous forests occupied the Fall Line Hills. As spruces retreated from the former and southern pines moved into the latter between 11,000 and 9,000 years ago, the current distinctions between the limestone uplands and sandstone hills may have been established.

Interestingly, few differences between Late Paleoindian and Early Archaic plant use are apparent. The plant assemblages from Dust Cave, LaGrange, and Rollins Bluff Shelters demonstrate little change between the two periods. Use of black walnut may decrease, but significant change is not evident until the close of the Early Archaic, when hickory becomes predominant in the Kirk

Stemmed component at Dust Cave. The relative productivity of key plant foods, such as hickory, may have changed little during the Pleistocene/Holocene shift. A likely increase in oaks, and therefore in acorns, appears to have had little impact on early gatherers' food choice. The exception may be at Stanfield-Worley, where significant deposits of acorn meats have been recovered. Unfortunately, this possibility cannot be further addressed at present because mixing of the site's deposits does not allow separation of the Late Paleoindian (Late Pleistocene) and Early Archaic (Early Holocene) plant assemblages at this point.

It is important to keep in mind, however, that changes in productivity of plant communities also affects animal communities. An increase in oaks, and therefore acorns, would support an increase in the population of deer, turkeys, squirrels, blue jays, and other animals that subsist on mast resources in autumn and winter. Such a population increase would decrease the amount of time a hunter spends searching for prey, and would thus make hunting more profitable (see below).

In general, then, I assume that the differences in productivity of the physiographic regions may have been minimal in the Late Paleoindian period, but became more apparent during the Early Archaic period as southern pines moved into the Fall Line Hills. I also contend that among topographic zones, river and creek bottoms remained the richest communities in terms of number of species present, regardless of time period. Similarly, I argue that uplands and slopes yielded the highest nut productivity. These assumptions are certainly subject to review as more fine-grained information about local paleoenvironments becomes available.

Summary

The GLO field notes indicate that the various physiographic regions in the study area support plant communities that differ in productivity. The richest of these are found in creek bottoms, characterized by high diversity, low percentages of pine, and species that favor rich, low woods. The slopes and particularly the uplands of the Tennessee and Moulton Valleys, underlain by limestone, also claim low percentages of pine and higher numbers of oaks and hickories. By contrast, the highly dissected sandstone hills of Little Mountain, the Fall Line Hills, and the Cumberland Plateau support relatively high percentages of pine and chestnut. I generally rank these regions and topographic zones in this order, according to their productivity of plant foods.

As the productivity of these regions is related in large part to their geology and topography, these rankings may be expected to hold in the past as well. During the Late Pleistocene and Early Holocene, creek bottoms also likely supported the richest plant communities. Weedy herbaceous taxa and fruit taxa that prefer alluvial settings likely occurred in greater quantities in these topographic zones. Differences in productivity between the slopes and uplands of those physiographic regions underlain by limestone and those characterized by sandstone may have been less distinct during the close of the Late Pleistocene. Non-analog spruce woodlands appear to have covered the limestone-derived soils of the valley regions, while deciduous forests inhabited the sandstone hills. Nut-bearing trees may have been poorly represented in spruce woodlands, while they may not have thrived as well in the poorer soils of the sandstone hills. By the Early Holocene, as mixed hardwoods replaced the spruce woodlands and forests of oak, hickory and pine moved into the sandstone hills, the differences in productivity between the regions likely approximated those seen today.

MODELING RESOURCE PROCUREMENT AND TRANSPORT

Among the various factors, such as availability of water, firewood, and the presence of other groups, that affect decisions about where and when to move a campsite, one of the most salient is the structure of food resources (Kelly 1983; 1995:121, 126). Central place foraging theory contends that foragers should locate their campsites in order to minimize the costs of transporting food items to the site (Orians and Pearson 1979; Zeanah 2000). Stated slightly differently, foragers should choose campsites that maximize their return rates for procuring food items. As discussed in Chapter Two, return rates are measured as the energy obtained from an item minus the energy expended in procuring that item, divided by the time required to procure the item. This is described by the following equation (after Zeanah: 2000:Table 1.4):

$$r = \frac{e_{\mathrm{obt}} - \left[H_{\mathrm{t}} * H_{\mathrm{c}} + \left(\sum_{s=1}^{n} D_{\mathrm{s}} * W_{\mathrm{s}} \right) + \left(\sum_{f=1}^{n} D_{\mathrm{f}} * L * U_{\mathrm{f}} \right) \right]}{H_{\mathrm{t}} + \dfrac{\sum_{s=1}^{n} D_{\mathrm{s}}}{V}}$$

where

r = return rate (kcal/hr)

e_{obt} = energy obtained per load (kcal)

H_{t} = handling time per load (hr)

H_{c} = handling costs per load (kcal/hr)

D_{s} = distance of slope s traveled to and from the nearest patch of the resource (km)

W_{s} = cost of walking across slope s (kcal/km)

D_{f} = distance of slope f from the nearest patch of the resource to camp (km)

L = weight of one load of the resource (kg)

U_f = cost of carrying one load across slope f (kcal/kg/km)

and V = walking speed (km/hr).

Here the energetic costs of procuring the item include handling costs, or the energy required to obtain and process a food item; the costs of walking to and from the patch where the food item can be found; and the cost of carrying the food item back to camp. Similarly, the time component includes the time required to obtain and process the item, as well as the time to walk to and from the patch where it can be found.

In determining the relation of a site location to food procurement, the costs associated with travel to patches where food can be obtained are of particular interest. In practice, most researchers estimate these costs by approximating the distance associated with various slopes along a path between a central place and a resource patch (e.g. Gremillion in press.; Zeanah 2000). Here I use a geographic information system (GIS) to evaluate the slopes of the project landscape. This technique has several advantages. First, I can rapidly calculate the costs not only of a single path between two points, but also the costs of traveling in any direction from a particular point. In other words, I can simultaneously calculate and compare the costs of traveling from a campsite to numerous resource patches. Furthermore, I can calculate and compare the return rates associated with exploiting particular resources from various points on the landscape. Second, geographic information systems organize and display landscape information, facilitating the recognition of patterning within and associations among various landscape characteristics (ESRI 1998). These include characteristics that affect site location, such as distance to water sources, slope, and aspect (Kvamme 1999). Thus I can calculate return rates for various resources from various points on the landscape, as well as relate these points and return rates to archaeological sites, physiographic regions, topographic locales, and any other landscape characteristics that can be mapped.

Calculating and Mapping Return Rates

In order to determine the return rate of a resource, values must be assigned to the different variables of the equation. These values are listed in Table 9.11 for the various food items considered here. The energy obtained (e_{obt}) from each load is relatively easy to determine: it is the caloric value of a given amount of a resource. In keeping with Zeanah (2000), I use load sizes (L) of 15kg and 30 kg, which are in line with ethnographic observations (Bettinger et al. 1997:892). Most food items include inedible portions that can either be removed in the field or at a campsite (Bettinger et al. 1997; Metcalfe and Barlow 1992). If processing occurs in the field, then the entirety (or some greater portion) of the load is presumably edible and the caloric value can be directly calculated; otherwise the edible portion of the load must first be determined.

Handling time (H_t) includes collection and processing. For animal resources, it also includes stalking. These times are variously observed, estimated from historic accounts, or determined experimentally. The latter two categories are somewhat problematic. Estimates are at best educated guesses. Experiments are primarily conducted by inexperienced gatherers, collectors, fishers, and

Table 9.11. Values of Variables Used in Equation for Return Rates of Resources.

	Load size, L (kg)	Edible portion (kg)	Caloric content (kcal/kg)	Calories in load, e_{obt} (kcal)	Handling time, H_t (hr)	Handling costs, H_c (kcal)
Animal Resources						
Deer, fall, uplands	30	21	2560	53760	9^a	3240
Deer, fall, bottoms	30	21	2560	53760	11^a	3960
Deer, spring, uplands	30	21	1260	26460	13^a	4680
Deer, spring, bottoms	30	21	1260	26460	11^a	3960
Deer, fall, uplands, 2 hunters	30	21	2560	53760	6.4^a	2304
Squirrel, spring	30	21	3360	70560	54.3^b	19548
Squirrel, fall	30	21	4440	93240	46.6^b	16776
Turkey, fall, uplands	30	21	3430	72030	17.5^b	6300
Turkey, fall, bottoms	30	21	3430	72030	23.5^b	8460
Turkey, spring, uplands	30	21	2260	47460	51^b	18360
Turkey, spring, bottoms	30	21	2260	47460	36^b	12960
Waterfowl	30	21	3050	64050	20.3^b	7308
Fish, spawning, slough	30	21	1540	32340	2.4^b	864
Fish, spawning, stream	30	21	1540	32340	3.9^b	1404
Fish, stream	30	21	1540	32340	8.1^b	2916
Mussels, pristine	30	2.4	1720	4128	5^c	1800
Mussels, depleted	30	8.1	1720	13932	63.8^c	22968
Mussels, pristine, field process	30	30	1720	51600	6.2^c	2232
Mussels, depleted, field process	30	30	1720	51600	22.9^c	8244
Plant Resources						
Grapes	15	12.75	670	8542.5	3.3^b	1188
Mulberries	15	14.55	430	6256.5	0.75^b	270
Chenopod greens	15	6	430	2580	2.5^b	900
Other greens	15	6	230	1380	2.5^b	900
Amaranth, strip	15	15	3740	56100	41.5^d	14938
Amaranth, cut	15	2.1	3740	7854	4.9^d	1764
Chenopod, strip	15	15	4140	62100	64.4^e	23184
Chenopod, cut	15	2.1	4140	8694	6.9^e	2484
Black walnut	15	2.91	6180	17983.8	30.6^f	11016
Hazelnut	15	5.04	6280	31651.2	57.9^f	20844
Hickory, crack and pick	15	5.57	6570	36594.9	242.3^f	87228
Hickory, smash and boil	15	5.57	6570	36594.9	11.3^f	4068
Acorns	15	4.7	5050	23735	26.0^c	9351

[a] Value calculated by assuming a density of 15 deer/km^2 for fall uplands, 10 deer/km^2 for fall and spring bottoms, 8 deer/km^2 for fall bottoms; 0.5 km/hr for search speed, 35m search radius, 4 hrs pursuit upon encounter, and 1 hr butchering (all but density derived from Winterhalder et al. 1988).

[b] From Reidhead 1981.

[c] From Bettinger et al. 1997.

[d] From Peterson and Munson 1984.

[e] From Seeman and Wilson 1984

f From Talalay et al. 1984.

hunters, and/or employ tools unavailable to prehistoric groups. However, they do provide an indication of the costs associated with various resources and may be used for broad comparisons between resources. I calculate handling costs (H_c) by multiplying the handling time by 360 kcal/hr, in keeping with Winterhalder and colleagues (1998). Admittedly, using a fixed rate does not account for variation between tasks; grinding seeds is presumably more energy-intensive than winnowing. Largely because I could not find more detailed information about the caloric costs associated with various activities, I presume that the assumed value provides an average of these costs.

I derived the costs associated with walking and transporting items across a landscape from values of the calories (kcal) per kilometer associated with walking various slopes at a given speed provided by Brannon (1992) and Zeanah (2000) (Table 9.12). I fit a regression line to a plot of kcal/km versus slope (defined as percent grade), which yielded the following equation:

$$W_s = (-2 * 10^5 * (\text{slope})^3) + (0.0933 * (\text{slope})^2) + (2.9297 * \text{slope}) + 66.534$$

which has an associated R^2 of 0.987. Unfortunately, the regression equation overestimates the costs of lower-grade slopes, namely those between –10 and 10 percent. While fourth- and fifth-order polynomial lines more adequately estimated costs associated with smaller slopes, they produced much larger errors for slopes with high values. As the project area includes many locales with steep slopes, I chose the second-order polynomial equation given above. Future objectives include refinement of this equation.

I similarly derived the costs associated with carrying a load across a given slope from values given in Brannon (1992) and Zeanah (2000) (Table 9.12). The regression line fit to a plot of kcal/km versus slope is described by the equation:

$$U_f = (3 * 10^5 * (\text{slope})^3) + (0.0038 * (\text{slope})^2) + (0.0401 * \text{slope}) + 0.5164$$

which has an R^2 of 0.9994. In keeping with Jones and Madsen (1989), Barlow and Metcalfe (1996), and Zeanah (2000), I assume a walking speed (V) of 3 km/hr. Bettinger and colleagues (1997:895) note that while faster walking speeds have greater caloric costs, they also allow foragers to transport

Table 9.12. Costs Associated with Walking and Carrying a Load at a Speed of 3 Km/Hr.

Slope (%)	Walking Cost (kcal/km)	Carrying Costs (kcal/kg)
-40	88.4	2.78
-35	76.8	
-30	72.6	1.85
-25	69.2	
-20	60.0	1.11
-15	39.6	
-10	36.6	0.42
-5	39.8	
0	50.6	0.40
5	75.4	0.74
10	115.2	1.32
15	140.2	2.10
20	169.4	3.13
25	202.8	4.46
30	239.8	6.11
35	281.2	8.01
40	325.2	10.24

resources at a faster rate, thus increasing the return rate. Adjustments in walking speed are therefore additional ways in which the model can be further refined.

The distance and associated slopes over which foragers walk was obtained using the ArcView component of ArcGIS 8.1. I downloaded 7.5-minute digital elevation maps (DEMs) from the USGS that cover the three counties within the project area. These DEMs provide elevation data for 30- by 30-meter cells within a grid (USGS 1997). With this data, ArcView develops a topographical map of the area and calculates the slopes associated with each cell, as well as the aspect of these slopes. I plotted the four rockshelter sites on the map, and used the Spatial Analyst extension of the program to derive the distance and direction to each site (Figure 9.8).

The Spatial Analyst extension can also be used to calculate a cost-weighted distance to a particular point. In other words, it is possible to assign a caloric cost to traversing each 30-meter cell, and sum up these costs to a given locale. Unfortunately, the program does not recognize uphill and downhill slopes: all slopes are assumed to be positive, or uphill. Using the "raster calculator"

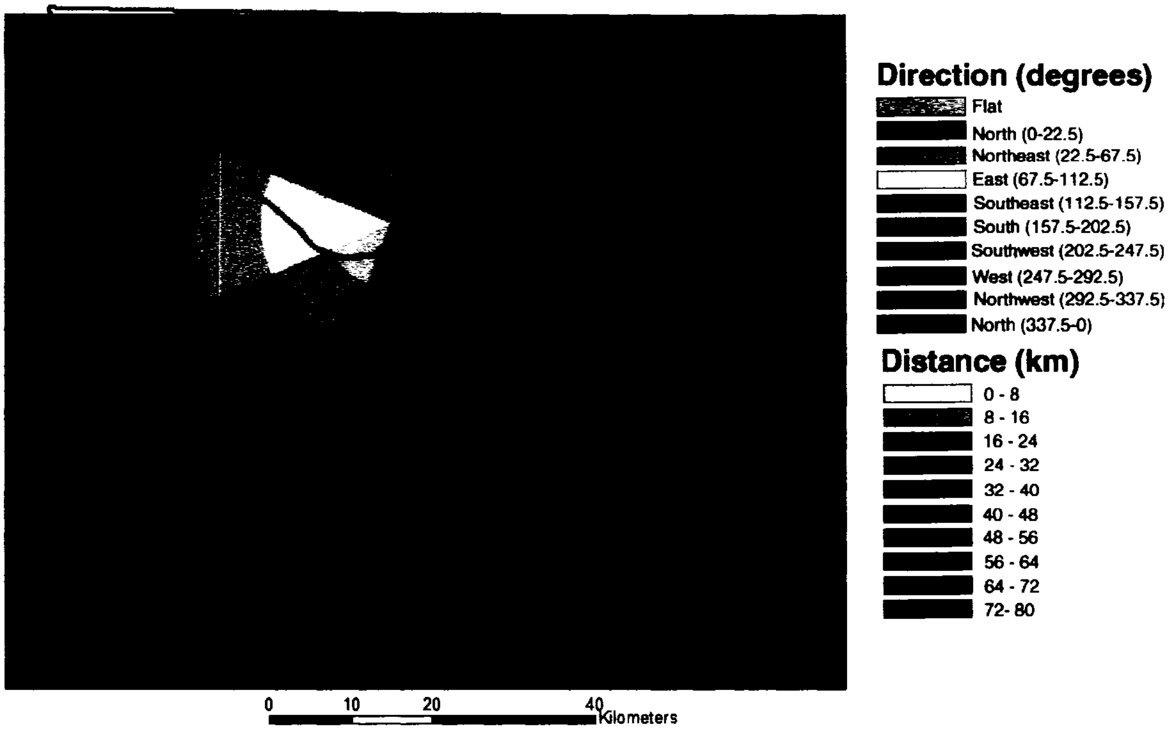

Figure 9.8. Map displaying direction and distance to a given site. Direction is given a value between 0 and 360 degrees (for example, north *to* the site is displayed in red), and distance is displayed as increasing values from the site.

function, which performs arithmetic functions on each cell, I created a map that assigned positive or negative values to slopes based on the following equation (suggested by Thomas F. Detwiler, personal communication 2005):

$$\text{Slope Multiplier} = \text{Cos}\ [(\text{direction to site}) - (\text{aspect of slope})]^{2}$$

in which both are described between 0 and 360 degrees[3] (Figure 9.9). For travel towards the site, the equation is positive; for travel away from the site, the equation is multiplied by negative one. Thus if one is south of the site and walking north towards it (180 degrees), and encounters a slope with a

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[2] The term within the brackets is also multiplied by (pi/180) to transform the value into radians.

[3] For aspect of slope, north corresponds to 0 and south to 180 degrees. However, direction to site is defined in the opposite manner, as a person walking north towards a site is actually south of the site.

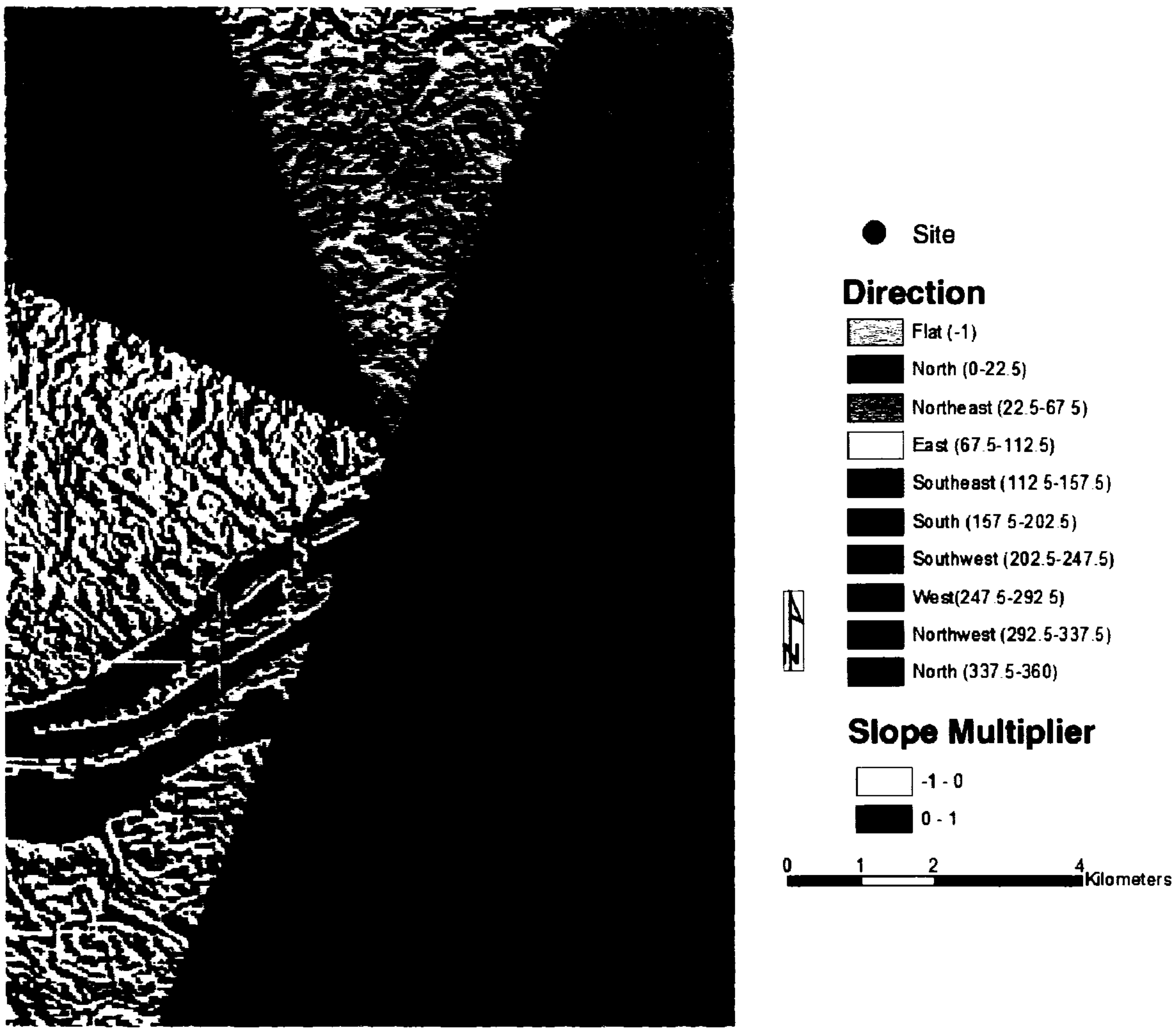


Figure 9.9. Map displaying positive and negative slopes (dark and light) with respect to travel towards a given site (colored bands).

northern aspect (0 degrees), then the downhill slope is assigned a value of -1. The equation assigns a value of zero to east- and west-facing slopes, as no additional costs should be associated with traversing these slopes sideways (neither up nor down). All aspects in between are weighted accordingly by a value between 1 (or –1) and zero. These multipliers are then applied to the slopes, and the resulting weighted slopes can then be used in a raster calculation to compute the caloric cost of traversing each 30-meter cell (W_s). Travel towards the site includes the additional equation (U_f) for the cost of carrying a load across each cell.

The Spatial Analyst can then be used to calculate the cost-weighted distance – here, the cost of travel in kcal – to a given point on the map. From each cell, the program chooses the adjacent cell with the lowest cost. It then adds the cost of traveling from a given point to each cell, resulting in a "least-cost route." In other words, each cell is assigned the lowest total cost of traveling to the site to that cell, resulting in a map that displays these additive costs. The two sums, both to and from the site, can then be added to give a roundtrip total (Figure 9.10).

One of the interesting characteristics of these maps is that they display more or less concentric circles of costs. It appears that the local topography does not significantly affect the costs of traversing the landscape. Indeed, the northwest Alabama landscape is generally hilly, such that a person who travels uphill is likely to travel downhill shortly. So although there is some variability in the map at smaller scales, the larger picture is one of relatively similar travel costs regardless of the direction of travel. Due to this fact, there are relatively small differences in the costs of traveling to and from each of the four sites, even though they are in different topographic settings. Costs are slightly greater at Rollins Bluff Shelter, due to the very hilly local landscape, but again, these differences are slight. As such, I present the results of roundtrip travel from Dust Cave and consider it generally representative of the remaining three sites.

Employing the raster calculator once more, the return rate of exploiting a particular resource at each cell can be determined. Using defined values for e_{obt}, H_c, H_t, and V, the summed costs of travel to and from each point are input, as well as the distance from the site to each cell. The resulting map defines the return rate of the resource for each cell (Figure 9.11), allowing the viewer to readily evaluate the costs and benefits of exploiting the resource in a given landscape.

Comparing Animal and Plant Resource Procurement

Using the above process, I created return rate maps for the animal and plant resources listed in Table 9.11. These taxa were chosen in part because they repeatedly occurred in the organic assemblages from the four rockshelter sites, and also because I was able to obtain the necessary

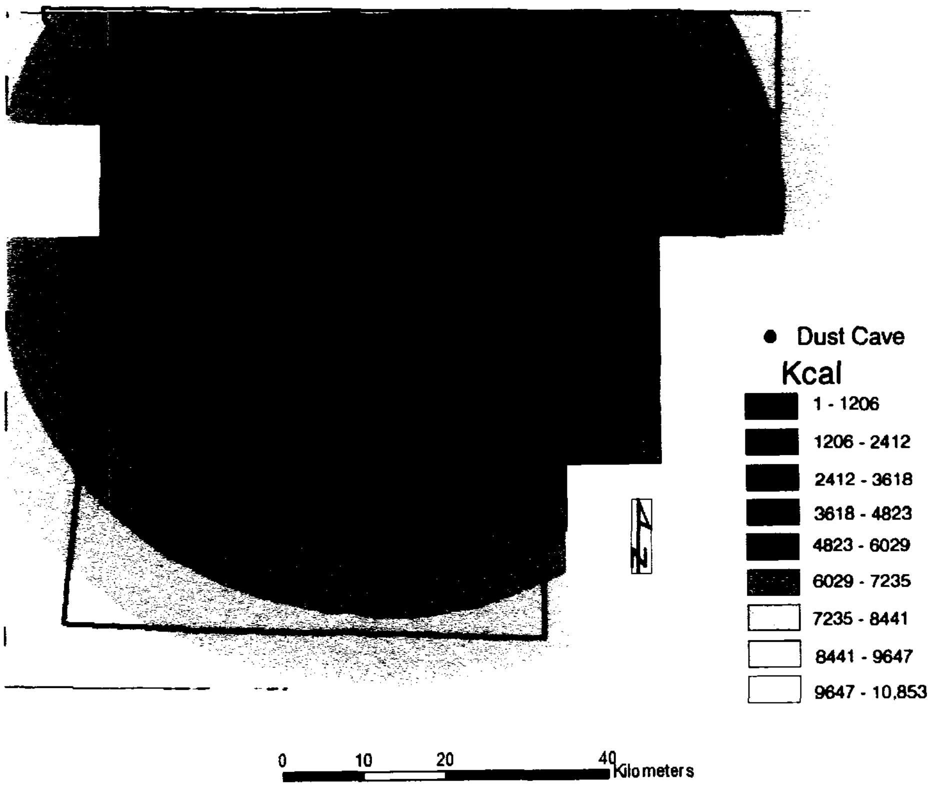


Figure 9.10. Roundtrip travel cost (kcal) at any given distance from the site.

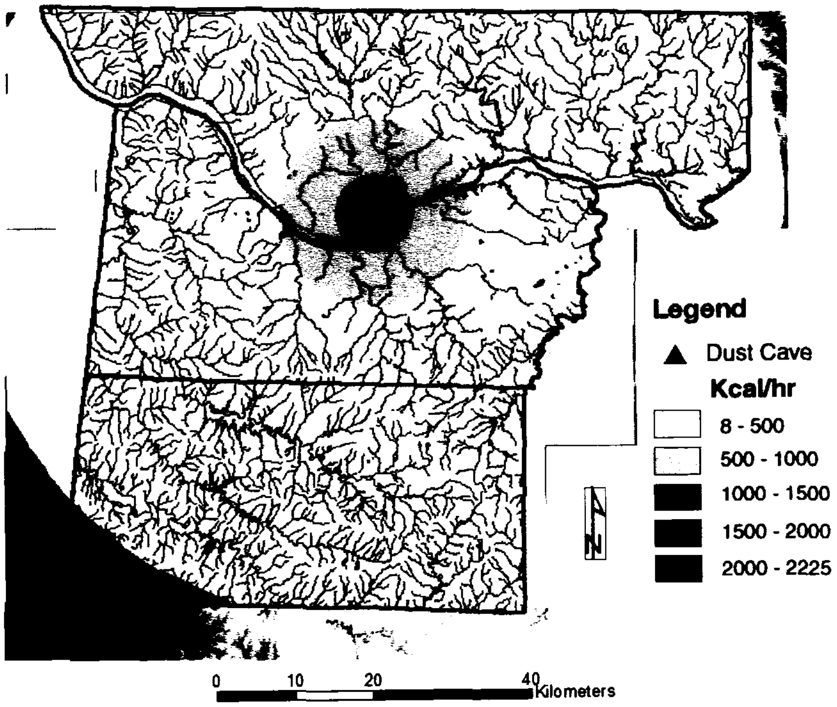


Figure 9.11. Return rate map for 15 kg load of grapes.

information for the return rate equation for each. The results are informative, and in some instances rather surprising. I begin with the animal resources, and then discuss the various plant taxa. I also explore the advantages of hunting or gathering in groups of various sizes. To better facilitate comparison among the different resources, I plot the values for return rates at various distances from the site. This gives a two-dimensional picture that illustrates how rapidly return rates fall as foragers travel further distances.

Animal Resources. In general, animal foodstuffs provide large packages of calories with low processing costs, particularly compared to plant foods. However, most are mobile, and thus often require a significant time investment for stalking and hunting. The various taxa are notably similar in caloric content, generally ranging between 125 and 250 kcal per 100g, although seasonal differences in fat may significantly increase these values to above 300 kcal per 100g (Table 9.11). The greatest difference among the animal taxa is the size, and thus the corresponding amount of time required to obtain a load of 15 or 30 kg. A single deer provides at least two 30 kg loads, while 41 squirrels are required to reach 30 kg. Not surprisingly, then, it takes a forager roughly ten times as long to obtain 30 kg of squirrels than 30 kg of deer. Accordingly, these differences in handling time and associated costs largely account for the differences between the animal taxa.

The return rate values for deer in autumn in the uplands (Figure 9.12) indicate a high of some 5600 kcal/hr, which decreases asymptotically as one travels further from the site. In comparison, the highest return rate for squirrel is only 640 kcal/hr and decreases at a much slower rate. The difference between the two in the shape of the graph is primarily due to their associated processing costs. It takes much more effort to capture enough squirrels to comprise a 30-kg load than a single deer, particularly in autumn in the uplands. This decline is due primarily to travel costs; the rather large handling time, presuming a lengthy pursuit of the prey. By simply comparing the heights of the two graphs, it is readily observable that a hunter is more likely to pursue deer than squirrel at a distance

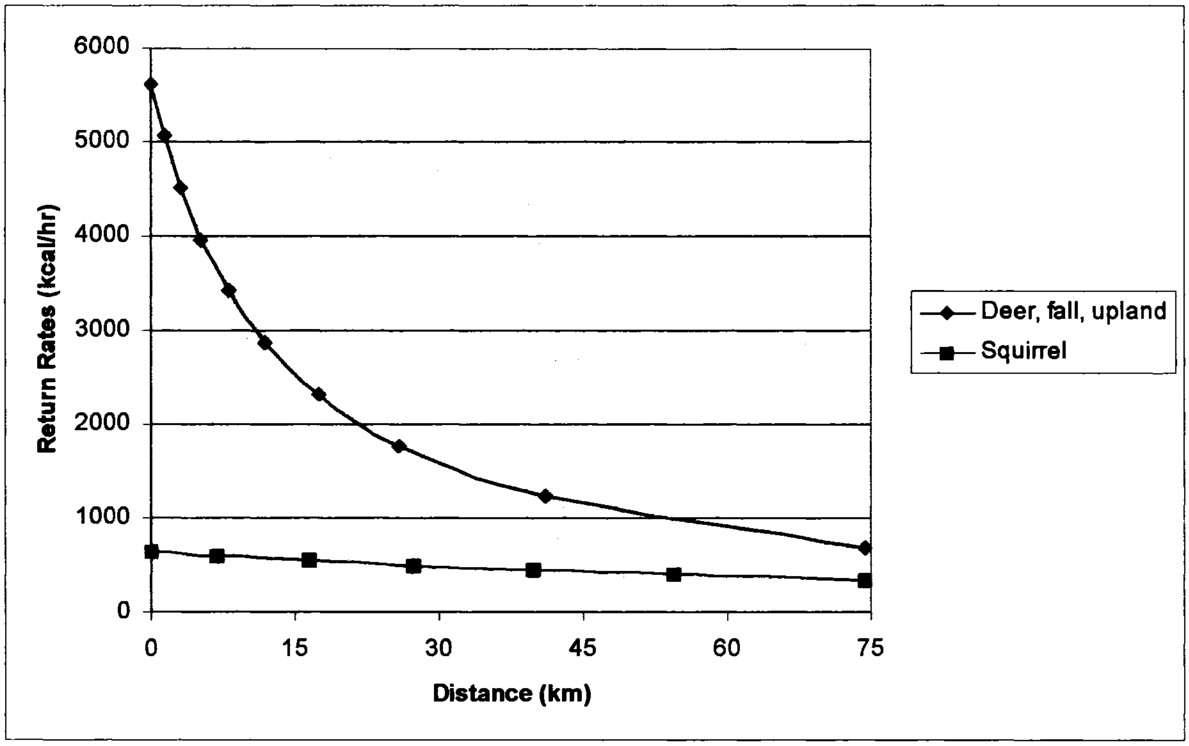


Figure 9.12. Comparison of return rates to distance for deer and squirrels.

from the site: a 30-kg load of deer yields over 1500 kcal/hr at a distance of 15 km, while 30 kg of squirrel provides only 550 kcal/hr.

Fluctuations in prey in both time and space must also be considered. Game animals are mobile, traveling primarily between food and water sources. In the spring, we might expect deer populations to be denser in areas where high-quality forage is readily available. In the project area, deer might be most frequently encountered in the creek bottoms in spring, where herbaceous plants are likely most abundant and a wide variety of trees are present. In contrast, the largest population of deer in autumn should be found in the slopes and uplands, where nut mast is more plentiful. These population shifts change the encounter rate for hunters, and therefore affect the handling time associated with hunting in particular settings. Thus the return rate for hunting deer in the spring should be highest in the creek bottoms, and even higher in the slopes and uplands in autumn, if the above assumptions are correct.

In addition, one must take into account seasonal variability in the quality of game meat. Animals are much leaner at the close of winter and the start of spring, prior to the availability of high-quality forage, namely spring leaves and shoots. As a result, the caloric content of meat is lower in spring than in autumn, when animals store fat for the coming winter. The affect of these seasonal differences on both the caloric value of game and the movement of populations is illustrated in Figure 9.13. The return rate of deer in fall is much higher than that in spring; the return rate is also higher in settings in which deer populations are higher. Squirrels are also leaner in spring than autumn, but do not travel far from wooded areas in any season.

Deer may also "yard" in winter, or aggregate in large groups in areas where forage is relatively easily obtained. This behavior is only observed in areas where snow stays on the ground throughout winter. This certainly does not apply to present-day Alabama, nor perhaps to the region during the Early Holocene. Given the presence of spruce in the region during the Late Pleistocene, however, snow likely did remain on the ground through winter, as it does in boreal forests today. As such, deer likely did yard, forming dense congregations that Late Paleoindian hunters could track and exploit during winter. The lower encounter rates would be offset to some degree by lower caloric values.

These same considerations – the influence of handling time, seasonal availability, and seasonal fat content – apply to wild turkey and waterfowl (Figure 9.14). Because the time needed to acquire and clean 30 kg of turkey is estimated at roughly half that of waterfowl, the return rate of hunting wild turkey is twice that of waterfowl. Accordingly, foragers are more likely to hunt turkey at a considerable distance from a campsite than waterfowl. Both turkeys and waterfowl are also very seasonal in their availability. Waterfowl were presumably available in significant quantities only during several weeks in the spring and fall, as these migratory birds passed through the project area (Walker 1998). The seasonal availability of wild turkey is somewhat less restricted, but return rates would have been significantly higher in the fall, when these birds form flocks. The flocks disperse in early spring for breeding, and as a result these wily birds are much more difficult to hunt. Reidhead

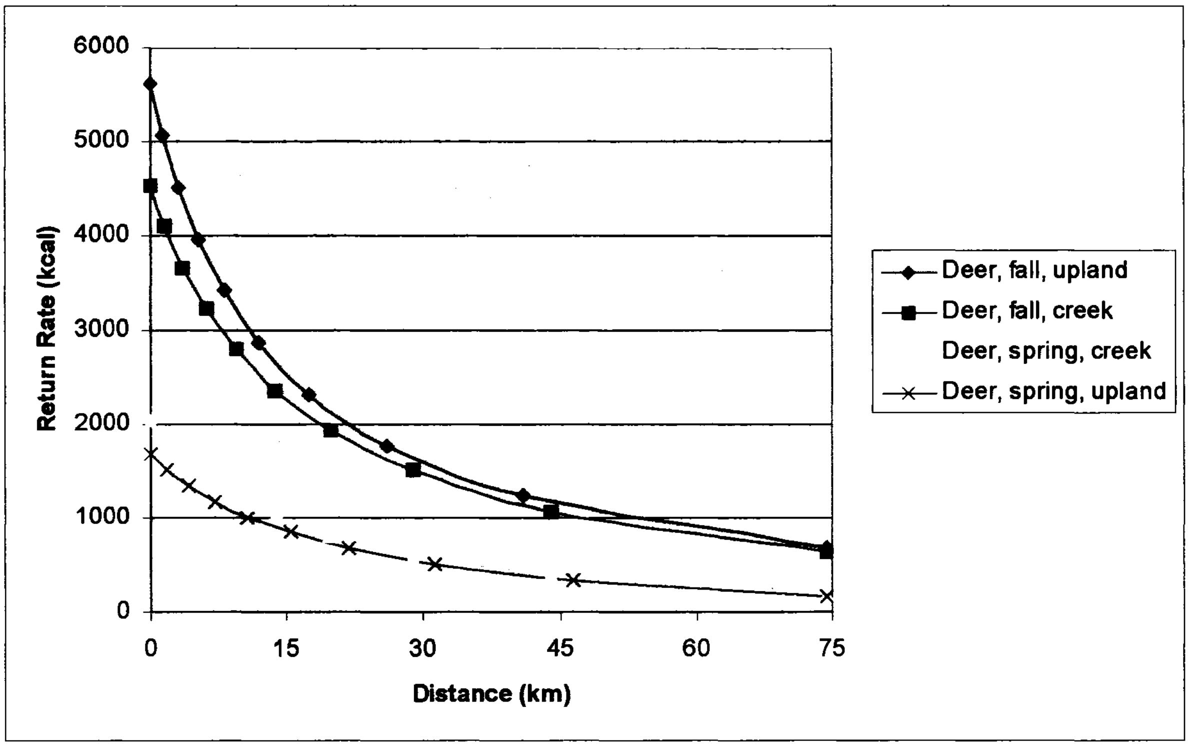


Figure 9.13. Comparison of return rates to distance for deer in various seasons and settings.

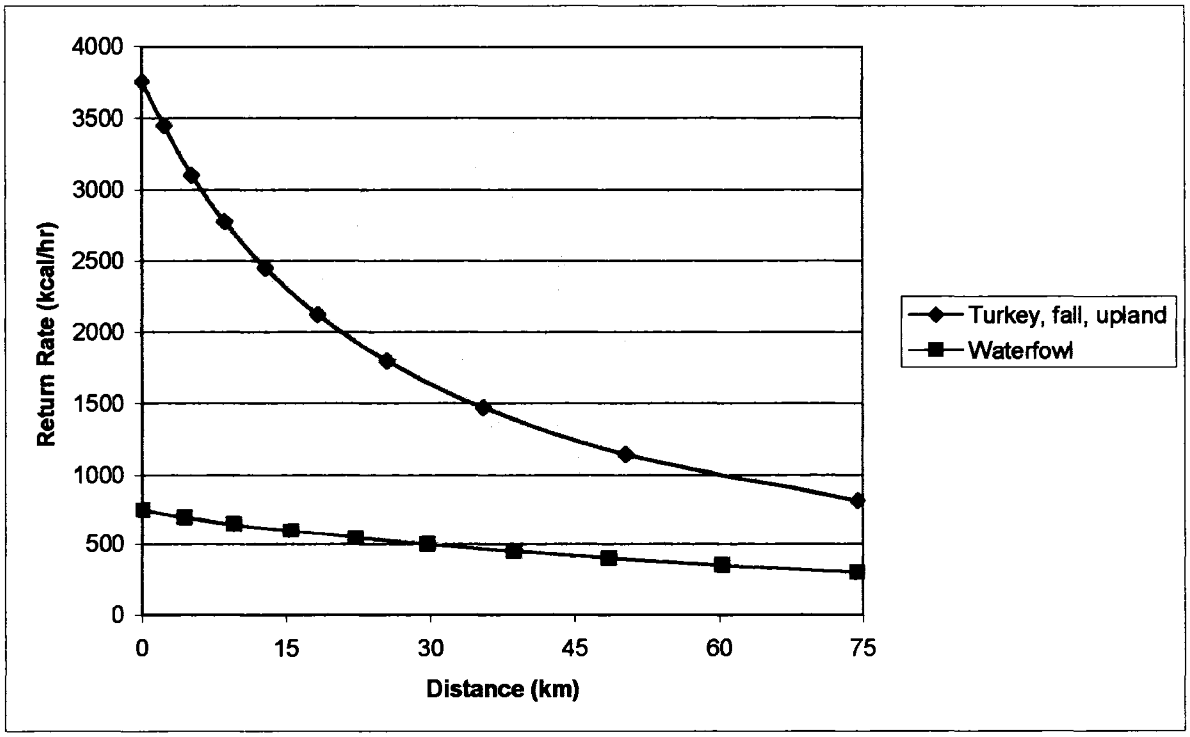


Figure 9.14. Comparison of return rates to distance for turkey and waterfowl.

(1981:154) assumes that the time required to hunt wild turkeys in the spring and summer may be double that of the fall. Turkeys and waterfowl are also limited in their spatial distribution. Waterfowl are found only along waterways and in the vicinity of ponds and lakes. Turkeys are more likely found in the slopes and uplands in autumn to feast on nuts, and in creek bottoms in the spring to take advantage of spring foliage.

Among the most spatially limited animals are fish, which may supply calories at a surprisingly high rate. Reidhead (1981:135-136) provides several estimates of fishing costs. The first, which included experimental use of logs to trap fish in a slough and subsequently catch them by hand, gave a handling rate of 6.25 kg of fish per hour. Such a high rate may have been reached in the spring, when spawning fishes were likely available in large numbers in shallow creeks and backwaters (Walker 1998). This handling time yields an extraordinary return rate of over 6000 kcal/hr; fishers can travel up to 7.5 km and still obtain fish at a rate of 3000 kcal/hr (Figure 9.15). Reidhead (1981:136) also provides several other estimates of handling rates for fish. A more moderate estimation of 3.8 kg/hr for obtaining spawning fish with use of bow and arrow yields a return rate of 3000 kcal/hr within 2.8 km of camp. A still lower estimate of 1.85 kg/hr for fishing in a sizeable creek, presumably with a hook, gives a return rate of over 1400 kcal/hr within 3 km of the site. This last figure is more comparable to other smaller animal resources. Fish are available in spring, summer and fall, but as noted above, several spawning species, including suckers, are present in significantly greater numbers in shallow streams and creeks during spring.

Also limited to aquatic settings but available year-round are mussels, which present several interesting choices to would-be collectors. Bettinger and colleagues (1997:896) note that while mussels may be collected either by plucking individuals or by detaching large sections of colonies (termed "stripping"), the latter method is much less efficient because many small individuals are collected as well. They also observe that depleted beds provide higher return rates than pristine ones, suggesting that plucking sizeable mussels from depleted beds is easier because they are not as

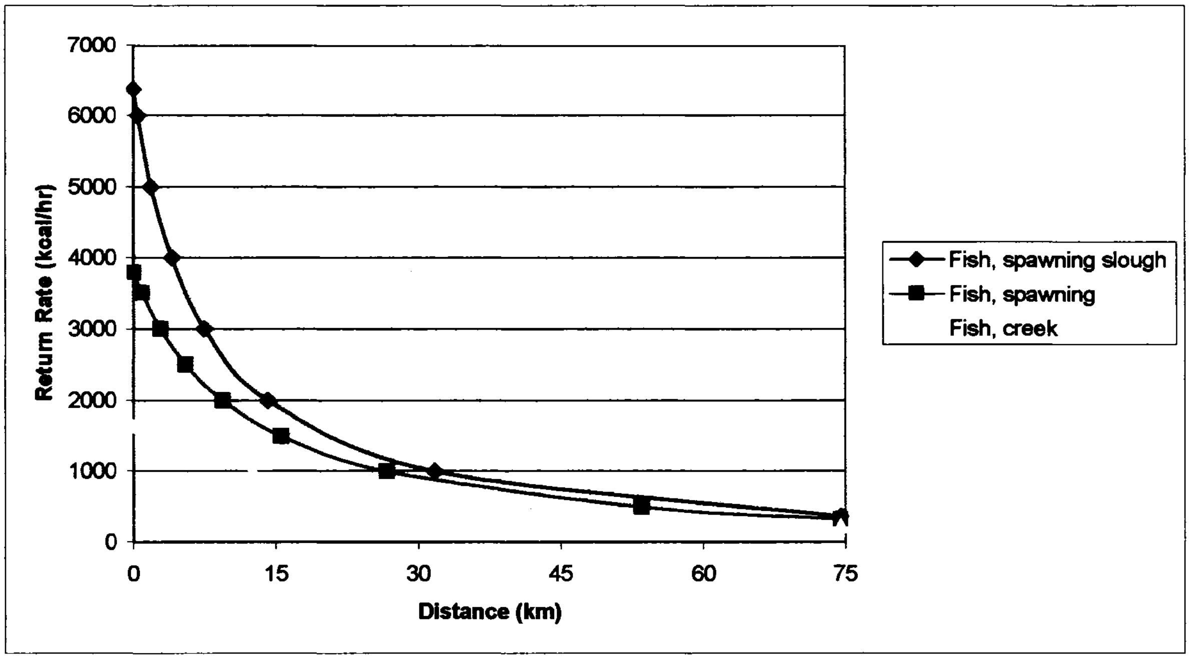


Figure 9.15. Comparison of return rate to distance for various fishing techniques.

strongly attached due to their rapid growth (Bettinger et al. 1997:896). I therefore assume that early shellfish collectors used the plucking method, and compare the return rates for both depleted and pristine colonies. It is certainly possible that early foragers significantly impacted mussel beds both in the Muscle Shoals area and along creeks. Using these values, it is not surprising that depleted colonies yield significantly higher return rates than do pristine colonies (Figures 9.16). Perhaps more surprising is the fact that collectors might transport a 30 kg load of whole mussels, shells and all, from depleted beds at a distance of 8 km and still gain 900 kcal/hr.

Mussels also present an interesting decision about whether to process the shellfish in the field. The majority of the weight of mussels is comprised of shell; collectors might be well served to spend more of their time processing a large quantity of mussels at the procurement site and transport just the meat back to camp (Bettinger et al. 1997). In the example here, collectors would profit from field processing if they traveled only 70 meters from base camp.

The mussels also readily illustrate the differences in return rate between carrying a 15 kg and a 30 kg load. Comparing the return rate maps for the two load sizes of mussels collected from

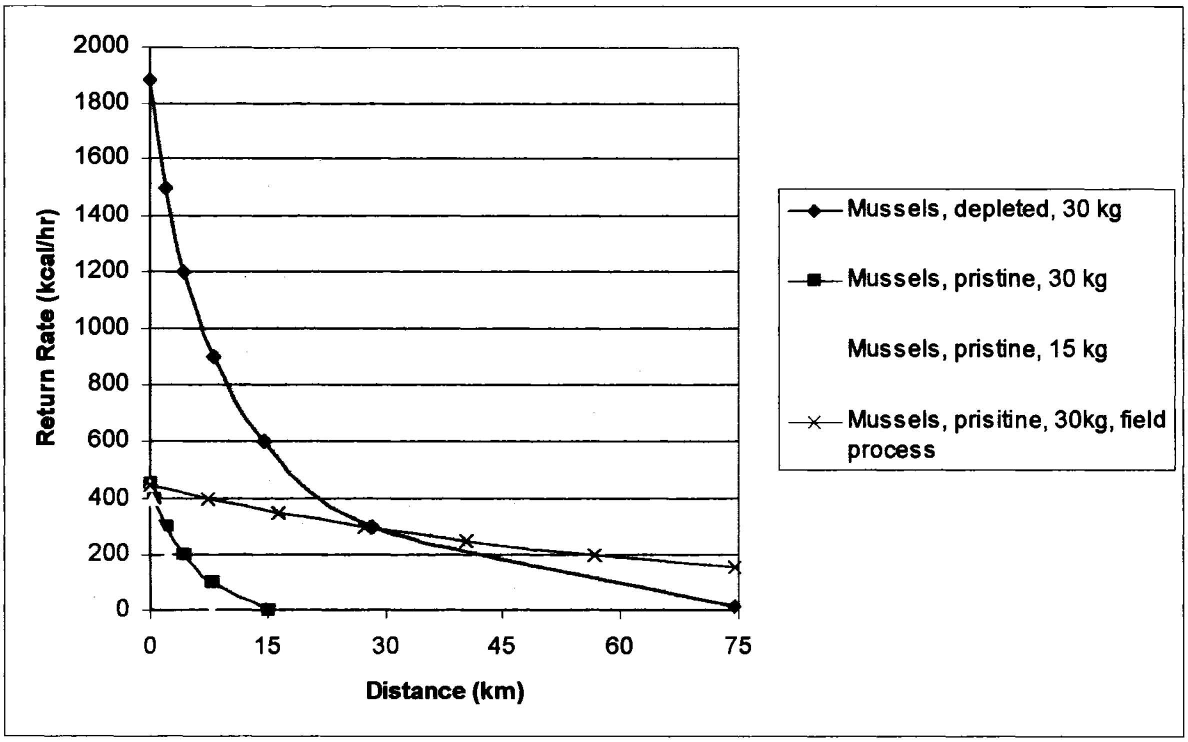


Figure 9.16. Comparison of return rates to distance for exploiting mussel beds.

pristine beds without field processing, we see that the maximum return rates are not significantly different for the two. Handling times and costs both increase as the load increases, but the transport costs are slightly lower per kilogram for the larger-sized load. As such, this portion of the equation increases at a slower rate, increasing the distance at which it is still profitable to obtain and transport a load back to camp.

In sum, the animal data suggest that larger prey, such as deer and turkeys, are more likely to be exploited at farther distances from a campsite than smaller prey like squirrels and waterfowl. Foragers are also likely to use fish at a significant distance from their camp, as well as mussels, particularly if they process the shellfish in the field. Although limited to bodies of water, mussels are the only foodstuff that does not vary in time or space. Fish are available in greater quantities during spring spawning runs; waterfowl are present only during spring and fall migrations; turkeys and deer frequent slopes and uplands in the fall and creek bottom communities in the spring. Squirrels, turkeys and deer also vary seasonally in the calories that they provide. These variables of population density and caloric value duly affect return rates.

Plant Resources. Similar to the animal resources, the plant foods considered here generally fall into two categories: items with low caloric values and low handling costs, and high-calorie items with high handling costs. Fruits and greens comprise the first group, and nuts and seeds make up the latter. Plant foods also vary in their spatial and temporal distribution, although their lack of mobility makes their presence and abundance in a particular area considerably more predictable. As such, search costs are minimal for plant resources, especially if foragers monitor their seasonal availability.

Fruits examined here include grapes and mulberries (Figure 9.17). The high return rates of these items are notable. Grapes provide a maximum of just over 2000 kcal/hr for a 15 kg load, while mulberries supply a staggering return rate of nearly 8000 kcal/hr. It is also immediately apparent from the graphs that the return rates of these items decrease rapidly as one travels further to obtain them. For these low-cost foods, the travel component dominates the equation. A similar trend is apparent for greens, including higher-calorie chenopod leaves and other greens (Figure 9.18). Because these items are lower in calories than fruits, they have significantly lower return rates and are more dramatically impacted by travel costs.

These return rates are seasonally defined, corresponding with the availability of fruits in the summer and leafy greens in the spring. The return rates also assume that gatherers can collect the entire 15 kg load in a single patch. This may be the case at the height of seasonal availability, and within settings where the fruits and greens thrive. Mulberries and spring greens likely occur in greatest quantities in creek bottom communities, while grapes may be found in various wooded, ecotone, and lowland habitats. Outside of preferred areas, additional handling time and costs must be added for travel between patches in order to obtain a full load, which lowers the return rate of the resources.

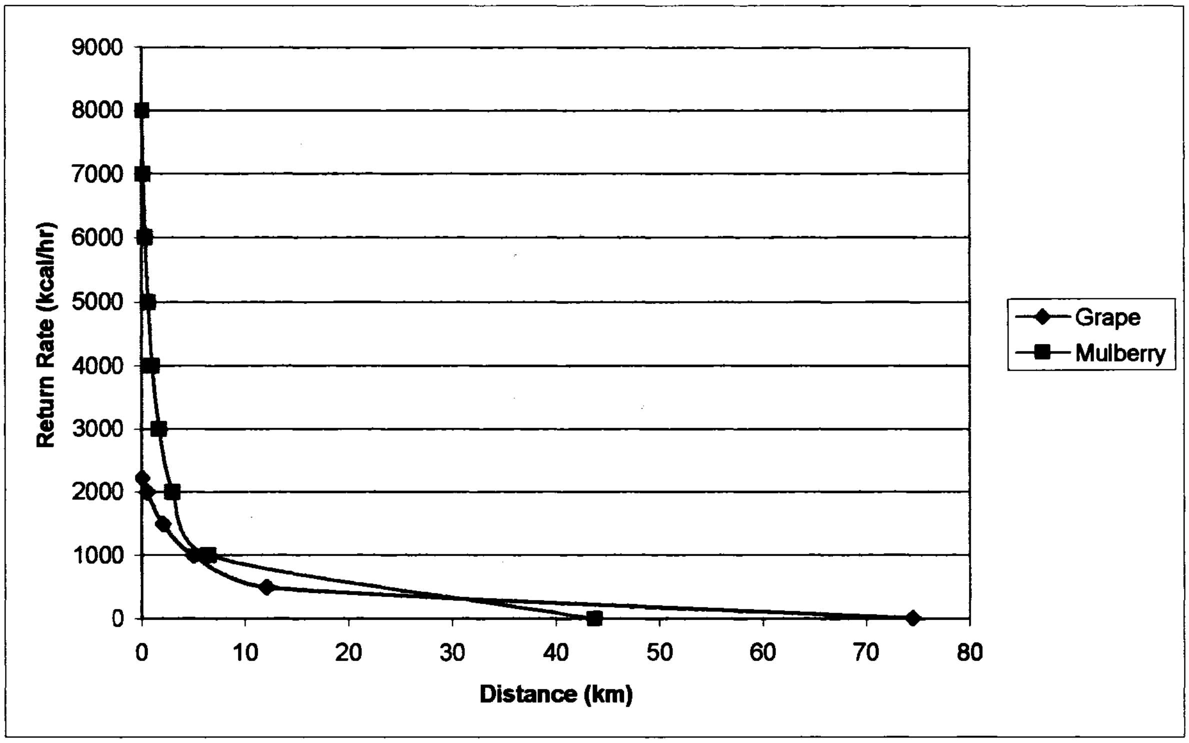


Figure 9.17. Comparison of return rates to distance for mulberry and grape.

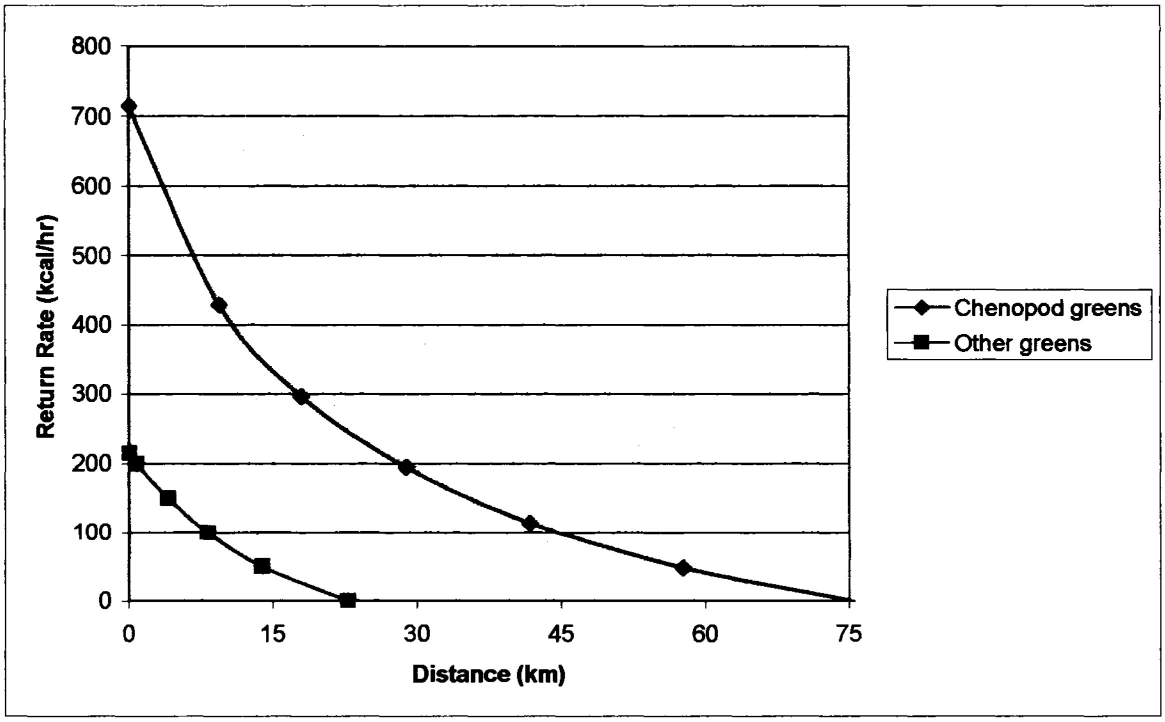


Figure 9.18. Comparison of return rates to distance for leafy greens.

Seeds and nuts present a slightly different picture, due to their high caloric value as well as the significant processing costs they require. Both chenopod and amaranth seeds are high in caloric content, but chenopod seeds apparently have slightly higher handling costs than amaranth. These costs are derived from experimental studies with more or less control over measurements of handling time (Peterson and Munson 1984; Seeman and Wilson 1984; see Chapter 7). Although the return rates may not be entirely accurate, they do estimate the relative ranking of the two and the impact of travel costs on their use.

Both sets of experiments compared the return rate of two collection methods. The first is cutting, in which seed heads are cut from mature (often dried) plants and taken back to the campsite to be threshed, winnowed, and to remove the papery perianth that encloses the seeds. The second method is stripping, in which the seeds are stripped from the seed head and collected in a container. While this method is relatively time-consuming in the field, it negates the need for threshing. Stripping basically constitutes "field processing" (Bettinger et al. 1997; Jones and Madsen 1989; Metcalfe and Barlow 1992), in which the low-utility plant stems are left in the field and a larger load of high-utility seeds is transported back to the site.

The maps of the two seeds and two methods (Figure 9.19) illustrate that while the cutting method yields a higher return rate at close distances, the stripping method is profitable at significantly greater distances. This can be demonstrated further by subtracting the map of stripping return rates from the cutting return rates. The resulting map (Figure 9.20) readily displays the distance at which stripping becomes more profitable than cutting for chenopod, namely just over four kilometers for a 15 kg load.

The nut taxa are also processed using two different methods. The first is crushing and boiling: the nuts are crushed in a nutting stone or mortar, and then the resulting hodgepodge of meats and shell are thrown into a container of boiling water. The meats, which float to the top, are skimmed off, while the shells sink to the bottom. The nutmeats may also be melted into an oil during boiling. The

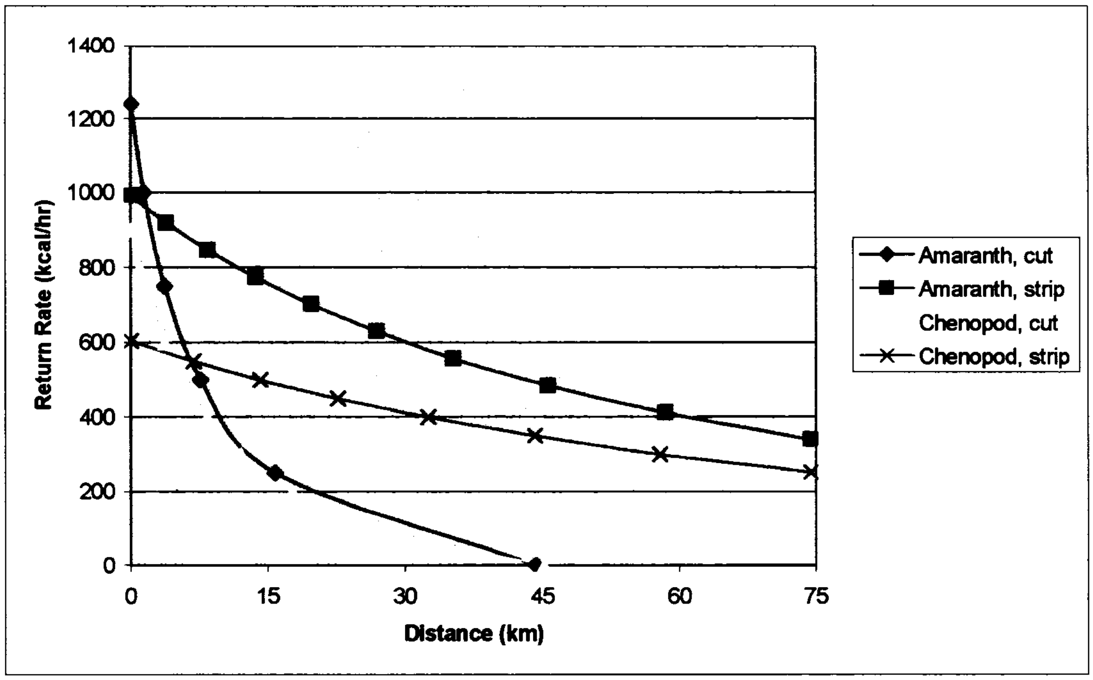
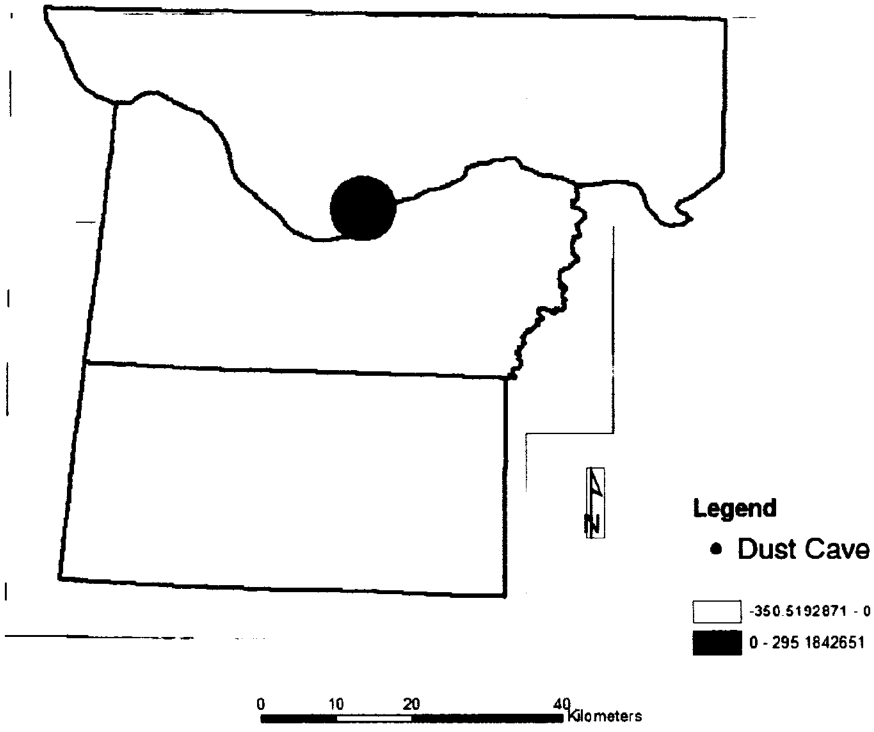


Figure 9.19. Comparison of return rate to distance for harvesting edible seeds.



. Figure 9.20. Distance at which stripping is more profitable (light blue) than cutting (dark blue) a 15-kg load of chenopod seeds.

second method is cracking and picking, in which the nutmeats are simply picked out from the shell. As discussed in Chapter 7, the first method is especially efficient for extracting hickory. The nutmeats are tightly encased in the shell, so that one actually loses energy by trying to pick the meats from the shell. However, boiling is not applicable to black walnut or hazelnut. Portions of the black walnut hull adhere to the ridges of the shell; if boiled, the tannins in the hull would be released and spoil the nutmeats. Hazelnut meats, on the other hand, do not float, thus negating the usefulness of this method for separating nutmeats and shell.

Because the handling costs of black walnuts and hazelnuts are so high, the return rates of the two nuts are markedly low even though they are rich in calories (Figure 9.21). Chenopod greens actually yield higher return rates at short distances than do black walnuts and hazelnuts. These high handling costs also significantly influence the equation, so that the return rates of the two nuts slowly decrease with distance from the site; transport costs are small in comparison.

Hickory, on the other hand, yields a notably high return rate (Figure 9.21). In fact, the return rate of a 30 kg load of hickory nuts is comparable to, if not greater than, the return rates for hunting any animals other than deer. Similar to the other nuts, the processing costs are high relative to travel costs, so that the return rate slowly diminishes with distance.

Although acorns are generally processed using the crack-and-pick method, they require a significant additional step. As discussed in Chapter 7, tannins must be leached from acorn meats before they are edible. This gives acorn a relatively high handling cost, which, in combination with a lower caloric content, results in a lower return rate for acorn as compared to hickory (Figure 9.21). The return rates also decrease relatively slowly with distance.

Similar to leafy greens and fruits, seeds and nuts are limited in time and space. The weedy seeds that produce edible seeds are found in quantity in creek bottoms, while nut taxa are more predominant in slopes and upland forests. Nuts ripen and fall in autumn, while seed heads mature and dry in late autumn and early winter. Outside of these areas and seasons, gatherers may incur additional costs in travel between patches in order to obtain a full load.

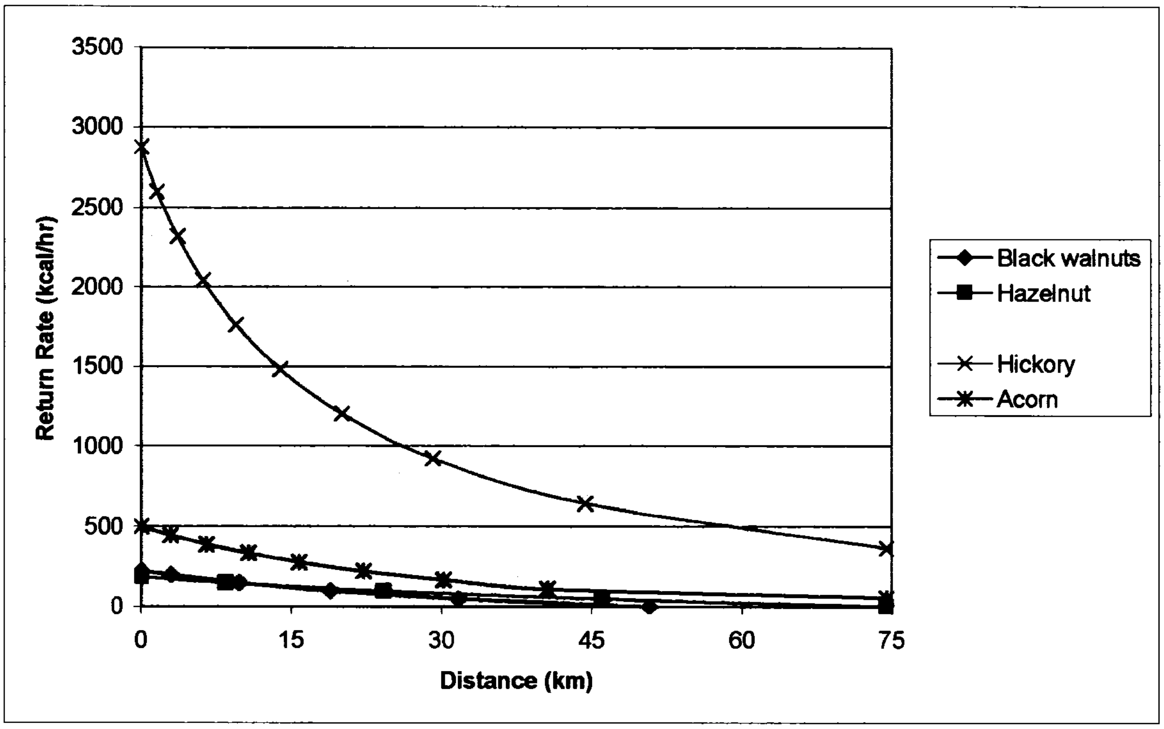


Figure 9.21. Comparisonof return rate to distance for various nut taxa.

In sum, the plant resources separate into two categories, based on their caloric value and handling costs. Fruits and greens generally conform to the standard notion that plant resources are not profitably acquired at long distances from a campsite. However, fruits in particular demonstrate significant return rates, comparable to or higher than animal resources at short distances. Seeds have lower return rates than fruits at short distances due to their higher processing costs, but also are profitable at much greater distances. Furthermore, they illustrate the utility of field processing at given distances from a site.

Among the nuts, hickory clearly yields the highest return rate, which is not surprising. What is perhaps surprising is that the return rate is comparable to or greater than hunting most animals. More intriguing is the very low return rate of black walnut and hazelnuts. Due to the high processing costs of the two, their maximum return rates are lower than any other resource except for "other greens". The fact that their nutshells, particularly hazels, are often poorly represented in archaeobotanical assemblages may thus be related more to their high processing costs than their local availability.

Task Groups. Evolutionary ecology assumes that individuals make foraging decisions. As such, the efforts of a single hunter or gatherer are calculated in the return rates discussed above. However, early foragers certainly lived, traveled, and worked in groups. It is of interest, then, to consider the size of work groups apportioned to different subsistence tasks, and the circumstances in which two people can yield a higher return rate than a single person who does twice the work.

There are several factors that might affect task group size. Perhaps the most important is prey package size. For large prey such as deer, which generally weigh over 60 kg, two people are required to carry back an entire animal. As such, two people can split several of the costs associated with hunting deer. Both incur travel costs, as well as the costs involved in searching for and pursuing prey. Butchering costs may be divided, but perhaps more importantly, two people can survey twice as much area, thus doubling the opportunity to encounter prey. The return rate is thus higher for two hunters by nearly 2500 kcal/hr (Figure 9.22). However, hunting parties of more than two appear unlikely, as the third hunter would not carry a full load of venison back. An exception may be larger hunting drives, in which numerous group members surround and drive several animals towards waiting hunters. To the extent that this technique requires lower pursuit costs per person, and results in several prey being taken, it may well yield a higher return rate.

For smaller animals or plant foods, however, two people would simply have to capture or collect and process twice as many items to procure two loads. There do not appear to be energetic advantages to exploiting these resources in larger groups. However, there may well be safety in numbers, as well as a number of social reasons to travel in groups.

It may also be advantageous to focus group members' efforts on obtaining high value food items that are available for relatively short periods of time, particularly if they can be dried and stored

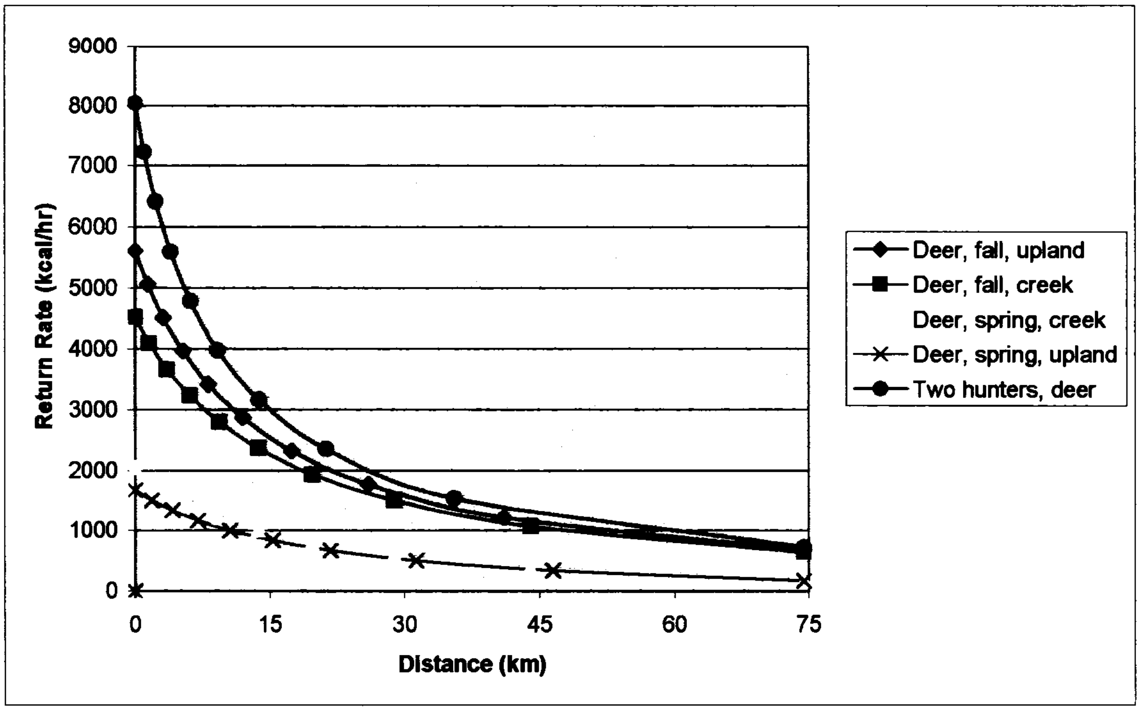


Figure 9.22. Comparison of return rate to distance for hunting deer, alone or with two hunters.

for future use. These resources might include migratory waterfowl, although the return rate for these birds is relatively low. More likely are spawning fishes, for which the return rate is significant.

Autumn deer and turkeys, fattened for the winter and less skittish in the rutting season and in flocks, might also have been seasonal targets of task groups. Plant foods that may have been targeted include fruits, which have very high return rates due to their low processing costs, and hickory nuts, high in fats and readily processed in bulk. Task groups may also have been sent to obtain edible seeds such as amaranth and chenopod in early winter. Alternatively, individuals may have exploited items more generally available and/or associated with lower return rates, such as squirrels and leafy greens, in a more opportunistic fashion.

Stone Resource Procurement

The costs of procuring raw materials for making stone tools can also be evaluated using the portion of the equation that calculates transport costs. Figure 9.23 displays the roundtrip costs of obtaining a 30 kg load of blue-gray Fort Payne chert from any given point in the project area. As should be expected, costs are mostly tied to the distance from outcrops of the chert. Differences in terrain appear to have relatively little effect on the costs, likely related to the definition of costs associated with the given slopes. I assume that knappers fashioned early-stage preforms at the outcrops, a form of field processing, in order to maximize the utility of the material they ultimately transported to subsequent camps.

Interestingly, the costs of transporting blue-gray Fort Payne chert to Stanfield-Worley are less than those to LaGrange. However, occupants at LaGrange appear to have had ready access to the material. The vast majority of tools and flakes are comprised of it, and few of the tools show evidence of curation. Instead, blue-gray Fort Payne chert appears to have been relatively inexpensive for LaGrange occupants.

There are several possible explanations for this apparent disjunct between chert use at LaGrange and the map of chert transport costs. First, it could be that the distribution of blue-gray Fort Payne chert is poorly mapped. Secondary cobbles of the raw material may be available in tributaries further upstream from the main river channel that presented here. Second, travel costs may be poorly calculated. Occupants of LaGrange may have traveled from the Tennessee River to within two kilometers of the site by canoe via nearby Spring Creek or Dry Creek, thus lowering the costs of transporting chert. Third, they may have not experienced the time constraints that the occupants of Stanfield-Worley faced. As Randall (2002) suggests, groups using Stanfield-Worley may have focused on autumn hunts and nut collection and processing, with little time for tool manufacture. This would necessitate curation of existing tools. Alternatively, occupants of LaGrange may have

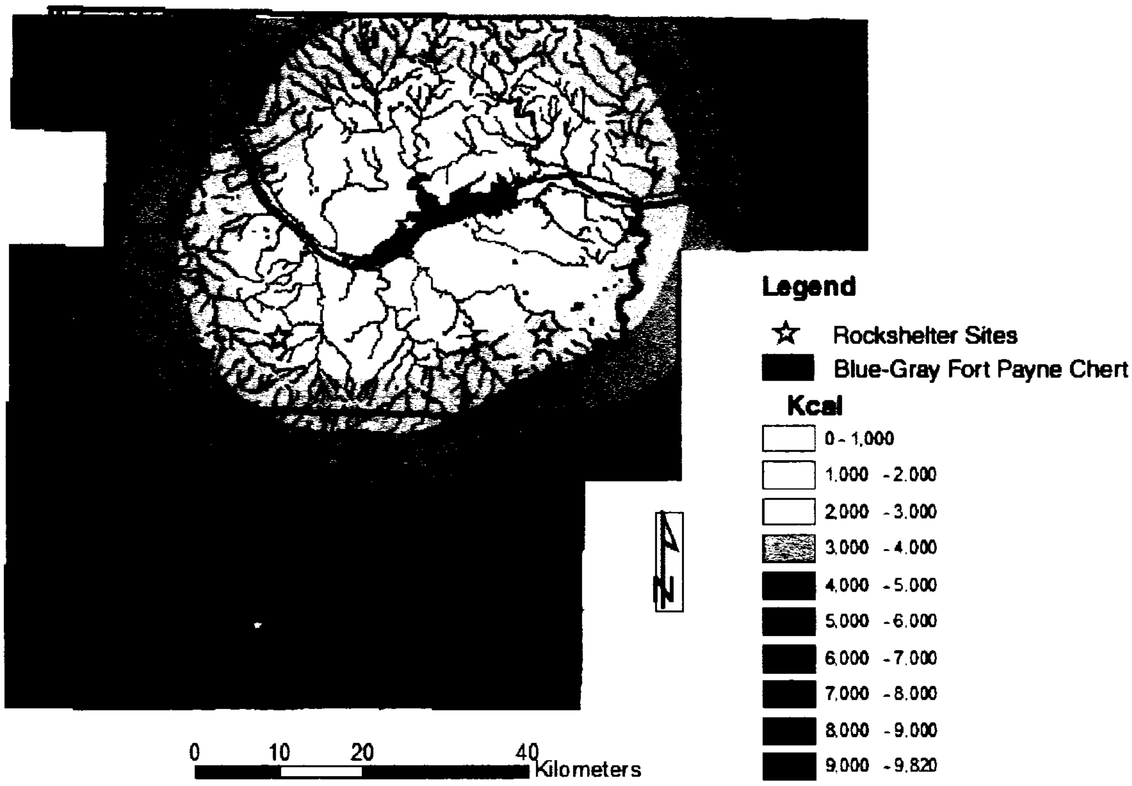


Figure 9.23. Costs of procuring blue-gray Fort Payne chert.

been able to return more frequently to the Tennessee River. Of course, it is possible that best explanation is a mix of these three.

Because there is no caloric return associated with obtaining chert, and because other chert sources were locally available throughout the region, it is likely that foragers obtained blue-gray Fort Payne chert during subsistence-related forays to the river. However, it is difficult to evaluate the advantage of using this high-quality chert over lesser quality local cherts. If hunters could more efficiently kill or butcher game with certain styles of projectile points or knives, and if knappers could only make these tools on high-quality chert, then foraging groups may have scheduled more frequent forays to the river. Whether subsistence tasks or raw material needs drove these forays would then be debatable.

Discussion

Several observations can be made about subsistence strategies in northwest Alabama from the perspective of central place foraging theory. The most important feature of a resource that affects its return rate on a given landscape is the handling cost associated with its use. High handling costs in effect mask the costs of transporting an item, dominating the return rate equation. As such, foragers can travel farther across the landscape to obtain these resources and still secure a positive return rate. These include most animal resources, as well as nuts and seeds. Items with lower processing costs are much more sensitive to travel costs; these include fish, mussels from pristine beds, fruits and greens.

Two factors that increase the distance over which a forager will travel for a given food item are load size and field processing. The cost of transporting a 30 kg load is less per kilogram than the cost of a 15 kg load, further reducing transport costs compared to handling costs. Field processing similarly minimizes transport costs relative to handling costs. In particular, field processing facilitates the exploitation of mussels and edible seeds over greater distances.

Temporal and spatial differences in availability must also be kept in mind. Among animal resources, larger populations may be found in particular environments, often at particular times of the year. For example, turkeys and deer likely frequented forests in uplands and along slopes in fall to take advantage of nut harvests, and in spring moved into creek bottoms where high-quality forage was likely available in greater quantities. Deer and turkey meat are also highest in calories in fall. Return rates for both of these animals thus vary with season and by habitat. Aquatic resources such as fish, mussels and waterfowl are obviously spatially restricted, but spawning fish and migratory waterfowl are also temporally limited. Plant foods are similarly restricted in time, and to some degree in space. Foraging peoples must therefore have traveled to particular habitats in certain seasons to exploit these resources.

Using this information, I suggest the following seasonal rounds for early foraging groups living in northwest Alabama, and argue that stone procurement would have been embedded within these subsistence-focused rounds. In spring, groups likely would have resided in creek bottom areas, where they could exploit spawning fish and waterfowl passing through the area on their flight north, as well as denser populations of wild turkey and deer. By situating camps in creek bottom settings, early foragers could also readily exploit spring greens without traveling far from camp. Hunters may have set off in pairs to pursue deer, while larger group efforts may have concentrated on exploiting fish. Individual gatherers likely collected leafy greens close to camp.

Such spring occupations are suggested by the faunal and floral evidence at Dust Cave and LaGrange, which both afford access to floodplain settings. Seeds of plants with spring greens, such as chenopod, amaranth, and poke, were recovered at the two sites. Waterfowl comprise a significant portion of the early faunal assemblage at Dust Cave, which also includes spawning fishes such as suckers (Walker 1998).

Foraging groups also may have spent a significant portion of their summers in creek bottoms to take advantage of ripening fruits that have high return rates, such as the mulberry recovered from LaGrange. In bottom settings, foragers could also obtain aquatic resources such as mussels, turtles, and fish, found in the Dust Cave faunal assemblage (Walker 1998). Groups likely often traveled along slopes and into the uplands as well, to gather grapes and other fruits found in a variety of settings. Because animals also prize these fruits, gatherers presumably monitored their ripening in order to collect them before animals did, and likely sent sizeable work groups to collect as many berries as possible. Gatherers also likely monitored nut-bearing trees toward the end of summer. Not only are nuts soon eaten by competing wildlife or attacked by molds on the ground, but oaks, hickories and walnuts produce substantial yields only once every two to five years. While monitoring and collecting other plants, gatherers likely took note of which groves or individuals would produce bumper crops during a given year as well as the status of ripening nuts. Such upland forays might explain the grape and sumac seeds recovered at all four rockshelter sites.

In autumn, foraging groups likely spent considerable time in the forests that occupied the slopes and uplands of the project area. Fattened deer and turkeys also frequented these forests to eat nuts. These animals would have provided high return rates to hunters, who may have pursued them in groups of two or more. Gatherers likely organized sizeable work groups to collect hickory nuts in particular, and to a lesser degree acorns, before other animals significantly impacted harvests. They probably also gathered black walnuts as well as they encountered them, but most likely did not set out with the express purpose to collect them. The ubiquitous recovery of hickory and frequent recovery of acorns speak to the use of all four rockshelters in autumn. The high numbers of deer and turkey at Stanfield-Worley (Parmalee 1962), and lesser quantities of the two species at LaGrange (Curren 1976) and at Dust Cave (Walker 1998), also reflect autumn occupations.

Foraging peoples may have returned to creek bottoms in late autumn and early winter to gather edible seeds in quantity. This is suggested by the recovery of chenopod seeds and wild legumes at both Dust Cave and LaGrange. Deer, turkeys and other game may also have been drawn to this setting to take advantage of persisting seeds and fruits, giving hunters as well as gatherers reason to return to the floodplains.

Further into winter, as stores gave out, gatherers likely gleaned what remaining seeds and fruits they could, perhaps opportunistically, as the return rates would have been lower than ideal. In the Late Paleoindian period, when winters may have brought significant snows to the area, hunters likely took advantage of yarding deer, perhaps in larger hunting groups. Foraging groups may then have moved into the uplands and slopes, particularly of the Tennessee Valley, where the conifers of the spruce woodlands might have provided shelter and food, serving as a yarding area for deer in winter.

Taking a broader, regional perspective and applying the physiographic rankings developed from the GLO data to this sketch of seasonal rounds, it seems likely that both Late Paleoindian and Early Archaic groups preferred the wider creek bottoms of the Tennessee and Moulton Valleys. These presumably would have provided larger resource patches than their counterparts in the sandstone hill regions. Early groups may thus have spent their springs and large parts of their summers in these areas. The wooded slopes and uplands of the various physiographic regions likely differed little in the Late Paleoindian period, such that we might expect peoples using Quad, Beaver Lake, and Dalton tools to gather nuts and hunt autumn game equally in all five physiographic regions. Late Paleoindian peoples may have sent hunting forays into the uplands of the Tennessee Valley in the heart of winter to hunt deer that might have yarded in the spruce woodlands of the region. As mixed hardwood forests overtook the spruce woodlands of the limestone regions and oak-hickory-pine forests encroached upon the sandstone hill regions, Early Archaic peoples may have preferred to spend their autumns in the more productive uplands and slopes of the Tennessee and Moulton Valleys. In late fall and early winter, they likely returned to the creek bottoms of these regions to collect edible seeds and hunt the game attracted to the seeds. Early Archaic groups may also have traveled into uplands and hills in winter to hunt game searching for persisting nuts, fruits and seeds.

These models, both of central place foraging and of seasonal movements in northwest Alabama, can be further modified and adapted to various situations. Many of the terms of the return rate equation can be further refined. Caloric content of various foodstuffs may be relatively constant, although different cooking methods certainly affect the nutritive value of some foods. Perhaps more importantly, the value of non-food byproducts of animal and plant resources, as well as other resources such as stone, is not considered by the equation. Bone and shell may be used to make tools as well as ornaments and other material goods; nutshell may serve as a fuel; skins and hides are made into clothing, blankets, containers, and shelters; stems are woven into mats and baskets. As such, the utility of these various foodstuffs is likely underestimated by considering nutritive value alone.

Moreover, estimates of handling costs in particular may be replaced by ethnographic observations or experimental results. The handling costs might also be expanded to included efforts associated with cooking, drying, smoking, and/or storing various foodstuffs. Handling times also change with the density of resources, as noted above. Densities may change due to human predation and modification of landscape, as well as climate change. This is particularly seen in the example of mussels, for which the return rates increase markedly as humans deplete mussel colonies. Humans may also use fire to several ends: to clear underbrush to make travel easier and improve visibility; to promote the growth of favored plants; and to attract desirable game. All of the above would decrease handling costs and/or time.

Changes in technology also impact handling costs. As noted above, hickory nuts are efficiently processed only with use of boiling technology. Several researchers (Munson 1986; Stafford 1991) have suggested that early foraging groups did not employ stone boiling technology until the Middle Archaic period, when large features with significant quantities of carbonized hickory nutshell appear on archaeological sites throughout the Eastern Woodlands. However, there is nothing to indicate that earlier peoples were not familiar with this technique. Indeed, the dominance of hickory above other nut taxa at all four rockshelter sites suggests that the occupants did employ an efficient manner of processing hickory nuts.

Travel costs might be adjusted to include consideration of ground cover, as well as travel by water. This would require a level of detail currently unavailable for the local environment in the project area. Finer-scale environmental reconstructions would also enhance estimations of the availability of various plant resources, as well as rankings of the population density of animals, in the different physiographic regions and topographic zones considered here. These would improve approximations of handling costs as well.

Whether the above modifications are applied or not, this central place foraging model is highly useful, in that it highlights those resources which direct camp placement. The model of seasonal rounds developed above, at both the local and regional perspectives, places resources with relatively low handling costs and/or those that are reliable and predictable in time and space at the center of groups' movements, and decisions to move, across the landscape. These are resources that are targeted by women and children, who require steady nutrition for their survival and success. It is the needs, the activities, and the decisions of women, the elderly, and children, then, that lie at the center of early foragers' mobility patterns.

Summary

The application of central place foraging theory to the landscape of northwest Alabama suggests that foraging groups would not travel far from their base camp to collect items low in caloric content, such as leafy greens. Nor would they travel significant distances for items with low processing costs, like fruits and perhaps fish, as travel costs quickly diminish return rates. Food items high in calories that require more significant processing, such as deer, turkeys, and likely hickory nuts, might be acquired from greater distances, as transport costs are relatively low as compared to handling costs. Those resources that require even greater processing, such as seeds, or that have substantial byproducts, as do mussels, are likely to have been processed in the field if collected a significant distance from camp.

Under the assumption that early foraging groups maximized their return rates, their seasonal rounds likely began in creek bottoms in the spring, where deer and turkeys would have been drawn to leafy greens that people might also have eaten, and waterfowl and spawning fish would have been available. In summer, these groups likely sent sizeable work groups to gather fruits, both in creek bottom communities as well as in forested uplands and slopes. Foragers presumably monitored the ripening of both fruits and nuts during their gathering and hunting forays in order to take advantage of these resources before harvests would be significantly impacted by animal consumption. In autumn, groups likely moved into the slopes and uplands to gather nuts, sending smaller parties to hunt the deer, turkeys, and other game that feast on the nuts as well. Towards the end of autumn, they may have moved back into the creek bottoms, or sent work parties, to collect edible seeds and hunt the animals attracted to these weedy stands. Through winter, they likely moved through various habitats, living on stores, perhaps gathering persisting fruits and seeds, and hunting animals subsisting on these winter holdovers.

It is important to note that I consider the rockshelters to be examples of sites visited by early foragers in each of these environmental settings, rather than special-use sites within a seasonal round. Their artifact assemblages do not suggest that occupations of the rockshelters differ significantly from open-air sites. In addition, the artifact density at the four sites is relatively low, indicating that foraging groups likely visited them for rather short periods, with relatively long lapses between visits. As such, I view Dust Cave and LaGrange as examples of sites with access to both floodplain and upland resources, and Stanfield-Worley and Rollins as upland sites, that just happen to have extraordinary preservation of organic remains, unlike their open-air counterparts.

The model presented here suggests that camps are sited to take advantage of resources with low processing costs, which are also the resources targeted by women, children and the elderly. In other words, the locations of campsites correlate to the activities of gatherers, and the nutritional needs of women and children. Thus gatherers – women, children, and the elderly – play a central role in the mobility decisions and subsistence strategies of early foraging groups.

This sketch of seasonal rounds, as well as the parameters of the central place foraging model that underlie it, can be further refined, particularly by more detailed and reliable reconstructions of past local environments. These would clarify the size and density, as well as the location, of both plant resources and the animals that subsist on them. Future research should concentrate on improving our understanding of local landscapes.

PATTERNING IN THE SITE FILE DATA

Although Futato (1995), Goldman-Finn (1994) and Meeks (2001) have mined the Alabama Site File Database for patterning in early settlements within the region, their research addressed different time spans or different geographic regions than those I consider here. I examine the site file data by phase, from the Early Paleoindian Clovis phase through the Middle Archaic Eva/Morrow Mountain phase (Table 9.13; Appendix F). I frame the Late Paleoindian and Early Archaic data with these earlier and later phases to provide a broader context of landscape use in the region. It is important to note that Beaver Lake occupations are included in the Cumberland phase (Middle Paleoindian) in the database rather than the Quad phase (Middle/Late Paleoindian), as would be more

Table 9.13. Paleoindian, Early Archaic, and Middle Archaic sites within Lauderdale, Colbert and Franklin counties.

Period	Phase	Number of Sites
Middle Archaic	Eva/Morrow Mountain	59
Early/Middle Archaic	Kirk Stemmed	24
Early Archaic	Bifurcate	40
	Kirk Corner-Notched	165
	Early Side-Notched (Big Sandy)	91
Late Paleoindian	Greenbrier	26
	Dalton	55
Middle/Late Paleoindian	Quad	36
Middle Paleoindian	Cumberland (Beaver Lake)	55
Early Paleoindian	Clovis	43

consistent with current understandings of regional chronology (Sherwood et al. 2004). This should be kept in mind as the two phases are compared.

The influence of formal archaeological testing on the structure of the database must also be noted. The vast majority of the surveys performed in the project area have concentrated on lands owned and/or affected by the Tennessee Valley Authority and its damming activities. As such, most of the sites are located within the Cedar Creek, Bear Creek, and Little Bear Creek valleys, and of course the Tennessee River Valley (Figure 9.24). The karstic uplands, particularly the sinkholes, of the latter have also received much archaeological attention. These certainly introduce biases to the data, particularly with respect to the use of uplands in the remaining physiographic regions, for which comparatively little data is available. The absolute number of sites located in each physiographic region is therefore not necessarily meaningful. However, as long as surveyors systematically recorded all sites from all time periods that they came across within the surveyed areas, and there is no reason to think otherwise, the data can be used to discern trends through time within each physiographic region.

This also rests on the assumption that sites from all time periods have equal chances of being discovered and recorded. Paleoindian toolkits, with their unifacial technology, may be more easily recognized than the more expedient Early Archaic toolkits, regardless of whether diagnostic points

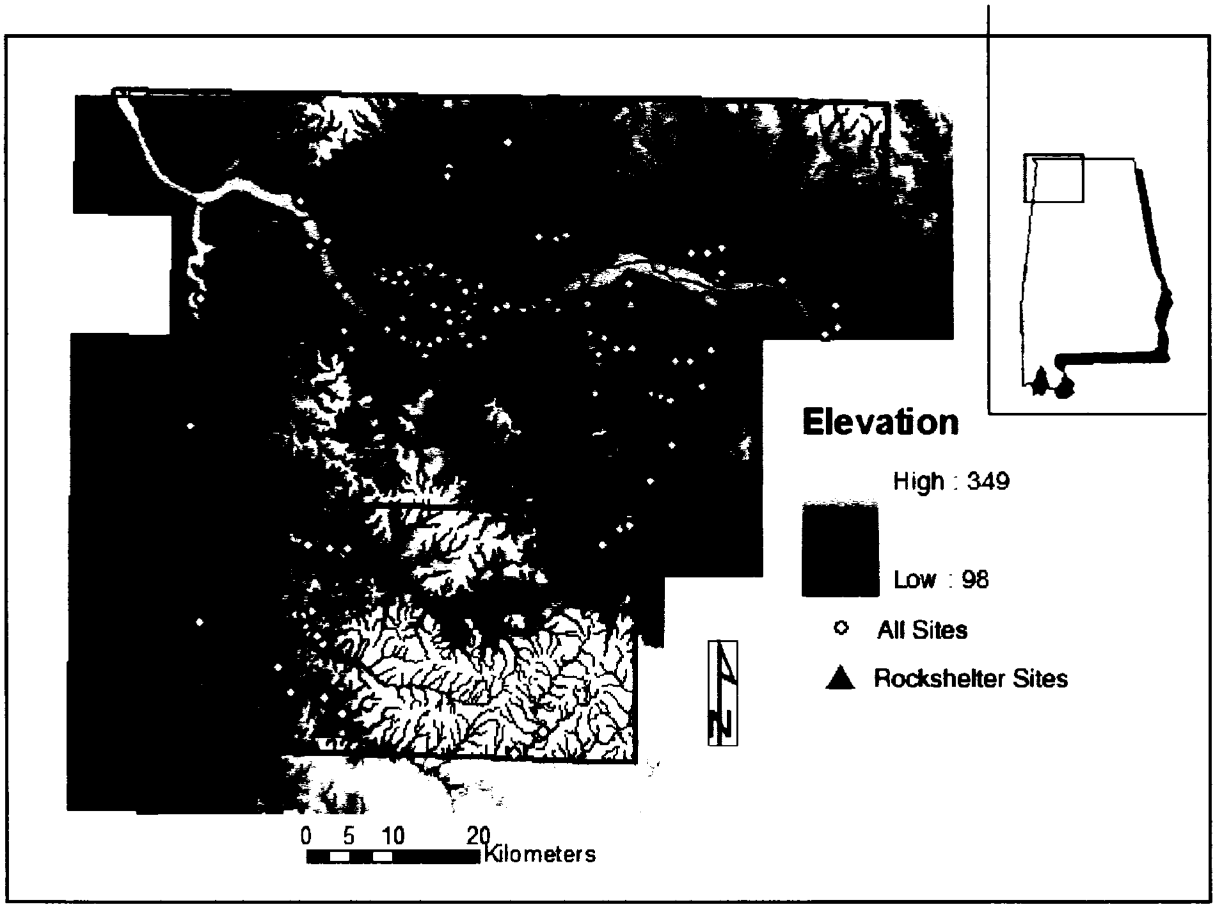


Figure 9.24. Paleoindian, Early Archaic, and Middle Archaic sites in the project area. Inset shows location of project area within the state of Alabama.

are present. However, hafted bifaces are key components of all Paleoindian and Early Archaic toolkits, so that significant differences between the visibility of the various periods and phases are unlikely. Perhaps of greater concern is whether Paleoindian sites located along waterways may be covered by alluvial deposits or scoured away by meandering of rivers and streams. Indeed, Collins and colleagues (1994) argue that the Tennessee River significantly incised the valley between roughly 18,000 cal B.P. and 12,500 cal B.P., making the possibility of finding intact sites that predate the leveling of river extremely low. This should be kept in mind particularly when comparing Clovis and Cumberland site frequencies with later phases.

The database includes quantitative information regarding the elevation, distance to water, and the length of the major and minor axes of the sites, as well as qualitative information about the nature of the nearest water source, the topographic setting, and the physiographic district in which each site is located. I found few quantitative differences among the sites. Cumberland phase sites have significantly lower elevations, but the remaining phases overlap significantly in the range of their elevation values (Figure 9.25). Boxplots of distance to water also demonstrate no significant differences between the phases (Figure 9.26). Subtle differences in site size[4] may be present (Figure 9.27). Early Side-Notched (or Big Sandy) sites, and to some extent Kirk Corner-Notched sites, appear to be slightly smaller in size than those in earlier phases, with the exception of Greenbrier. In contrast, Kirk Stemmed and Eva sites display a much wider range of site sizes, particularly on the smaller end of the scale. This is in part related to the fewer number of sites with available data for these periods.

Qualitative differences among the sites are more pronounced. In terms of the nearest water source, all Paleoindian sites show a distinct preference for sinks, which are located in the karstic uplands of the Tennessee Valley region (Figure 9.28). This is not surprising, given that a number of surveys have particularly targeted these upland sink areas (Futato 1996; Goldman-Finn 1995a; Waselkov and Hite 1987). However, the percentage of sites located near sinks decreases over time, falling below 30% in the Early Side-Notched phase. This percentage rises again through the Bifurcate phase, displaying values similar to earlier Paleoindian sites, but then drops dramatically in the Kirk Stemmed phase. In both the Kirk Stemmed and subsequent Eva/Morrow Mountain phases, sites are much more evenly distributed among water sources, with higher percentages located near rivers and major tributaries than in previous phases. As suggested by Futato (1995) and Goldman-Finn (1994), this may be related to stabilization of the rivers and/or drier and warmer conditions during the Holocene.

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[4] Site size is defined as the site area, which is computed by treating the site as an ellipse. For an ellipse, area = pi * radius a * radius b, where radius a is the major axis of the site and radius b is the minor axis of the site. Measurements of both axes are included in the Alabama Site File Database for a number of sites.

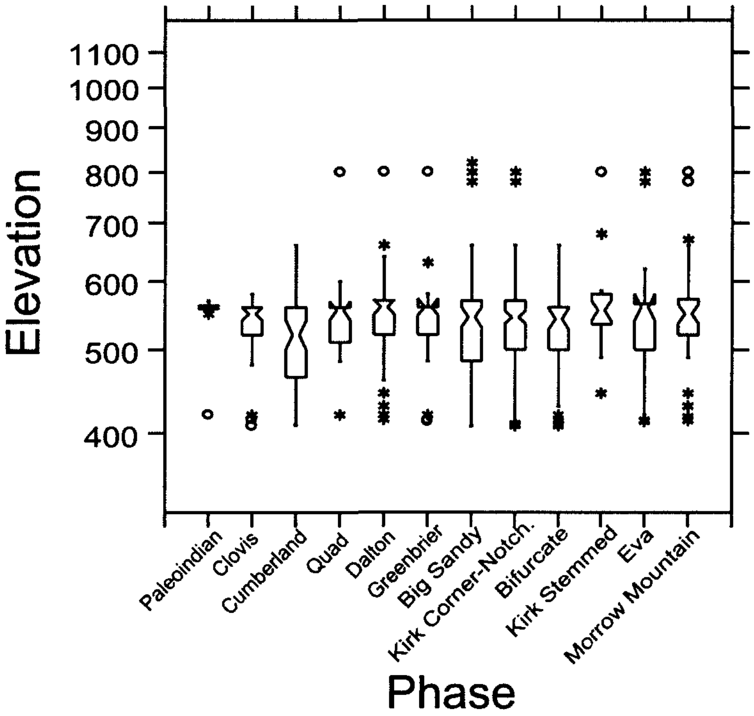

Figure 9.25. Boxplot comparing elevation of sites by phase. Note that the y-axis is scaled logarithmically.

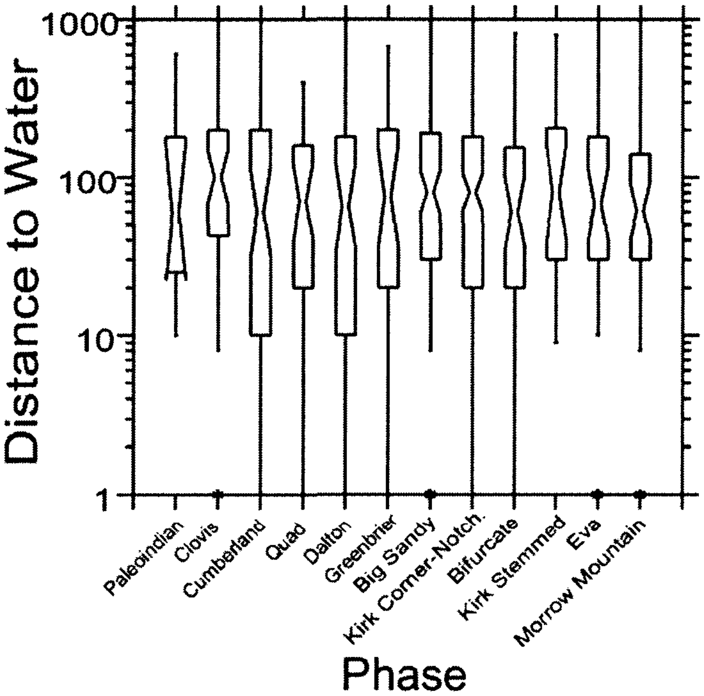

Figure 9.26. Boxplot comparing distance to water of sites by phase. Note that the y-axis is scaled logarithmically.

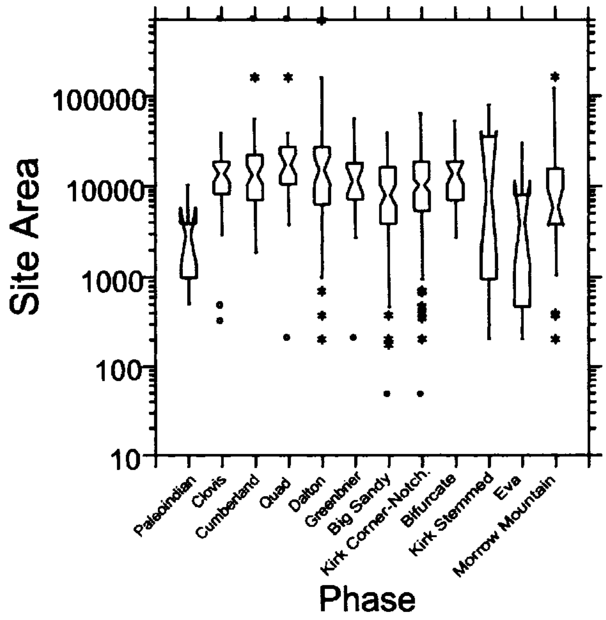

Figure 9.27. Boxplot comparing site area by phase. Note that y-axis is scaled logarithmically. Site area was computed by treating the site as an ellipse; area = pi * radius a * radius b, where the radii are the major and minor axes of the site.

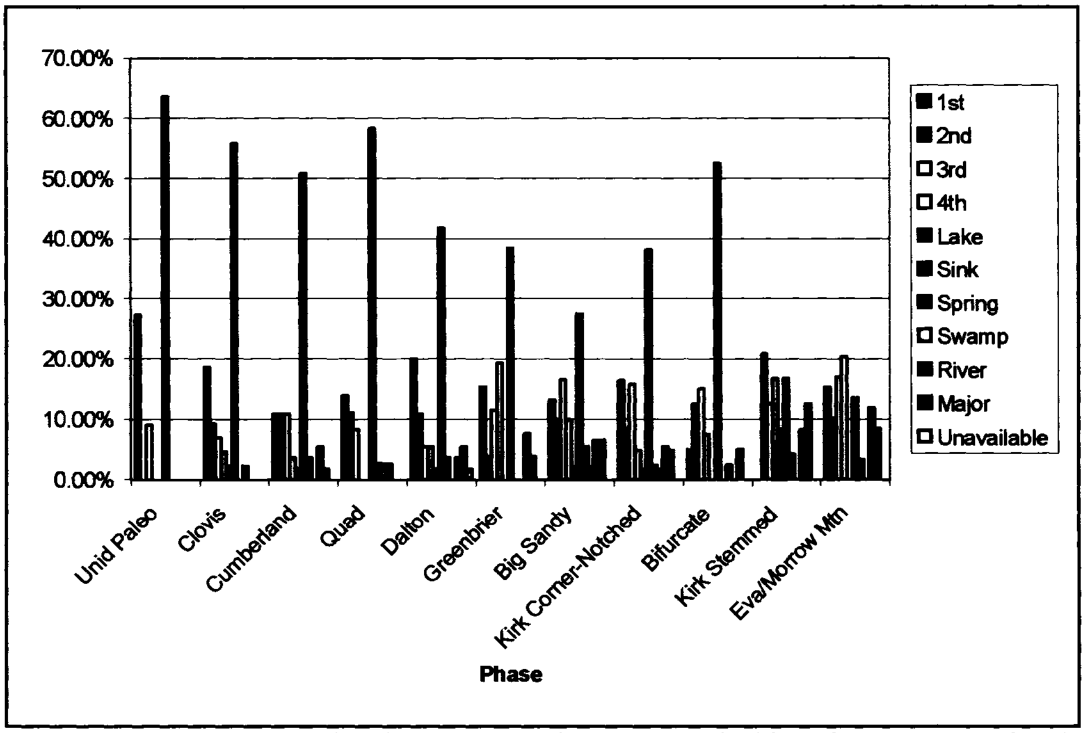

Figure 9.28. Bar graph comparing the percent of sites associated with each water source by phase.

These trends coincide with patterning in sites by topographic zone (Figure 9.29). Most Paleoindian sites are located in the uplands, where sinks are also found. This may be related to the changing morphology of the Tennessee River, which may well have scoured away evidence of early sites (Collins et al. 1994) and/or covered them in alluvial deposits. Perhaps not surprisingly, then, use of floodplains remains low until the Greenbrier phase and then decreases again through the Kirk Corner-Notched and Bifurcate phases to values similar to Paleoindian sites. The percentage offloodplain sites increases dramatically in the Kirk Stemmed phase, however, nearly doubling the value for Greenbrier sites. This preference for floodplain sites and decrease in use of upland areas continues through the Eva/Morrow Mountain phase, and again may be related to stabilization of major waterways during the Holocene.

Similar patterning is seen among use of physiographic districts (Figure 9.30). The vast majority of sites from all phases are located in the Tennessee Valley region. However, the placement of sites in other regions increases steadily through time. The percentage of Fall Line Hills sites increases through the Greenbrier phase, and then decreases again through the Bifurcate phase. In contrast with the Paleoindian sites, however, Early Archaic sites are regularly located in Moulton Valley and Cumberland Plateau as well. Again, the most dramatic difference is seen in the Kirk Stemmed and Eva/Morrow Mountain phases, when roughly 40% of sites occur outside of the Tennessee Valley region for the first time. Unlike trends in nearest water source and topographic setting, this pattern is not likely related to stabilization of rivers and hints at more complex shifts in landscape use by the close of the Early Archaic period and the subsequent Middle Archaic.

The frequency of sites per hundred years also demonstrates interesting trends (Table 9.14). The frequency of Quad sites may drop slightly, which Meeks (2001) suggests is related to repeated use of particularly favorable sites, which tend to be somewhat larger in size. However, the general picture is one of stability until the Early Side-Notched and particularly the Kirk Corner-Notched phase, when the number of sites per century increases by an order of magnitude. In the succeeding

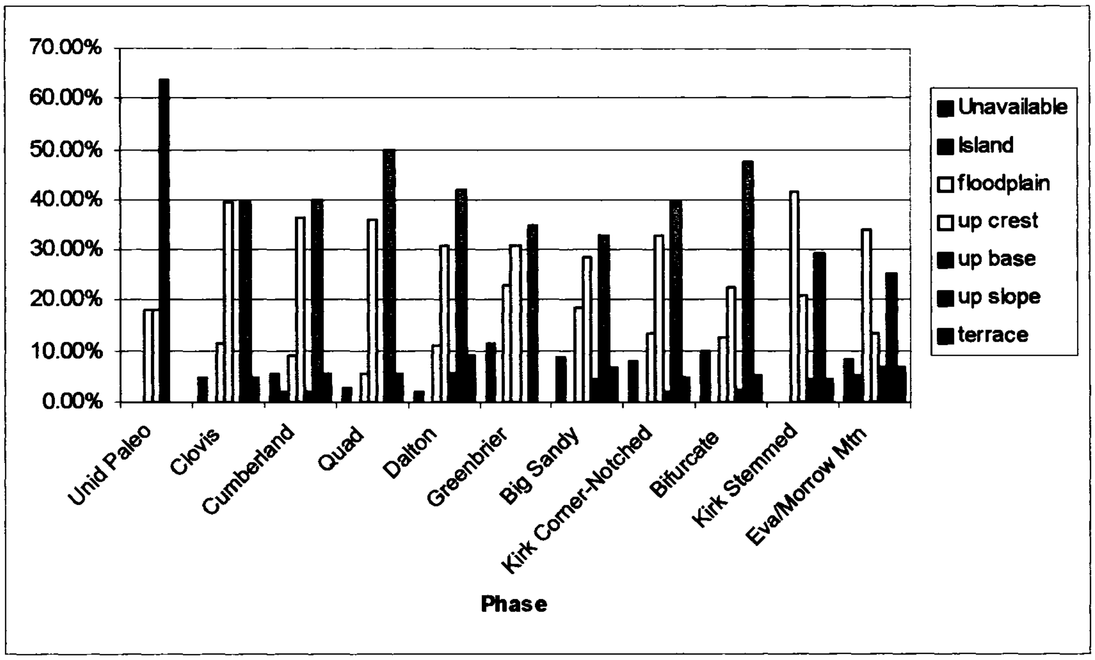

Figure 9.29. Bar graph comparing the percent of sites associated with each topographic zone by phase.

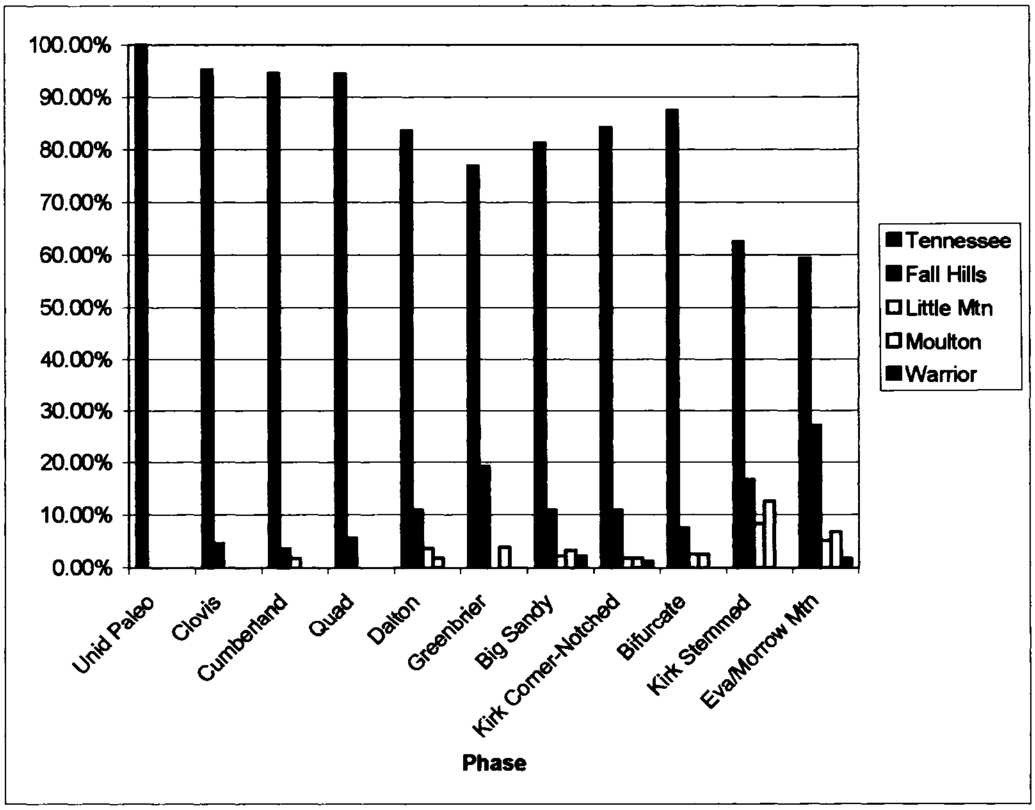

Figure 9.30. Bar graph comparing the percent of sites associated with each physiographic district by phase.

Table 9.14. Site frequency and reoccupation.

Phase	Sites (N)	Time Span[a]	# Sites/100 yrs	# Reoccupied Sites	% Reoccupied Sites
Clovis	43	600	7.17		
Cumberland	55	900	6.11	22	40%
Quad	36	900	4.00	16	44%
Dalton	55	800	6.88	23	42%
Greenbrier	26	800	3.25	27	100%
Early Side-Notched	91	700	13.00	15	30%
Kirk Corner-Notched	165	700	23.57	66	40%
Bifurcate	40	1200	3.33	35	88%
Kirk Stemmed	24	1100[b]	2.18[b]	3	13%
Eva/Morrow Mountain	59	900	6.56	11	19%

[a] Given in calibrated radiocarbon years, following Sherwood et al. 2004.

[b] The span associated with Kirk Stemmed may be truncated to 600 years (Sherwood et al. 2004); this gives a frequency of 4.00 sites per 100 yrs.

Bifurcate phase, the frequency of sites drops just as dramatically. By the Eva/Morrow Mountain phase, the number of sites per century returns to values seen in earlier Paleoindian phases. The reoccupation of sites demonstrates somewhat greater stability, however (Table 9.14). Roughly 40% of the sites in the Paleoindian and Early Archaic phases are ones that were occupied in the immediately preceding phase. The value is slightly higher for the Quad phase and lower for the Early Side-Notched phase, although if Dalton and Greenbrier sites are collapsed into a single category, reoccupation in the Early Side-Notched is much more comparable to other phases.

Bifurcate phase sites are significantly different, however: 88% of the sites represent reoccupations. Along with the drop in frequency of sites, this may represent significant conservatism in landscape use. Meeks (2001) speculates that this significant Bifurcate shift may be related to stresses brought by the 8.2 ka cooling event. Coupled with the similarity among the placement of these sites and earlier Paleoindian sites in terms of nearest water source, topographic zone, and to some extent physiographic district, Bifurcate peoples may have faced constraints similar to these earlier groups.

Just as significant is the dramatic decrease in reoccupation of sites in the subsequent Kirk Stemmed and Eva/Morrow Mountain phases. Although there are relatively few Kirk Stemmed sites in the project area, only three represent reoccupations. Similarly, Eva/Morrow Mountain groups appear to be establishing new sites. Viewed in concert with the significant differences between these and earlier phases in terms of nearest water source, topographic zone, and physiographic district, Kirk Stemmed and Eva/Morrow Mountain peoples organized their landscape settlement in much different manners than did preceding occupants of the region.

In general, then, there appear to be subtle as well as more definitive differences in regional site distribution through time. The first of these begins in the Dalton phase and continues into the Early Archaic period. The number of sites in regions other than the Tennessee Valley increases, along with the use of floodplain areas and a decrease in use of sites near sinks. The number of sites, particularly those associated with the Kirk Corner-Notched phase, also increases markedly. In the Bifurcate phase, however, these trends are reversed. Bifurcate peoples appear to prefer sites more similar to those used by Paleoindian peoples, near sinks and away from floodplains. Landscape use shifts dramatically at the start of the Kirk Stemmed phase, however, and continues into the subsequent Eva/Morrow Mountain phase. Kirk Stemmed peoples reoccupy few of the sites used by their Bifurcate predecessors, opting for more floodplain locales and a larger percentage of sites in regions other than the Tennessee Valley.

These trends largely speak to continuity in Late Paleoindian and Early Archaic peoples' use of the landscape in the study area. Their expansion into areas beyond sinks, uplands, and the Tennessee Valley may be related in part to climatic shifts and the subsequent response of plant and animal communities. Peoples using Bifurcate diagnostic bifaces may have reversed this expansion, perhaps as the 8.2 ka climatic oscillation brought cooler winter temperatures to the region. The subsequent warmer and drier conditions are associated with a dramatic shift in landscape use by Kirk Stemmed peoples. This corresponds with the complete absence of uniface blades in toolkits, a possible intensification of hickory nut use, and a shift towards use of animals found in closed habitats. Whether this break in continuity in site use, toolkits, and subsistence patterns represents a significant shift in local peoples' interactions with the landscape, or whether it reflects the influx of a new population in the region, remains to be seen.

RESOURCE USE FROM A REGIONAL PERSPECTIVE

The larger question is how these patterns in site distribution relate to the above discussions of local resource distribution and seasonal movements between habitats. There are several trends in particular that require further explanation. The first is the apparent preference of Clovis, Cumberland, and Quad peoples for sites outside of the floodplain, as well as sites within the Tennessee Valley. Conversely, the expansion of Dalton and Early Archaic peoples into other topographic and physiographic regions is also of interest. The third trend of note is the marked shift in site use that begins with the Kirk Stemmed phase.

The GLO data suggest that creek bottoms are the richest topographic zones in the project area, a characteristic that can arguably be pushed back into the Late Pleistocene. Yet early foraging groups do not appear to have resided in floodplains to any great degree until the Dalton phase, during the transition to Early Holocene climatic conditions. It seems unlikely that these groups did not use floodplain resources, however. Aside from a rich array of herbaceous plants and fruit trees, creek bottom communities supplied fish and waterfowl on a seasonal basis, and likely provided food and cover for game as well. Sinks may have offered some of these resources, such as waterfowl and herbaceous plants. It is possible that workgroups traveled relatively short distances into the floodplains to procure fish and fruits and process mussels, and then transported these resources back to elevated camps. However, given the exponential decline in the return rate of fish with increasing distance, I believe it is more likely that foragers lived in the floodplains in spring to take advantage of spawning fish and other immediate resources, and used these upland sinks during autumn, where they could readily exploit migratory waterfowl attracted to the sinks, as well as ripening nuts, and the deer, turkeys, squirrels, and other animals feeding on mast. Although preservation conditions make it unlikely, recovery of organic remains from upland sinks might clarify use of these sites.

An alternative explanation for the large percentage of early sites near sinks is that frequent shifts in watercourses may have eroded early occupations from the floodplains and terraces, rather than simply discouraging them. The increase in floodplain sites during the Dalton phase may be explained just as well by the possibility that river stabilization allowed terraces and levees, and the sites located on them, to remain intact (Collins et al. 1994). Additional detailed studies of the geomorphologic history of the Tennessee River would further clarify the likelihood of finding intact sediments dating to the Clovis through Quad phases.

The paucity of Clovis through Quad sites outside of the Tennessee Valley physiographic region is also puzzling, assuming that archaeological surveyors are equally likely to record these early phases and later occupations at sites outside of the Tennessee Valley region. I have suggested that during the Late Pleistocene there were few differences in productivity between the limestone valley regions and the sandstone hills, yet the earliest groups appear to have selectively occupied the former compared to later populations. Many of these early sites are located along slopes and in the uplands. As such, it is possible that they primarily represent sites associated with the exploitation of deer that aggregated in spruce-woodland "yards" during cold and snowy Late Pleistocene winters. The Tennessee Valley may have provided better "yards" than the other physiographic regions. Such an interpretation would require the assumption that these groups discarded few items in the course of other seasonal hunting and gathering activities, such that other sites, particularly those in other physiographic regions, are poorly recognized. This is certainly possible, especially for those tasks such as gathering that do not require formal stone tools.

Alternatively, it is possible that the productivity of the Tennessee Valley region actually was higher than other physiographic regions throughout the year, such that Clovis through Cumberland groups preferred to live in this area. Subsequent peoples may thus have migrated into the surrounding physiographic regions as productivity improved in these surrounding areas, or as increasing populations filled all suitable sites within the Tennessee Valley. If more detailed reconstructions of local vegetation do suggest similar levels of productivity between the Tennessee Valley and surrounding physiographic regions during the Late Pleistocene, and the patterns in site distribution prove not to be related to survey bias or destruction of earlier sites by unstable Late Pleistocene streams, then population pressure should be considered.

I have further suggested that the productivity of the sandstone hill regions should rank lower than that of the limestone valley regions during the Early Holocene. Yet the site file data indicate that from the Dalton through the Kirk Corner-Notched phases, groups began to occupy these presumably less productive regions to greater degrees. Barring survey bias, it is possible that presumed differences in productivity did not in fact exist. The sandstone hill regions may have been particularly rich in autumn nut harvests, especially chestnuts, as well as the game populations these would support. Indeed, occupants of Stanfield-Worley appear to have used the rockshelter during forays with the express purpose of hunting game and collecting and processing nuts (Randall 2002). These tasks may also have driven the occupation of Rollins shelter. Alternatively, if the Tennessee Valley was indeed more productive than other regions, it is also possible that increasing population sizes forced Dalton and Early Archaic peoples to occupy less productive sites outside of the Tennessee Valley.

While these groups frequented creek bottoms within the Fall Line Hills, as evidenced by sites such as the Hester site (1Fr311), located along Cedar Creek, they also maintained ties to the Tennessee River. This is evidenced by their use of blue-grey Fort Payne chert, particularly to manufacture Dalton tools. They could have obtained the chert directly during visits to the river, which may have coincided with exploitation of spring resources such as spawning fish and migratory waterfowl or with autumn aggregations of bands. Alternatively, they may have obtained the chert through trade, but the substantial proportions of Dalton toolkits comprised of Fort Payne chert suggest otherwise. Dalton and Early Archaic groups developed ties to the local landscape as well. This may be suggested by use of local foodstuffs, such as black walnut at Stanfield-Worley, as well as investment in site furniture such as bedrock mortars and nutting stones. These local ties are further expressed during the Early Archaic period as groups occupying the sandstone hills increase their use of local cherts.

Differences in productivity between the limestone and sandstone regions should be most distinct at the onset of the Kirk Stemmed phase, when plant communities appear to have been largely comparable to current ground cover. Yet Middle Archaic peoples further occupy physiographic regions outside of the Tennessee Valley, and decidedly shift their use of topographic settings. The infrequent reoccupation of earlier sites further suggests an abrupt departure from earlier landscape use. These groups appear to have changed their subsistence strategies as well; organic remains at Dust Cave suggest that they shifted their focus to use of hickory nuts and closed-habitat animals. Analyses of Kirk Stemmed and later occupations at other sites in the region would significantly further our understanding of Middle Archaic lifeways.

SUMMARY

Consulting GLO field notes for information about local plant communities, employing central place foraging theory, and comparing the results with regional site distributions, I suggest that Late Paleoindian and Early Archaic peoples moved seasonally between rich, riverine habitats and forested slopes and uplands. Through these moves, foraging groups could take advantage of seasonally available plant foods, as well as the animals attracted to these patches. Groups likely placed their camps so as to be able to procure items with low handling costs, such as leafy greens, fruits, and fish, at short distances. They could travel farther for resources high in calories with more significant handling costs, including deer, turkeys, and hickory nuts.

These items with low handling costs are also those that are targeted by gatherers: reliable, predictable foodstuffs, some of which can be readily pursued by children, that provide a steady source of nutrition for children and pregnant or nursing mothers. Camps are sited relative to gatherers' activities, then, as well as the needs of women and children. Rather than orienting mobility around hunting and procurement of stone for tool-making, the model presented above places the decisions, actions, and requirements of gatherers – women, children, and the elderly – at the center of settlement and subsistence strategies.

In addition to deciding where to site their camps, foragers made decisions about how to allocate their efforts to exploit resources that are temporally coincident. Early foraging peoples likely sent large work groups to collect high value items that are temporally limited, such as spawning fish, mulberries, and hickory nuts. Gatherers probably did not expend concerted efforts on low value items such as leafy greens; individuals likely collected these as needed or desired from weedy stands close to camp. Hunters most likely pursued deer in groups of two, enabling them to carry most of the carcass back to camp. They may also have performed hunting drives in larger groups on occasion. However, they would have found little economic advantage in pairing up to hunt smaller animals.

Within the project area, the different physiographic regions appear to vary in productivity, as suggested by the GLO records. Higher frequencies of pine in the Fall Line Hills, Little Mountain, and Cumberland Plateau regions suggest that these areas are less productive than their counterparts in the Tennessee Valley and Moulton Valley. Furthermore, the upland forests of the Tennessee Valley may have been fairly open, favoring open growth conditions that boost the mast production of trees. These differences in productivity may have been less pronounced during the Late Pleistocene, when mixed hardwoods communities that characterized the Fall Line Hills were displacing the spruce woodlands in the Highland Rim.

Subtle differences in productivity between the limestone valley regions and sandstone hills may have been present during the Late Pleistocene, however. Clovis, Cumberland, and Quad peoples apparently preferred the Tennessee Valley over neighboring physiographic regions. Expansion of Dalton and Early Archaic groups into the surrounding areas may reflect the filling up of the Tennessee Valley as much as amelioration of harsher climatic conditions.[5] These further-flung groups still maintained close ties with the Tennessee Valley, however, returning to the Muscle Shoals

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[5] This is an example of "ideal free distribution," another concept in human ecology, which argues that individuals will occupy the best sites or patches first; as these fill up and resources become depressed, subsequent groups move into locales that originally were less desirable (Fretwell and Lucas 1970).

area to obtain blue-gray Fort Payne chert, out of which they manufactured most of their formal stone tools. The large number of archaeological sites located along the river near the shoals, particularly in the Seven-Mile Island Archaeological District, may well represent the aggregation of multiple bands in the immediate vicinity to retool, share information, and enjoy the company of friends and relatives. These large aggregations may have taken place in early autumn, when fruits were ripe, nuts just mature, and animals fat and bold with their preparations for the coming winter. It is also possible that bands met along the river in spring, to take advantage of spawning fishes and migrating waterfowl. But because game would still be lean and plant foods other than low-value leafy greens would have been scarce, such hypothetical meetings likely would have been relatively small and subdued.

Early Archaic peoples further strengthened their ties to local communities, increasingly using local raw materials to make their stone tools. More striking, however, is the juxtaposition of Bifurcate peoples' conservative land use, which resembles earlier Paleoindian more than Early Archaic patterns, and the subsequent shift in landscape use seen in the Kirk Stemmed phase. These latter groups reoccupied few sites, and instead established new camps in a wider variety of topographic and physiographic settings. As such, they exhibit dramatically different relationships with the landscape than their predecessors.

CHAPTER TEN:
CONCLUSIONS

Presumably due to lack of data, researchers often give little attention to the use of plants by early hunter-gatherers in North America. Within the space of several sentences, they note that early gatherers collected nuts and berries, and sometimes elaborate on the use of nuts. These brief accounts understate the importance of plant foods and gathering to these groups, however. As observed among modern hunter-gatherer peoples living in non-arctic environments, plant foods likely comprised a significant portion of early foragers' diet, and acquiring and processing those plants likely demanded considerable effort from group members, particularly women, children and the elderly.

In order to examine the role of gathering in the lifeways of southeastern Late Paleoindian and Early Archaic groups, I have analyzed the carbonized plant assemblages from four rockshelter sites in northwest Alabama. I approached the data with three objectives: to describe the nature of plant use in the region; to explore the activities associated with use of those plants; and to construct a model of subsistence strategies and mobility patterns that expressly addresses the role of gathering. The results have implications for our understandings of the settlement and subsistence strategies of hunting-and-gathering peoples beyond the early prehistoric Southeast. I review each of these objectives, as well as the implications of the results, in turn below.

THE NATURE OF PLANT USE IN THE LATE PALEOINDIAN AND EARLY ARCHAIC PERIODS

In line with conventional wisdom, the food plant assemblages at the four rockshelters reflect that early gatherers did indeed collect nuts in particular, as well as fruits. But the recovery of edible and other wild seeds also suggests that gatherers used an array of herbaceous plants, perhaps for their leafy greens and medicinal properties in addition to their edible seeds. I briefly recap the use of these various plant food categories suggested by the four assemblages below.

Among the nut taxa, and among the plant remains in general, hickory nutshell was predominant. It was recovered from all but a single sample, and often in sizeable quantities. The frequent recovery of hickory may be related in large part to its robusticity; it certainly preserves better than more fragile acorn shell, wood, and smaller seeds. The prevalence of hickory may also be due to its use as a fuel, in addition to a foodstuff. Site occupants may have purposefully burned hickory nutshell, which is high in oil content, thereby further increasing its potential for preservation. In any case, early foragers of the region appear to have significantly exploited hickory nuts, a foodstuff that is high in fat and calories, processed relatively quickly in bulk, and readily stored.

In contrast, black walnut shell was more limited in its recovery. Closely related to hickory, black walnut shell is also very robust, and the nutmeats are similarly high in fat and calories. However, gatherers do not appear to have used black walnuts to the same degree as hickory nuts. This may be due in part to more restricted availability of walnut trees, but is also likely related to the nut's high processing costs. Because a significant amount of energy is required to pick the meats from the nutshell, gatherers gain little for their efforts. Similar to walnuts, hazelnuts were infrequently recovered and have a relatively low return rate due to their high processing costs. Although the meat is easily pulled from the cracked shell, hazelnuts must be picked from shrubs. They also mature earlier in the fall and prefer different habitats than the other nuts, further suggesting that their use differed significantly.

Although present in smaller quantities than hickory, acorn shell was consistently recovered from the samples. Its shell is also more fragile than the other nuts, making it highly likely that acorns are underrepresented relative to their use. Yarnell and Black (1985:97) suggest that acorns were actually the most important foodstuff of some pre-ceramic Southeastern groups prior to the practice of corn agriculture. However, acorns yield lower energetic return rates than do hickory nuts. Acorns demand more processing, due largely to the tannins that must be leached from the meats. They also have a lower fat content, and therefore provide fewer calories, than the other nuts. But acorns are also higher in carbohydrates. Often ground into a flour by historic native peoples, acorns may have played a distinctly different dietary role than the more oily nuts.

Fruits were recovered in much smaller numbers and less frequently than nutshell, but this more likely reflects their lower preservation potential than their dietary importance. Of the various fruit taxa recovered, persimmon, grape and sumac repeatedly occurred in the samples, across all sites. This pattern of recovery suggests that these fruits in particular were regular components of early groups' diets. The plant assemblages at the two sites located along the Tennessee River also contained significant numbers of hackberry seeds. In general, the fruits have lower caloric values than the nuts, but they also have significantly lower processing costs. As a result, their energetic return rates are sizeable, particularly when transported over short distances. It is likely, then, that gatherers specifically targeted these low-cost resources during the height of their availability in summer.

A variety of edible seeds were recovered from the assemblages, particularly from sites with access to the Tennessee Valley. Of these edible seeds, most are represented by few specimens, often only in a single sample or a single site. These include smartweed and possible amaranth seeds. Due to their infrequent recovery, these seeds may be incidental inclusions. Wild legumes were recovered more frequently, however, as were chenopod seeds. The latter demonstrate a much different pattern of recovery than the other edible seeds, particularly at Dust Cave, where they occurred in significantly more samples and in much greater quantities. Taken together, the patterns suggest that early gatherers did indeed utilize edible seeds. The relationship between gatherers and these taxa, particularly chenopod, is of notable interest, as gatherers in the Southeast eventually cultivated and in some instances domesticated these edible seeds in the Late Archaic period, around 3,500 years ago. The evidence presented here extends interactions between people and these plants into the Late Paleoindian period, some 9,000 years earlier.

Edible seeds are more similar to nuts than fruits in their nutritional value as well as their processing costs. Relatively high in fat and protein, and therefore in calories, the edible seeds also require significant processing to strip or thresh them from the seed heads. They generally have lower energetic return rates than nuts, suggesting that gatherers would collect dried seed heads in late fall or early winter, after the height of nut harvests.

The recovery of a number of the seed taxa hints at the use of leafy greens and spring shoots by early gatherers. These include chenopod, purslane, smartweed, pokeweed and bedstraw. Although the seeds ripen in fall and the greens and shoots are generally only palatable in spring, it is not unreasonable to presume that gatherers would have utilized greens and shoots, particularly because they are the first plant foods, other than roots and tubers, available to foragers at the end of lean winters. Early peoples certainly interacted with these weedy plants. Even if the seeds were incidental inclusions rather that having been used by site occupants, these weedy plants must have grown close to the habitation sites. As such, early peoples were certainly familiar with them. Although high in vitamins and minerals, leafy greens have relatively low energetic return rates, due primarily to their low caloric content. As such, gatherers likely did not travel far from habitation sites to collect these plant foods.

Few changes through time are apparent within the assemblages for which the Late Paleoindian and Early Archaic components could be separated. Use of black walnut and chenopod may decrease, while the opposite trend may be argued for wild legumes. However, there does not seem to be a significant shift in use of plants until the close of the Early Archaic period, when early groups appear to increase their use of hickory, and perhaps acorn. On the whole, however, the climatic and environmental transition from the Late Pleistocene to Early Holocene conditions appears to have had little impact on gathering within the project area.

The plant assemblages from the four rockshelter sites are generally comparable to those recovered from other sites in the Southeast (Table 10.1). Hickory nutshell is similarly predominant and ubiquitous, with acorn recovered regularly in smaller quantities. Black walnut and hazelnut

Table 10.1. Non-wood plant taxa recovered from Late Paleoindian and Early Archaic sites in the Southeast.

	Late Paleoindian Sites			Early Archaic Sites									
	Hester[a]	Rodgers[b]	Pearson[c]	Hester[a]	Patrick[d]	St. Albans[e]	Pearson[c]	1Gr1x1[f]	1Pi61[f]	1Gr50[f]	Lower Kirk IB[g]	Upper Kirk IB;BF[g]	Bifurcate IB;RI;CI;BF[g]
Acorn	x		1	x	x	x	3	0.5g	0.3g		9.7g	22.6g;14.5g	18.7g;11.6g;37.1g;2.5g
Beechnut													<0.2g;0;0;0
Black walnut	x	x		x						0.2g	<0.1g	0g;0.4g	0.9g;0;0;0
Chestnut												0g;0.2g	9.6g;0;0;0
Hazelnut													<0.2g;0;0;0
Hickory	x	x	265	x	x	x	1315	4.7g	50.1g	2.5g	49.5g	47.7g;38.2g	173.7g;76.4g;384.7g;15.8g
Juglandaceae	x										<0.5g	0;0.4g	0.9g;0;0;0
Amaranth												1	
Asteraceae													16
Bedstraw													27
Bramble													1
Chenopod						x					3		14
Copperleaf												1	
Grape					x							4	10
Hackberry		x		x									
Knotweed													1
Maygrass													1
Peppervine											1		
Persimmon				x					1			3	
Pokeweed					x							2	27
Sumac											2		2

[a] Lentz 1986.
[b] Parmalee et al. 1976
[c] Detwiler 2003.
[d] Schroedl 1978.
[e] Snider 1971.
[f] Caddell 1982.
[g] Chapman and Shea 1981. The abbreviations refer to the following: IB – Icehouse Bottom; BF – Bacon Farm; RI – Rose Island; CI – Calloway Island.

occur more sporadically. Two members of the Beech family, beechnut and chestnut, were recovered from two Early Archaic sites in eastern Tennessee but are poorly represented at the four rockshelter sites. Only several fragments from Dust Cave were identified as Beech family, but species could not be determined.

Similarities are also apparent among fruits. Most frequently recovered from southeastern sites are grape, persimmon, sumac, and hackberry. Among edible seeds, chenopod was recovered from the most sites and in the greatest quantities, similar to the rockshelter samples. Other edible seeds include amaranth and knotweed, also eventually cultivated by Southeastern peoples around 3,500 years ago. Pokeweed and bedstraw are among the taxa with leafy greens and spring shoots represented by seed taxa. Weedy taxa not present at the four rockshelter sites include maygrass, peppervine and copperleaf.

In general, then, the Late Paleoindian and Early Archaic plant assemblages from sites across the Southeast demonstrate greater similarities than differences. These similarities hold not only between the categories of plant foods recovered, but also within these categories. Hickory and acorn appear dominant among the nuts, with black walnut, hazel, beechnut and chestnut playing lesser roles. Grape, persimmon and sumac faithfully recur among fruits. Chenopod is more frequently recovered than other edible seeds. In addition, there are no glaring differences between the Late Paleoindian and Early Archaic assemblages, as the scarcity of taxa other than nuts from Late Paleoindian sites is more likely due to sample size and perhaps preservation issues rather than shifts in gathering practices.

Although the assemblages are largely similar across time and space, we should not then conclude that gatherers performed the same tasks between 12,500 and 8,000 years ago at all sites in the Southeast. They do appear to have been presented with similar resources, the use of which entails particular costs and benefits. However, both the costs and benefits vary in relation to the landscape and the distribution of resources, including plants, animals, and stone materials, upon the landscape. Because they articulate with the exploitation of other resources, the decisions and activities associated with gathering surely varied in different landscapes. I further discuss such variations within the project area below.

ACTIVITIES ASSOCIATED WITH GATHERING PLANT FOODS

An understanding of the decisions and actions involved in exploiting the various plant taxa described above is critical for two reasons. First, such information gives meaning to an otherwise rather uninteresting list of carbonized plants and their counts and weights, and encourages us to contemplate the peoples who used them. Second, it suggests activities that should be considered in models of early subsistence strategies and mobility patterns. In this project I have compiled botanical and ethnographic information to better understand who might have collected the various plant taxa listed above, and where, when, and how they might have done so.

First and foremost, gatherers require knowledge of the habitats in which the various plants thrive and the seasons in which they ripen. This knowledge not only demands a catalogue of the plants that populate the landscape and their properties, but also a detailed mental map of the distribution of plants on the landscape, as well as a calendar of seasonal progressions. Gatherers would take note of idiosyncratic events and accordingly adjust their "calendars" and emphasize particular areas on the "map". A cold spring would delay blooming, while an early frost might hasten the availability of nuts and seeds. A series of floods or a wildfire would depress the immediate availability of plant foods in the area affected, but would heighten yields in the following year.

To stay abreast of both the location of productive stands and the timing of harvests, gatherers certainly monitored the growth of plants on the landscape around them. Such monitoring could have taken place during the course of other activities, such as collection of firewood or water, while hunting or checking traps, on the way to fishing spots or berry patches, while moving camp from one spot to the next. This information may well have been shared among members of a group, or between groups during larger (macroband) aggregations.

Once plant foods ripened, group members would need to decide whom to send to patches to gather the plant foods. Across ethnographic foraging groups, the gathering of most plant foods falls largely to women. Rather than an agreement between men and women to complement their food tasks, this decision appears to be related to the need of women to obtain stable nutrition for themselves and their children. Generally predictable in time and space, particularly when monitored over the course of a season, plants serve as reliable sources of food. Children likely joined women in gathering, particularly of plant foods such as fruits that require little processing. Individuals likely gathered foods for themselves and their families, rather than sharing among larger groups. This is suggested not only by ethnographic accounts, but also by the fact that neither handling costs nor handling times for the plant foods considered here appear to decrease for task groups of two or more. This does not mean that gatherers performed their tasks alone. They may have gathered in groups, for camaraderie as much as safety or any other reason, particularly if the resource patch was large enough to support the efforts of multiple gatherers.

While the larger pattern suggests that women gathered, and on the other side that men hunted, there was likely a large degree of overlap, both among different individuals and for different food resources. Women may well have hunted, particularly smaller animals that are more reliably taken. They may also have joined men on longer hunting forays. And men may well have gathered, particularly those resources such as nuts that have a short period of availability, have high return rates, and may have served as important staples stored over the winter.

Whether men or women gathered plant foods, it is highly likely that women processed and prepared them. This allocation of food preparation to women similarly holds across ethnographic foraging groups, and includes both plant and animal foods. As such, the tools associated with food preparation likely belonged to women, and may have been made by them as well. In addition to knives and scrapers, these would include nutting stones. Bedrock mortars such as those at Stanfield-Worley may have belonged to a particular woman and her family, perhaps marking her/their usufruct rights to the shelter and the resources in its vicinity.

Once gathered and processed, early groups may have stored some of these plant foods. No evidence for underground storage by Late Paleoindian and Early Archaic peoples has been found in the region, particularly at the four rockshelter sites discussed here. Yet this does not preclude the use of bags, baskets, and other above-ground containers for storing foods. We should not rule out the possibility, then, that early peoples gathered and processed plant foods for storage. Indeed, storage of plant foods is perhaps necessary to support the argument that groups invested heavily in the collection of resources such as nuts, seeds, and fruits by moving their campsites and engaging the labor of all group members. Such large-scale efforts would not generally be needed to meet an individual's daily nutritional requirements.

In addition to the above activities, early groups may also have actively shaped the distribution of plant resources on the landscape. They may have encouraged the growth of particular species, perhaps by pruning, transplanting, dropping seeds, or clearing away competition (e.g. Fowler 1996; Scarry and Yarnell n.d.). Using controlled fires, they might also have created and/or maintained forest clearings (e.g. Fowler 1996). This would produce edges situations favored by shrubs such as sumac and hazel, and frequented by game like deer and rabbits. It would also allow the crowns of nearby nut-bearing trees to grow in a more open setting, thus increasing their yield (e.g. Munson 1986). Again, no direct evidence for such interactions between early southeastern groups and the landscape is available, but given the intimate knowledge of the landscape that these early peoples likely had, such an intimate relationship is not improbable.

MODELING EARLY FORAGING LIFEWAYS IN NORTHWEST ALABAMA

Early peoples' relationships with the local landscape certainly extended beyond plant resources. At the very least, they also interacted with animal populations and exploited water and stone resources. In the project area, they took advantage of rockshelters from time to time as well. In order to model Late Paleoindian and Early Archaic lifeways, we must consider how early foragers' subsistence strategies articulated with the spatial and temporal distribution of plant, animal, and stone resources on the local landscape.

To address this articulation, I first examined the various subsistence activities performed at each of the rockshelter sites. At Stanfield-Worley, occupants appear to have focused their time and energy on collecting and processing hickory nuts and acorns, as well as hunting deer, turkey, and other game, and preparing hides. The heavy curation exhibited by the stone tools indicates that the occupants were heavy consumers of tools that appear to have been produced elsewhere. Because the majority is made from blue-gray Fort Payne chert, it is likely that the occupants outfitted their toolkits while visiting sites near outcrops along the Tennessee River.

Faunal evidence at Rollins is more scant, but occupants appear to have similarly concentrated on hunting, hide preparation, and collecting and processing nuts and fruits. They also used formal tools made from blue-gray Fort Payne chert, particularly during Dalton occupations. However, they appear to have made and maintained tools from locally available cherts as well. The occupants at Rollins thus do not appear to have been as narrowly focused on hunting and gathering activities as those who lived at Stanfield-Worley. Located over 40 kilometers from outcrops of blue-gray Fort Payne chert, much greater than Stanfield-Worley's ten kilometer distance, Rollins' occupants may have exercised greater license to make formal tools from other local cherts. In contrast, Stanfield-Worley's occupants apparently preferred to curate their worn tools and wait until they could return to the Tennessee River to make replacements.[1]

In contrast to these two rockshelters located within the sandstone uplands, occupants of the two sites with immediate access to the Tennessee Valley appear to have exploited edible seeds. Although this pattern may be shaped to some degree by sampling errors, it is suggestive of the spatial availability of edible seeds. While at LaGrange, occupants appear to have collected and processed

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[1] As an aside, this is likely part of the reason that so many Paleoindian and Early Archaic chipped stone tools have been found in Lauderdale and Colbert counties. High-quality chert was inarguably inexpensive in the area. Whether they used them at sites in the immediate vicinity or brought them in from more distant areas, early knappers certainly discarded their used tools as they replaced them with newly fashioned ones.

nuts, as well as a variety of fruits and edible seeds, particularly wild legumes. They also hunted animals and prepared hides, but did not curate their stone tools, although LaGrange is located a similar distance from the Tennessee River as Stanfield-Worley. Cobbles or outcrops of blue-gray Fort Payne chert may have been available in the creek running just north of the site, given the vast majority of tools made from this chert and occupants' apparent willingness to discard it.

Blue-gray Fort Payne chert was also inexpensive for occupants of Dust Cave, located on the backwaters of the Tennessee River. The stone tool assemblage at Dust Cave suggests that occupants spent a considerable amount of time manufacturing tools from the chert, particularly during the Early Side-Notched component. In addition to hunting and preparing hides, occupants also collected and processed nuts, fruits, and edible seeds. The faunal assemblages at both cave sites suggest the possibility of a spring occupation as well, driven by the availability of migratory waterfowl and spawning fish. Use of leafy greens by the sites' spring occupants should also be considered.

Although the plant assemblages from the four sites are largely similar, dominated by nutshell, several recurring fruits, and in some instances edible seeds, the subtle differences between them suggest a different focus on gathering activities at each. When viewed in combination with hunting activities and stone tool use, it becomes apparent that the occupations at each are notably different, not only between sites but also within sites through time. Use of plant, animal, and stone resources appears to be particular to each site, to be shaped by the local availability of these resources.

Mathematical models within evolutionary ecology address the impact of local resource structure on procurement strategies. I applied a central place foraging theory model that evaluates the costs of transporting various plant, animal, and stone resources across the local landscape to the rockshelter sites. I judge the salient features of the landscape to include the topography, bedrock geology, and the general distribution of plant resources. I consider both seasonal and spatial distributions, the latter inferred from a combination of historic descriptions of vegetation and paleoenvironmental reconstructions. I assume that the distribution and density of animal populations are dependent on the structure of local vegetative communities, in addition to water.

Using these variables within the mathematical model and mapping the results with the aid of a geographic information system, I calculated the return rates for a number of plant and animal resources used by Late Paleoindian and Early Archaic peoples. Several key observations can be made from the results. First, with respect to distances at which items can be profitably procured, resources are more usefully separated into categories of high versus low processing costs than high versus low return rates. Items with very high return rates but very low processing costs, such as mulberries, are likely to be exploited relatively close to camp as the benefits of obtaining them decrease rapidly with the distance traveled to obtain them. It is important to note that plant and animal resources do not simply divide into two separate categories. Instead, some plant foods, such as hickory, yield higher return rates and can be gainfully procured at greater distances than some animal foods, such as smaller animals.

Second, items with significant processing costs relative to caloric content have low return rates over any distance, as transport costs are small relative to handling costs. These include black walnut and hazelnut, which displayed markedly low return rates. Their scarcity in the samples may thus be related to their high processing costs rather than local availability. Third, the return rates of items with relatively low processing costs are rapidly affected by transport costs. These items, such as fruits, leafy greens, and fish, cannot be profitably transported over large distances. As such, foragers likely sited their camps near patches where they could readily procure these resources, which often yield high return rates over short distances. Fourth, field processing increases the distance over which items with significant byproducts, such as mussels and edible seeds, can be profitably transported.

Finally, seasonal and spatial differences in the availability of resources shape the return rates of resources in time and space. Plant food resources are clearly limited in their seasonal and spatial availability, fruiting at particular times and preferring particular habitats. Environmental reconstructions suggest that leafy greens and fruits likely preferred creek bottom habitats, while nut taxa were probably more plentiful in upland and slope settings. Animal resources also have seasonal components. The distributions of some animal populations shift seasonally, as various plant foods become available. Game such as deer and wild turkeys likely frequented slopes and uplands in fall to take advantage of nut harvests, and creek bottoms in spring to exploit the tender leaves and shoots of the rich plant communities there. Migratory waterfowl would have been available only in spring and autumn; spring spawning runs would have significantly increased the density of some fish species. The caloric content of game also varies seasonally, as animals put on fat in autumn and draw on these stores through early spring.

Taken together, the transport-dependent return rates and seasonal and spatial availability of the various resources suggest a larger picture of early groups' mobility patterns. They likely visited river settings in spring, particularly to take advantage of spawning fish, migratory waterfowl, and game foraging on young sprouts and leaves. Gatherers likely collected leafy greens as well, particularly those close to camp. In summer, groups may have moved their camps to be near patches of ripening fruits, which yield significant return rates when transported over short distances. In contrast, hunters likely exploited game, which are relatively more dispersed in summer, over longer distances. Groups probably shifted their camps to the uplands and slopes in autumn, both to collect ripened nuts and to take advantage of game populations also attracted to mast resources. Toward the end of autumn and beginning of winter, they may have returned to creek bottom settings to collect edible seeds. Into winter, logistic hunting parties, and perhaps groups as a whole, concentrated their efforts on tracking game populations, which probably dispersed across the landscape as spruce yards disappeared in the region in the Early Holocene. People may have picked persisting fruits and seeds as they came across them, but probably did not seek out such plant foods due to their low densities. Knappers likely procured stone materials during the course of other activities, such as seasonal rounds and aggregation events, in order to offset the associated costs.

In addition to these seasonal subsistence activities, early groups likely aggregated for social purposes. Such events provided opportunities for exchanging goods, ideas, information, and stories; meeting mates; and maintaining social ties. They likely aggregated when and where resources were plentiful. Autumn seasons and creek-bottom settings with nearby uplands are prime candidates. Late summer and early autumn fruits and nuts are available, while game animals carry an extra layer of fat. Migratory waterfowl frequent the area, wild turkeys travel in flocks, and rutting deer are less timid in their movements.

The plant, animal, and stone tool assemblages from the four rockshelter sites generally corroborate the above sketch of seasonal rounds. The cave sites along the river include fish species that do spawn, as well as migratory waterfowl and edible seeds available in spring. All four sites, which are located within or adjacent to slopes and uplands, claim plant assemblages rich in nut taxa and late fall fruits as well as faunal assemblages that include deer and wild turkeys, suggest autumn occupations. The three sites with ready access to creek-bottom communities include edible seeds in their plant assemblages, which occupants likely collected in late fall or early winter. Furthermore, the significant density of sites located in the Seven Mile Island archaeological district may well reflect seasonal macroband aggregations. With notably rich river and floodplain resources, nearby upland communities, and a high quality chert available in the immediate vicinity, this district is certainly a likely candidate for such aggregation events.

Let me take the opportunity here to point out that I do not argue that the same groups of peoples occupied these four rockshelter sites, moving from Dust Cave to Stanfield-Worley to LaGrange and back again. It is a possibility; foraging groups could certainly cover the distance between Rollins and Dust Cave during the course of a year (Kelly 1995: Table 4.1), and apparently did, given the use of blue-gray Fort Payne chert at Rollins. However, it is quite likely that multiple bands resided within the region, and each may have used the various sites on different occasions. Moreover, each of the cultural components at the four sites span several hundred years, if not close to a thousand. Any single group likely occupied a given site for only several days, or at most a couple weeks. As remarkable as the archaeological assemblages from rockshelter sites are, it is important to keep in mind that they represent generally brief occupations within a larger system of movements between sites across the landscape.

This larger system is reflected by the regional distribution of sites. The vast majority of the sites within the project area are located within the Tennessee Valley region, which may well be related to sampling bias. However, general trends through time can be discussed. After the close of the cooler Younger Dryas period, groups appear to have begun using areas outside of the Tennessee Valley to a greater degree. Early Archaic peoples also began to utilize local cherts to greater degrees, further suggesting a decrease in the importance of periodically living near the river. The expansion of sites into other physiographic districts may be related to environmental changes, or perhaps to an increase in population pressure within the Tennessee Valley region. This trend toward expansion is reversed by groups using Bifurcate tools, who appear to have been very conservative in their choice of site location. This conservatism may be related to another cooling event that occurred around 8200 years ago. Afterwards, peoples who made Kirk Stemmed bifaces used the landscape in significantly different manners than their predecessors. They more frequently sited camps in floodplain settings, and increased their use of areas other than the Tennessee Valley. This shift in site placement coincides with a significant increase in nut processing and a trend towards greater use of animals associated with closed habitats at Dust Cave. Analysis of organic assemblages from additional sites would elucidate whether these subsistence trends extend beyond Dust Cave.

GATHERING BEYOND NORTHWEST ALABAMA

The results of this project have several important implications beyond providing information about the lifeways of Late Paleoindian and Early Archaic peoples in northwest Alabama. These implications can be drawn from the plant assemblages, the application of central place foraging theory, and the regional model of seasonal rounds. They speak not only to the ways in which we approach archaeological foraging groups in the Southeast, but also to studies of hunter-gatherer lifeways in other times and places.

Implications from the Archaeobotanical Data

Several important points stem from the plant assemblages recovered from the four rockshelter sites. First, the assemblages certainly do not reflect the entirety of early peoples' plant use. This is suggested by the recovery of miscellaneous seeds that are not in themselves edible, but are produced by plants that have edible leaves, shoots, or tubers, and/or plants that may exhibit medicinal properties. There are surely entire categories of foods and plant uses that fall outside the visibility of archaeologists. This is also true of uses of plants for material culture. Stone tools likely accounted for a relatively small percentage of the items made and used by early hunter-gatherers. This inherent bias should not discourage us from studying plant remains, but instead remind us to consider the possibility of use of foods, such as leafy greens, and material culture for which we are unlikely to have evidence.

Second, although the plant assemblages span the transition from the Late Pleistocene to Early Holocene environmental conditions, no significant differences between the assemblages are apparent. This is somewhat surprising, given the marked shifts in vegetation associated with this climatic transition. Given the fact that most of the assemblages begin with Dalton occupations, post-dating the last significant climatic oscillation, it is possible that earlier peoples changed their subsistence strategies in response to the changing environment. However, significant differences are also not detected at Dust Cave, which includes a Quad occupation, coincident with the Younger Dryas oscillation. It is possible that the most dramatic shifts in local environments occurred prior to this event, that the basic post-glacial resource structure of the region had already been established. It is also possible that early hunter-gatherers were very conservative in their subsistence strategies, particularly in use of plants. The plant assemblages serve as a reminder that we cannot simply assume that environmental changes directly evoke cultural changes, nor that cultural changes are necessarily direct responses to environmental shifts.

Third, although there are large similarities in the taxa recovered from the various sites, occupants appear to have performed different suites of activities at each site. The nature of these activities, largely related to subsistence and manufacture of material culture, appears to depend on the distribution of resources relative to the location of the site on the landscape. This is not too surprising; peoples are more likely to utilize aquatic resources when living near rivers. We often make this distinction when discussing exploitation of animal resources, but often gloss over differences in use of plant resources. The apparent assumption is that plant foods are generally ubiquitous, particularly in the temperate forests of the Southeast. The data presented here, however, indicate that hunter-gatherers do not simply opportunistically gather plant foods that they come across during the course of their day, but instead monitor the availability of plant resources, move their camps to gain better access to some plant foods, and specifically target particular species and particular patches. Gatherers engage in different activities at different sites, adjusted to the structure of local resources.

The latter two implications point to the need for paleoenvironmental reconstructions. Regional reconstructions of vegetation developed from pollen analyses are valuable, but do not provide information at the scale required to reconstruct the distributions of local plant and animal resources. The analysis of gastropods and microfauna that are sensitive to temperature changes, as well as phytolith and additional pollen analyses, might enable such fine-scale reconstructions. These would greatly enhance our understandings of early peoples' interactions with local landscapes.

Implications from the Model of Seasonal Rounds

One of the most striking characteristics of the model of settlement and subsistence strategies that I have sketched for northwest Alabama is that it does not differ dramatically from those proposed by researchers for other regions in the Southeast. Similar to others, I suggest that early groups resided in rich alluvial communities in spring and summer, moved into uplands in the fall to harvest nuts and target fattened deer, and dispersed in winter to hunt game and to subsist on what plant foods could be found. My model differs slightly in that I suggest that gatherers returned to creek bottoms in late fall or early winter to collect edible seeds.

By expressly considering how the use of plant foods impacts and is impacted by travel across landscapes, however, my model re-orients the focus of early foragers' settlement and subsistence strategies. Rather than focusing on hunting pursuits, stone procurement for tool-making, and perhaps the collection of nuts, the model I have presented here places the temporal and spatial availability of reliable, predictable foodstuffs with relatively low processing costs at the center of mobility decisions. These foodstuffs include fruits, seeds, and fish, items targeted by gatherers rather than hunters. This model suggests, then, that gatherers – namely women, children, and the elderly – had significant influence over the placement of camps, especially during periods of availability of valued resources that are spatially limited.

Use of plants certainly appears to have been a consideration in movements to and from sites. This is evidenced by investment in plant-processing tools and features at the sites. Mortars and nutting stones have been recorded at all four sites. Occupants pecked nutting stones into the bedrock at Stanfield-Worley, and constructed prepared clay surfaces both at this site and at Dust Cave (DeJarnette et al. 1962; Homsey 2004; Sherwood 2001). These surfaces appear to have been used for food processing, perhaps to parch nuts and/or seeds (Homsey 2004; Sherwood 2001). Site occupants clearly visited and re-visited the sites with the intention of collecting and processing plant foods, as much as to hunt game, fish, or collect mussels.

It is notable, however, that within the project area there is little spatial incongruity between animal and plant foods. For example, river floodplains are particularly rich habitats in spring, in terms of both plant and animal resources. Leafy greens are abundant in these disturbed settings, and would attract hungry animals as well as people. Spawning fish and migratory waterfowl provide an additional seasonal draw. In autumn, deer, turkey, and other animals are drawn to the uplands and slopes to exploit ripened nuts, which early gatherers also prized. Similar situations exist for fruits and edible seeds. In settings where there is greater incongruity in the location of plant and animal resources, such as the Great Basin (e.g. Zeanah 2000), the picture should be different.

In the Southeast, then, the question might be raised whether groups moved to particular settings to be closer to plant resources and subsequently took advantage of animals similarly attracted to those patches, or whether they moved to be near denser populations of animals and then gathered those plants that were nearby. I would argue that this question is relatively fruitless. As noted previously, animal and plant resources are not necessarily dichotomous. Relevant categories of resources do not appear to be those that do or do not have roots, but instead those that have low or high processing costs. Animal resources with low processing costs tend to be those that have shorter pursuit times, such as fish and rutting deer.

This redefining of resources on the basis of costs and return rates rather than plant versus animal fits well with ethnographic descriptions of women who may hunt as well as gather. Women do not appear to target simply plant resources, but instead those resources that provide a stable food supply for their children and themselves (Bird 1999; Panter-Brick 2002). In northwest Alabama, this would include fish and mussels, and perhaps rutting deer and flocking turkeys, as well as greens, fruits, nuts, and seeds. It may be that we archaeologists too narrowly define and use the terms "hunting" and "gathering," and should instead think of them as a continuum (Ingold 1986), as we have begun to consider human interactions with the landscape as a continuum between foraging and cultivation (e.g. Terrell et al. 2003).

These results have implications beyond the Late Paleoindian and Early Archaic periods in northwest Alabama. We should expect the activities of gatherers to direct mobility decisions of foraging groups living in environments with sufficient plant and/or low-cost resources – in other words, in any non-arctic environment. This includes not only the entire prehistoric Southeast, but also much of North America from the end of the Pleistocene onward. Thus in addition to rethinking previous models about Paleoindian and Early Archaic peoples in the Southeast, perhaps we should also reconsider whether the first peoples of North America pursued large mammals to the far ends of the continent or whether they followed available plant foods, as well as reliable and predictable animal resources like fish and waterfowl, along the continent's major river valleys. We could also apply this to later Archaic foraging groups and give a situated context for the interactions between people and weedy plants in disturbed, floodplain settings that led ultimately to the cultivation, and in some instances domestication, of several native plants.

Implications from the Application of Central Place Foraging Theory

Along with various other archaeological problems, from site placement to field processing, this study demonstrates the utility of central place foraging theory for understanding the settlement and subsistence strategies of early foraging groups living in the Southeast. In contrast to examples from the Great Basin, southeastern cases must address overlap in the spatial availability of resources. The outcomes of the mathematical model are thus perhaps not as clear-cut, but are certainly suggestive. At the very least, the algorithm reveals the influence of variables on the problem at hand. For example, it highlights the relationship between processing costs and transport costs of particular resources, and the impact of this relationship on the degree and manner in which these resources might be used. Such information assists in interpretation of the archaeological data.

This study also illustrates the benefit of applying central place foraging theory within a geographic information system. The use of GIS facilitates the detection of patterning within the data by graphically displaying the results. It also juxtaposes these results with key landscape features, such as topography and site placement, enhancing the ability of the researcher to think of the problem in terms of a multi-dimensional landscape. Such dimensions include not only elevation and spatial coordinates, but also ground cover, paths of travel, resource patches, or anything else that can be mapped.

In addition to field processing and site placement, I have also used central place foraging theory to consider the composition of workgroups sent out to obtain particular resources. It appears that cooperation is beneficial only when the package is too large for a single person to carry back to camp. These primarily include large animal prey, particularly within the study region. This also has implications for sharing; foragers rarely share small animal prey (Tucker 2001) or plant foods (Kelly

1995). People may travel and work together for companionship or perhaps safety, particularly when resources are abundant enough to allow multiple people to hunt or gather in a single patch. However, gatherers in particular do not appear to gain economically from working in groups, although they almost certainly gain socially. The exception may be the participation of children in the use of plant resources that they cannot collect at the same rate as adults. Hawkes and colleagues (1995) provide an example of children staying in camp to crack open mongongo nuts as their older female relatives head out to collect them. Although they cannot collect them as efficiently as adults do, children can process the nuts at a rate more comparable to adults. By dividing the efforts of the team in this way, mothers can maximize the return rate of their teams (Hawkes et al. 1995).

Such considerations also serve as reminders that the individuals making decisions modeled by these evolutionary ecology algorithms are people who engage in social interactions with others. They have identities and genders, as well as social roles. Even though we can never know the exact nature, or perhaps even some semblance of these roles and identities, such speculations are fruitful for expanding our ideas and interpretations, and hopefully our understanding of early societies. At the very least, they engage both archeologists and the public, and enhance our ability to perceive early hunter-gatherers as fully modern humans with intellectual, physical, and social capacities equivalent to our own.

CONCLUDING THOUGHTS

In closing, I would like to highlight what I consider to be the most important conclusions that can be drawn from this project, as well as future areas of research that would expand upon the results that I have presented. First, the plant assemblages from the four rockshelter sites suggest that gathering activities are tailored to local landscapes. Furthermore, gathering activities comprise more than collecting nuts and fruits while walking. It includes monitoring and perhaps managing the landscape, and requires an intimate knowledge of the landscape and its resources. In addition, gathering articulates with other subsistence as well as social activities.

As such, the model that I have formed here cannot be applied directly to other regions in the Southeast, in that local environments are likely to be different. However, my results do suggest that theories from evolutionary ecology, particularly central place foraging theory, can be successfully applied to address the subject of settlement and subsistence strategies in the Southeast. The mathematical models of evolutionary ecology distinguish salient variables within the problem at hand, and organize the data for use in interpretation.

Within models of mobility patterns, central place foraging theory suggests that researchers need to consider the nature of local resource distribution. This includes not only the location of stone outcrops and presumed hunting grounds, but also the spatial and temporal availability of plant resources and how this availability might affect the seasonal density of animal populations as well as plant foods. As such, it is likely that settlement patterns reflect the use of reliable, predictable resources rather than hunting technologies and pursuits.

Evolutionary ecology, with its focus on the individual, also reminds us that the archaeological record is the result of the decisions and actions of individuals. These individuals had identities, different genders, are of different ages, and assume different social roles. These identities and social roles shape and are shaped by such decisions and actions.

The project also highlights the interactions of peoples, plants, animals, and the landscape. The landscape was certainly anthropogenic, impacted by the gathering, hunting, and dwelling activities of human groups. It was also anthropogenic in that early peoples inscribed meaning to the landscape as well. For example, Late Paleoindian and Early Archaic occupants of LaGrange brought ochre with them to the site, presumably ritual in its use, and on at least one occasion buried their dead at the shelter (DeJarnette and Knight 1976). The sites were more than simply functional overnight stops.

As with most projects, this one suggests a number of topics to be further explored. The nature of early hunter-gatherer subsistence is certainly not answered once and for all by this research. Additional analyses of plant and animal remains, studied in concert with each other and material culture, are key to indicating whether some of the larger patterns noted here, such as the significant shift at the close of the Early Archaic period, hold both at other sites within the project area as well as other sites in the Southeast. Such analyses would also further our understanding of the diversity of subsistence strategies by early peoples in the region. More detailed reconstructions of local resources are also needed to understand how subsistence activities articulate with larger uses of and movements across the landscape. The application of the central place foraging theory within GIS can also be refined. For example, variables such as processing costs could be better approximated through experimental studies. Additional variables could also be included, such as ease of travel through areas with different ground cover or for use of waterways.

Also intriguing are questions about the relationships between hunters and gatherers in areas where not only hunted and gathered resources overlap, but the activities associated with one are closely related to the other. One might approach this by combing cultural studies of ethnographic groups for which this is the case, paying close attention to how individuals refer to themselves as hunters or gatherers. In addition to what it means to be a hunter or gatherer, the meaning that the landscape might hold for hunter-gatherers is also of interest. Much of this meaning is surely related to their intimate knowledge of and interaction with the landscape and the peoples, animals and plants that it supports (Ingold 1996). The landscape is not only inscribed with their daily practices, but also their histories.

Given this, I believe that we still have much to learn about Paleoindian and Archaic peoples. This project adds significantly to our understanding of the economic pursuits of early foraging groups in the Southeast, largely because I present much-needed botanical data. Yet so much remains to be known about how groups living in landscapes beyond northwest Alabama made a living, both gathering and hunting. If organic materials are not preserved, then we must be more creative about how we think about subsistence activities, perhaps relying more heavily on environmental reconstructions until better dietary evidence is available. We also must be more creative about envisioning the social identities of foraging individuals, and the social interactions among foragers and with the landscape. There are many archaeological, environmental, and ethnographic clues about such interactions that have yet to be gathered and processed. A researcher's work is never done.

APPENDIX A

Table A.1. Detailed Data for Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
Screen Samples:									
1	NA	NA	35"		360.11	259.90	1.02	26.44	50.31
22	125R1	9			5.95	1.14	1.14	0.00	0.00
30	130R2	9			0.36	0.36	0.00	0.00	0.00
29	130R2	11			0.37	0.37	0.37	0.00	0.00
27	130R3	12			4.85	4.85	4.85	0.00	0.00
10	130R3/4			Dalton	8.00	7.99	6.13	0.00	0.00
9	130R4	6	32"		1.42	1.41	0.57	0.00	0.00
35	140		40-45"		71.70	46.28	0.02	24.74	0.13
19	140R1	7	35"		12.35	12.29	0.00	0.04	0.00
31	140R1	8	40"		5.48	5.48	0.00	0.00	0.00
36	145R2	12			77.18	69.19	3.09	5.16	2.33
Pinch Samples:									
Block 1									
2261	110R6	4		Dalton	10.11	0.80	0.30	5.96	2.63
2258	110R8			Dalton	4.86	0.10	0.01	2.09	1.39
2259	110R8	1		Dalton	0.29	0.00	0.00	0.29	
2260	110R8	1		Dalton	5.25	0.09	0.04	4.24	0.85
Block 2									
2276	General Sample C-13	3		Dalton	106.36	12.82	8.19	71.40	14.33
2277	General Sample C-24	5		Dalton	74.50	7.10	4.00	56.49	9.17
2278	General Sample C-15	6		Dalton	40.06	4.16	1.89	32.17	2.86
2279	General Sample C-7	7		Dalton	0.00				
2280	General Sample C-22	8		Dalton	59.77	5.35	2.32	43.99	7.24
2281	120R3	11		Dalton	0.37	0.03	0.00	0.33	0.00
2270	120R6	2		D	11.45	0.93	0.59	6.57	3.63
2266	125R3 Sample C-5	9		Dalton	22.40	3.18	1.96	16.63	1.67
2267	125R3 Sample C-20	11		Dalton	9.88	4.23	4.07	5.05	0.17
2268	125R3 Sample C-17	12		Dalton	6.93	2.39	1.95	4.03	0.20

Table A.1 (continued). Detailed Data for Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
2282	125R3	13		Dalton	9.94	2.28	2.03	6.05	1.14
	Sample C-6								
2272	125R13	14		Dalton	3.54	0.98	0.67	1.54	0.01
	Sample C-14								
2269	125R4	11		Dalton	0.87	0.15	0.14	0.65	0.05
Block 3									
2283	135-140	1		Dalton	11.85	0.40	0.05	7.50	2.90
	Sample C-11								
2285	Block3	2		Dalton	11.15	2.19	0.27	7.72	0.64
	Sample C-19								
2286	Block3	3		Dalton	28.49	1.54	0.95	22.09	3.70
	Sample C-18								
2287	Block3	4		Dalton	9.74	1.00	0.27	7.06	0.99
	Sample C-10								
2284	Block3	10		Dalton	24.68	1.43	0.94	13.39	1.96
	Sample C-16								

Table A.2. Artifactual Data from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Shell Wt (g)	Lithic Count	Wt (g)	Bone Count	Bone Wt (g)
Screen Samples:									
1	NA	NA	35"		1.26	3	1.12		15.89
22	125R1	9			0.00	0	0.00	1	3.34
30	130R2	9			0.00	0	0.00	0	0.00
29	130R2	11			0.00	0	0.00	0	0.00
27	130R3	12			0	0	0	0	0
10	130R3/4			Dalton	0.00	0	0.00	0	0.00
9	130R4	6	32"		0.00	0	0.00	0	0.00
35	140		40-45"		0.00	0	0.00	2	0.09
19	140R1	7	35"		0.00	0	0.00	0	0.00
31	140R1	8	40"		0.00	0	0.00	0	0.00
36	145R2	12			0.00	1	0.23	1	0.19
Pinch Samples:									
Block 1									
2261	110R6	4		Dalton	0.00	1	0.01	10	0.56
2258	110R8			Dalton	0.00	0	0.00	8	1.23
2259	110R8	1		Dalton					
2260	110R8	1		Dalton	0.00	0	0.00	0	0.00
Block 2									
2276	Block2 Sample C-13	3		Dalton	0.00	5	0.45	40	6.61
2277	Block2 Sample C-24	5		Dalton	0.00	0	0.00	22	1.00
2278	Block2 Sample C-15	6		Dalton	0.00	0	0.00	16	0.52
2279	Block2 Sample C-7	7		Dalton					
2280	Block2 Sample C-22	8		Dalton	0.00	3	0.08	42	2.81
2281	120R3	11		Dalton	0.00	0	0.00	0	0.00
2270	120R6	2		D	0.00	1	0.00	5	0.07
2266	125R3 Sample C-5	9		Dalton	0.00	1	0.01	14	0.24
2267	125R3 Sample C-20	11		Dalton	0.00	0	0.00	2	0.00
2268	125R3 Sample C-17	12		Dalton	0.00	1	0.00	2	0.04
2282	125R3 Sample C-6	13		Dalton	0.00	2	0.00	2	0.04
2272	125R13 Sample C-14	14		Dalton	0.00	0	0.00	5	0.86

Table A.2 (continued). Artifactual Data from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Shell Wt (g)	Lithic Count	Wt (g)	Bone Count	Bone Wt (g)
2269	125R4	11		Dalton	0.00	0	0.00	0	0.00
Block 3									
2283	135-140 Sample C-11	1		Dalton	0.00	1	0.00	15	0.85
2285	Block3 Sample C-19	2		Dalton	0.00	0	0.00	6	0.10
2286	Block3 Sample C-18	3		Dalton	0.00	0	0.00	22	0.56
2287	Block3 Sample C-10	4		Dalton	0.00	1	0.02	9	0.27
2284	Block3 Sample C-16	10		Dalton	0.00	1	0.06	16	7.35

Table A.3. Plant Materials Recovered from Stanfield-Worley Paleoethnobotanical Samples. Note: Acorn, acorn meat, and persimmon include 1.40mm portion; items recovered from the 1.40mm screen are given in parentheses; items recovered from the 0.71mm screen are given in brackets.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Common Name	Count	Weight (g)
Screen Samples:							
1	NA	NA	35"		acorn	35	0.96
	"Level of Charred Acorns"				acorn meat	804	257.05
					coal	2	0.20
					hickory	4	0.49
					hickory hull	5	0.21
					honey locust	5	0.08
					insect	1	0.01
					Juglandaceae nutmeat	1	0.03
					pine cone	1	0.01
					unidentifiable	3	0.05
22	125R1	9			root - uncarbonized	1	1.47
30	130R2	9			cane	2	0.36
29	130R2	11					
27	130R3	12					
10	130R3/4			Dalton	acorn meat	3	0.62
	"material from Dalton Level"				cane	2	0.33
					hickory	3	0.28
					hickory hull	4	0.63
					persimmon	1	0.00
9	130R4	6	32"		acorn meat	2	0.84
35	140		40-45"		acorn	917	7.31
					acorn meat	732	38.09
					cane	11	0.23
					chestnut	134	0.23
					chestnut/acorn	32	0.25
					hickory	5	0.08
					insect	1	0.00
					persimmon cf.	1	0.01
					pine cone	9	0.06
19	140R1	7	35"		acorn	5	0.27
					acorn meat	40	10.99
					hickory	3	1.03
31	140R1	8	40"		acorn	1	0.03
					acorn meat	33	5.45
36	145R2	12			acorn meat	240	65.75
	"acorns"				black walnut	1	0.15
					hickory	1	0.10
					pine cone	7	0.06

Table A.3 (continued). Plant Materials Recovered from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Common Name	Count	Weight (g)
					unidentifiable	5	0.04
Pinch Samples:							
Block 1							
2261	110R6	4		Dalton	acorn meat	2	0.04
					black walnut	8	0.18
					hickory	10	0.22
					Juglandaceae	4	0.05
					unidentifiable	(3)	0.01
2258	110R8			Dalton	black walnut	1	0.04
					hickory	2	0.03
					Juglandaceae	1	0.01
					unidentifiable	1	0.01
2259	110R8 "above sterile"	1		Dalton			
2260	110R8 "above sterile"	1		Dalton	hickory	3	0.05
Block 2							
2276	Block2	3		Dalton	acorn	5	0.02
	Sample C-13				acorn meat	11	0.07
					black walnut	59	2.90
					hazel	(1)	0.00
					hickory	84	1.34
					Juglandaceae	11	0.13
					persimmon	8	0.05
					unidentifiable	20	0.13
2277	Block2	5		Dalton	acorn cf.	(1)	0.00
	Sample C-24				black walnut	73	1.69
					hickory	79	1.00
					Juglandaceae	31	0.31
					persimmon	3	0.01
					unidentifiable	17	0.09
2278	Block2	6		Dalton	acorn	4	0.03
	Sample C-15				acorn meat	3	0.02
					black walnut	43	1.19
					hickory	56	0.70
					Juglandaceae	16	0.19
					persimmon	4	0.11

Table A.3 (continued). Plant Materials Recovered from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Common Name	Count	Weight (g)
					pitch	1	0.01
					sumac cf.	2	0.00
					unidentifiable	4	0.02
2279	Block2	7		Dalton	nothing but dust		
	Sample C-7						
2280	Block2	8		Dalton	acorn meat	7	0.29
	Sample C-22				black walnut	36	1.03
	"All squares in Block 2"				grape	2	0.00
					hazel	(1)	0.00
					hickory	110	1.36
					Juglandaceae	36	0.29
					persimmon	3	0.03
					unidentifiable	7	0.03
2281	120R3	11		Dalton	black walnut	(1)	0.01
					hickory	1	0.01
					Juglandaceae	2	0.01
2270	120R6	2		D	acorn	(1)	0.00
					black walnut	1	0.02
					gall	1	0.01
					hickory	21	0.31
					unidentifiable	1	0.00
2266	125R3	9		Dalton	acorn meat	3	0.02
	Sample C-5				black walnut	13	0.44
					hickory	47	0.69
					Juglandaceae	4	0.03
					persimmon	3	0.04
					unidentifiable	2	0.01
2267	125R3	11		Dalton	acorn	1	0.00
	Sample C-20				acorn meat	7	0.03
					bark	2	0.05
					black walnut	1	0.05
					hickory	2	0.02
					unidentifiable	(4)	0.01
2268	125R3	12		Dalton	acorn	1	0.01
	Sample C-17				acorn meat	2	0.02
					bark	4	0.02
					black walnut	12	0.29
					hickory	2	0.04
					Juglandaceae	6	0.05

Table A.3 (continued). Plant Materials Recovered from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Common Name	Count	Weight (g)
					unidentifiable	1	0.01
2282	125R3	13		Dalton	acorn cf.	(1)	0.00
	Sample C-6				acorn meat	2	0.01
					hickory	9	0.23
					persimmon	1	0.01
					unidentifiable	1	0.00
2272	125R13	14		Dalton	acorn	2	0.00
	Sample C-14				acorn meat	3	0.02
					bark	4	0.04
					black walnut	3	0.09
					hickory	11	0.14
					Juglandaceae	1	0.01
					unidentifiable	1	0.00
2269	125R4	11		Dalton	Juglandaceae	(4)	0.01
Block 3							
2283	135-140	1		Dalton	acorn	2	0.02
	Sample C-11				black walnut	5	0.18
					hickory	9	0.14
					honey locust cf.	3	0.01
					Juglandaceae	(4)	0.01
					unidentifiable	(3)	0.00
2285	Block3	2		Dalton	acorn	2	0.00
	Sample C-19				acorn meat	1	0.00
					black walnut	56	1.23
					hickory	34	0.53
					Juglandaceae	12	0.12
					persimmon	6	0.04
					unidentifiable	2	0.01
2286	Block3	3		Dalton	acorn	5	0.01
	Sample C-18				acorn meat	10	0.12
					bark	2	0.02
					black walnut	5	0.06
					hazel	3	0.01
					hickory	25	0.35
					Juglandaceae	2	0.01
					persimmon	4	0.02
					pitch	1	0.00
					unidentifiable	4	0.01
2287	Block3	4		Dalton	acorn meat	(1)	0.00
	Sample C-10				black walnut	7	0.18

Table A.3 (continued). Plant Materials Recovered from Stanfield-Worley Paleoethnobotanical Samples.

Category: *Provenience* Catalog No.	Unit	Level	Depth	Zone	Common Name	Count	Weight (g)
					hickory	32	0.52
					Juglandaceae	2	0.02
					unidentifiable	(1)	0.00
2284	Block3	10		Dalton	black walnut	1	0.06
	Sample C-16				hickory	32	0.41
					Juglandaceae	1	0.01
					sumac	5	0.00
					unidentifiable	(4)	0.01

APPENDIX B

Table B.1. Detailed Data for Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
Control Block 1:									
127/132	Cut1	1	0-.2 ft	D	18.40	4.58	0.38	9.56	2.62
136/137	Cut1	1	0-0.2 ft	D	14.18	3.69	0.33	6.79	2.09
114	Cut1	3	.4-.6 ft	D	5.82	5.05	0.93	0.43	0.14
154/155	Cut1	3	.4-.6 ft	D	14.47	1.89	0.13	8.85	3.02
157	Cut1	3	.4-.6ft	D	143.08	16.82	7.88	97.1	15.89
	*half of 1.40mm sorted; remainder scanned								
133/138	Cut1	4	.6-.8 ft	D	30.62	4.55	0.15	15.32	8.58
146	Cut1	4	.6-.8 ft	D	9.68	1.42	0.09	4.32	3.27
124/125	Cut1	1	0-.2 ft	E	2.81	0.89	0.08	1.29	0.24
153	Cut1	1	0-.2 ft	E	13.95	2.02	0.07	6.36	4.42
128/129	Cut1	2	.2-.4	E	18.27	1.51	0.05	11.94	3.95
121/126	Cut2	1	0-.2 ft	D	15.51	3.59	0.30	9.12	0.74
145/150	Cut2	2	.2-.4 ft	D	19.15	3.00	0.13	12.62	1.78
158/159	Cut2	1	0-0.2ft	D	21	5.3	2.82	11.96	1.31
160	Cut2	1	0-0.2ft	D	81.17	10.07	7.13	61.34	4.08
122/123	Cut2	1	0-.2 ft	E	2.42	0.44	0.03	1.42	0.29
139/140	Cut2	2	.2-.4 ft	E	7.38	0.36	0.06	5.02	1.86
142/143	Cut3	5	.8-1 ft	C	17.02	3.24	0.86	8.85	3.38
148/149	Cut3	2	.2-.4 ft	D	9.54	1.29	0.28	4.38	2.81
115/120	Cut3	1	0-.2 ft	E	12.65	1.35	0.13	8.32	2.47
118/141	Cut3	3	.4-.6 ft	E	4.46	0.19	0.01	3.02	1.20
Control Block 2:									
130/131	CB2	6	1-1.2 ft	C	12.72	4.02	0.57	6.20	1.33
151/156	CB2	1	0-.2 ft	D	16.87	3.75	0.41	7.66	4.00
147	CB2	3	.4-.6	D	7.14	2.05	0.74	3.54	0.06
134/135	CB2	5	.8-1 ft	L	21.43	8.84	2.40	6.95	1.62
Square 95L5:									
119	95L5	16	60-64"		11.57	0.73	0.07	8.03	2.22
112/113	95L5	16	60-64"		32.62	0.44	0.07	27.53	3.97
152	95L5	16	60-64"		9.46	1.31	0.15	5.60	1.80
116/117	95L5	17	64-68"		17.17	2.00	0.09	8.97	5.34
144	95L5	18	68"		12.87	0.87	0.14	7.56	4.16

Table B.2. Artifactual Data from Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Shell Wt (g)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)
Control Block 1:									
127/132	Cut1	1	0-.2 ft	D	0.00	4	0.01	0	0.00
136/137	Cut1	1	0-0.2 ft	D	0.00	0	0.00	0	0.00
114	Cut1	3	.4-.6 ft	D	0.00	0	0.00	0	0.08
154/155	Cut1	3	.4-.6 ft	D	0.00	7	0.04	0	0.00
157	Cut1	3	.4-.6ft	D		16	0.18		0.11
133/138	Cut1	4	.6-.8 ft	D	0.00	25	0.18	1	0.00
146	Cut1	4	.6-.8 ft	D	0.00	6	0.08	0	0.00
124/125	Cut1	1	0-.2 ft	E	0.00	2	0.00	0	0.00
153	Cut1	1	0-.2 ft	E	0.00	7	0.04	0	0.00
128/129	Cut1	2	.2-.4	E	0.00	6	0.04	0	0.00
121/126	Cut2	1	0-.2 ft	D	0.00	6	0.03	0	0.00
145/150	Cut2	2	.2-.4 ft	D	0.00	13	0.16	2	0.21
158/159	Cut2	1	0-0.2ft	D	0.01	1	0.01	1	0.09
160	Cut2	1	0-0.2ft	D	0	1	0	6	0.12
122/123	Cut2	1	0-.2 ft	E	0.00	3	0.01	0	0.00
139/140	Cut2	2	.2-.4 ft	E	0.00	0	0.00	0	0.00
142/143	Cut3	5	.8-1 ft	C	0.00	6	0.04	0	0.00
148/149	Cut3	2	.2-.4 ft	D	0.00	19	0.26	0	0.02
115/120	Cut3	1	0-.2 ft	E	0.00	2	0.00	0	0.00
118/141	Cut3	3	.4-.6 ft	E	0.00	1	0.00	0	0.00
Control Block 2:									
130/131	CB2	6	1-1.2 ft	C	0.00	0	0.00	0	0.00
151/156	CB2	1	0-.2 ft	D	0.00	4	0.01	3	0.03
147	CB2	3	.4-.6	D	0.00	0	0.00	0	0.00
134/135	CB2	5	.8-1 ft	L	0.00	0	0.00	0	0.00
Square 95L5:									
119	95L5	16	60-64"		0.00	5	0.03	0	0.00
112/113	95L5	16	60-64"		0.00	7	0.08	0	0.00
152	95L5	16	60-64"		0.00	1	0.00	0	0.00
116/117	95L5	17	64-68"		0.00	5	0.04	0	0.00
144	95L5	18	68"		0.00	2	0.02	0	0.00

Table B.3. Plant Materials Recovered from Rollins Bluff Shelter Paleoethnobotanical Samples. Note: Acorn, acorn meat, and persimmon include 1.40mm portion; items recovered from the 1.40mm screen are given in parentheses; items recovered from the 0.71mm screen are given in brackets.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
Control Block 1:									
127/132	Cut1	1	0-.2 ft	D	4.58	0.38	acorn	2	0.00
							grape	1	0.00
							hickory	324	4.12
							pitch	3	0.06
							unidentifiable	3	0.01
							wild legume	1	0.00
136/137	Cut1	1	0-0.2 ft	D	3.69	0.33	acorn	2	0.00
							hickory	280	3.33
							pitch	1	0.01
							unidentifiable	4	0.02
114	Cut1	3	.4-.6 ft	D	5.05	0.93	acorn	15	0.07
							black walnut cf.	1	0.01
							hickory	158	3.89
							pitch	12	0.09
							unidentifiable	2	0.06
154/155	Cut1	3	.4-.6 ft	D	1.89	0.13	hickory	119	1.74
							pitch	(5)	0.01
							unidentifiable	(5)	0.01
157	Cut1	3	.4-.6ft	D	16.82	7.88	acorn	57	0.14
							bud	(1)	0
							hickory	572	6.4
							persimmon seed coat	[7]	0
							pine cone	(1)	0
							pitch	230	2.13
							unidentifiable	36	0.26
133/138	Cut1	4	.6-.8 ft	D	4.55	0.15	acorn	[2]	0.00
							black walnut	1	0.01
							black walnut cf.	2	0.03
							grape	1	0.00
							hickory	375	4.32
							pitch	3	0.03
							unidentifiable	1	0.01
146	Cut1	4	.6-.8 ft	D	1.42	0.09	acorn	1	0.00
							black walnut cf.	1	0.03
							hickory	103	1.27
							pitch	(3)	0.01
							unidentifiable	3	0.02

Table B.3 (continued). Plant Materials Recovered from Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
124/125	Cut1	1	0-.2 ft	E	0.89	0.08	acorn	2	0.00
							black walnut	1	0.01
							grape cf.	1	0.00
							hickory	70	0.79
							pitch	(1)	0.00
							unidentifiable	(4)	0.01
							unidentifiable seed coat	2	0.00
153	Cut1	1	0-.2 ft	E	2.02	0.07	acorn	[1]	0.00
							black walnut	4	0.05
							hickory	203	1.86
							Juglandaceae	(3)	0.01
							pitch	(6)	0.02
							unidentifiable	2	0.01
							unidentifiable seed coat	1	0.00
128/129	Cut1	2	.2-.4	E	1.51	0.05	acorn	3	0.00
							acorn meat	3	0.02
							black walnut	1	0.01
							grape	4	0.01
							hickory	149	1.41
							pitch	(4)	0.01
							unidentifiable	1	0.00
							unidentifiable seed coat	[4]	0.00
121/126	Cut2	1	0-.2 ft	D	3.59	0.30	acorn	2	0.01
							hickory	229	3.20
							pitch	5	0.06
							unidentifiable	2	0.02
145/150	Cut2	2	.2-.4 ft	D	3.00	0.13	acorn	1	0.00
							black walnut	1	0.01
							hickory	248	2.79
							pitch	1	0.01
							unidentifiable	6	0.04
							unidentifiable seed coat	2	0.00
158/159	Cut2	1	0-0.2ft	D	5.3	2.82	acorn	8	0.03
							acorn meat	(1)	0.00
							bean cf. (intrusive)	1	0.01
							hickory	156	2.17
							pine cone	1	0.00
							pitch	25	0.22
							unidentifiable	4	0.05
							unidentifiable seed	[2]	0.00

Table B.3 (continued). Plant Materials Recovered from Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
160	Cut2	1	0-0.2ft	D	10.07	7.13	acorn	21	0.05
							acorn meat	8	0.03
							hickory	204	1.81
							persimmon	3	0.02
							pine cone	1	0.01
							pitch	82	0.92
							unidentifiable	16	0.10
122/123	Cut2	1	0-.2 ft	E	0.44	0.03	acorn meat	(3)	0.01
							grape	5	0.00
							hickory	40	0.38
							persimmon	(1)	0.00
							pitch	(6)	0.01
							unidentifiable	(3)	0.01
							unidentifiable seed coat	[2]	0.00
139/140	Cut2	2	.2-.4 ft	E	0.36	0.06	acorn	1	0.00
							hickory	31	0.28
							persimmon	1	0.00
							pitch	(7)	0.02
							unidentifiable	(1)	0.00
142/143	Cut3	5	.8-1 ft	C	3.24	0.86	acorn	3	0.01
							black walnut	1	0.01
							hickory	178	2.09
							pitch	20	0.22
							unidentifiable	9	0.05
148/149	Cut3	2	.2-.4 ft	D	1.29	0.28	acorn	4	0.01
							hickory	97	0.97
							pitch	2	0.01
							unidentifiable	3	0.02
115/120	Cut3	1	0-.2 ft	E	1.35	0.13	hickory	127	1.18
							pitch	1	0.01
							unidentifiable	1	0.01
118/141	Cut3	3	.4-.6 ft	E	0.19	0.01	black walnut cf.	1	0.01
							hickory	19	0.17
							unidentifiable	(1)	0.00
Control Block 2:									
130/131	CB2	6	1-1.2 ft	C	4.02	0.57	acorn	[4]	0.00
							black walnut	1	0.01
							black walnut cf.	4	0.05
							hickory	248	3.20
							pitch	9	0.17

Table B.3 (continued). Plant Materials Recovered from Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
							unidentifiable	5	0.02
151/156	CB2	1	0-.2 ft	D	3.75	0.41	acorn	3	0.00
							black walnut cf.	1	0.01
							hickory	270	3.29
							unidentifiable	6	0.04
147	CB2	3	.4-.6	D	2.05	0.74	acorn	1	0.00
							acorn meat	1	0.02
							hickory	115	1.10
							pitch	6	0.05
							unidentifiable	19	0.14
134/135	CB2	5	.8-1 ft	L	8.84	2.40	acorn	3	0.00
							black walnut cf.	2	0.02
							hickory	607	7.04
							pitch	21	0.21
							unidentifiable	33	0.17
Square 95L5:									
119	95L5	16	60-64"		0.73	0.07	hickory	58	0.64
							pitch	1	0.01
							unidentifiable	(2)	0.01
112/113	95L5	16	60-64"		0.44	0.07	acorn	1	0.00
							hickory	41	0.45
							persimmon seed coat	[1]	0.00
							pitch	2	0.02
							unidentifiable	1	0.00
							unidentifiable seed	1	0.00
152	95L5	16	60-64"		1.31	0.15	acorn cf.	1	0.00
							black walnut	2	0.06
							hickory	103	1.08
							squash rind cf.	1	0.00
							unidentifiable	3	0.02
							unidentified seed	2	0.00
116/117	95L5	17	64-68"		2.00	0.09	acorn	[1]	0.00
							black walnut	5	0.08
							black walnut cf.	(1)	0.00
							hickory	195	1.73
							pitch	8	0.09
							sumac	1	0.00
							unidentifiable	(4)	0.01
144	95L5	18	68"		0.87	0.14	black walnut	(1)	0.01
							hickory	57	0.67

Table B.3 (continued). Plant Materials Recovered from Rollins Bluff Shelter Paleoethnobotanical Samples.

Provenience: Catalog Number	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
							pitch	5	0.05
							sumac	1	0.00
							unidentifiable	(1)	0.00

APPENDIX C

Table C.1. Detailed Data for LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
Screen Samples:									
62	S5E11	10		B	10.44	4.69	2.24	4.43	1.08
65	S5E11	11		B	6.11	2.65	2.06	2.71	0.69
71	S5E11	12	33-36"		2.20	1.00	0.49	1.17	0.00
70.5	S5E11	13	36-39"		0.08	0.04	0.04	0.04	
49	S5E11	15		D	0.29	0.27	0.27		0.02
60	S10E5	10		B	0.90	0.31	0.17	0.21	0.16
69	S10E5	11		B	1.57	0.00	0.00	0.08	
86	S10E5	11		B	0.09	0.09	0.00	0.00	0.00
97	S10E5	12	33-36"	B	0.46	0.00	0.00	0.36	
47	S10E5	13		C	0.44	0.07	0.00	0.00	0.05
74	S10E5	13		C	0.01	0.01	0.00	0.00	0.00
88	S10E5	14		D	0.25	0.24	0.00	0.00	0.00
89	S10E5	14		D	0.19	0.19	0.07	0.00	0.00
78	S10E5	15		D	0.46	0.26	0.00	0.04	0.00
79	S10E5	15		D	0.06	0.06	0.06		
42	S10E5	16	45-48"	D	3.88	0.04	0.00	0.00	3.84
80	S10E5	16		D	0.12	0.12	0.00	0.00	0.00
81	S10E5	16		D	0.43	0.43	0.00	0.00	0.00
54	S10E5	17		D	6.40	0.76	0.02	0.00	5.62
82	S10E5	17		D	0.20	0.09	0.00	0.12	0.00
43	S10E5	18		D	0.75	0.39	0.00	0.00	0.35
83	S10E5	18		D	0.03	0.00	0.00	0.01	
44	S10E5	16		E	1.95	0.35	0.00	0.00	1.60
51	S10E5	17	48-51"	E	1.08	0.10	0.00	0.00	0.98
41	S10E9	15		D	5.36	0.94	0.00	0.00	2.86
57	S10E10	10		B	52.58	4.45	1.95	29.87	17.84
68	S10E10	10		B	32.95	12.53	7.86	16.69	3.07
58	S10E10	11		B	1.81	1.18	0.47	0.58	0.03
85	S10E10	11		B	0.49	0.28	0.00	0.07	0.00
91	S10E10	11		B	0.78	0.48	0.04	0.29	0.00
77	S10E10	12		B	0.63	0.50	0.07	0.14	0.00
84	S10E10	12		B	0.20	0.19	0.00	0.01	0.00
61	S10E10	13		B	2.66	0.40	0.00	0.29	1.62
46	S10E10	10		C	1.75	1.00	1.00	0.00	0.74
75	S10E10	13		C	0.49	0.48	0.00	0.01	0.00
48	S10E10	14		C	0.83	0.49	0.00	0.00	0.35

Table C.1 (continued). Detailed Data for LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
52	S10E10	16		D	1.13	0.64	0.00	0.00	0.49
53	S10E10	16		D	1.50	0.31	0.00	0.00	1.03
55	S10E10	17		D	0.76	0.54	0.00	0.00	0.21
96	S10E10	15	42-45"	E	0.12	0.11	0.00	0.01	0.00
50	S10E10	19		E	0.56	0.07	0.00	0.00	0.49
40	S10E10	20		F	0.56	0.04	0.01	0.00	0.52
76	S10E11	12; "top"		C	0.31	0.30	0.00	0.01	0.00
87	S10E11	top		D	0.21	0.21	0.00	0.00	0.00
Flotation Samples:									
106	S10E10	14		B	1.55	0.32	0.04	0.81	0.07
107	S10E10	14		B	2.38	0.51	0.03	1.12	0.29
105	S10E10	15		C	4.92	1.33	0.19	2.62	0.13
104	S10E5	14		D	3.59	1.43	0.10	1.25	0.13
103	S10E5	15		D	2.41	0.86	0.04	0.89	0.11
101	S10E5	16		D	4.33	1.63	0.14	1.59	0.29
102	S10E5	16		D	5.62	1.85	0.09	2.01	0.15
99	S10E10	19		E	0.86	0.36	0.02	0.37	0.01
100	S10E10	19		E	0.82	0.13	0.02	0.52	0.00
98	S10E10	22		F	0.33	0.01	negligible	0.32	0.00

Table C.2. Artifactual Data from LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Shell Wt (g)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)
Screen Samples:									
62	S5E11	10		B	0.00	2	0.13	0	0.00
65	S5E11	11		B	0.00	0	0.00	0	0.00
71	S5E11	12	33-36"		0.00	0	0.00	0	0.00
70.5	S5E11	13	36-39"						
49	S5E11	15		D					
60	S10E5	10		B	0.00	0	0.00	2	0.20
69	S10E5	11		B				2	1.49
86	S10E5	11		B	0.00	0	0.00	0	0.00
97	S10E5	12	33-36"	B				1	0.09
47	S10E5	13		C	0.00	0	0.00	4	0.31
74	S10E5	13		C	0.00	0	0.00	0	0.00
88	S10E5	14		D	0.00	0	0.00	0	0.00
89	S10E5	14		D	0.00	0	0.00	0	0.00
78	S10E5	15		D	0.00	0	0.00	2	0.14
79	S10E5	15		D					
42	S10E5	16	45-48"	D	0.00	0	0.00	0	0.00
80	S10E5	16		D	0.00	0	0.00	0	0.00
81	S10E5	16		D	0.00	0	0.00	0	0.00
54	S10E5	17		D	0.00	0	0.00	1	0.03
82	S10E5	17		D	0.00	0	0.00	0	0.00
43	S10E5	18		D	0.00	0	0.00	0	0.00
83	S10E5	18		D				1	0.02
44	S10E5	16		E	0.00	0	0.00	0	0.00
51	S10E5	17	48-51"	E	0.00	0	0.00	0	0.00
41	S10E9	15		D	0.00	0	0.00	6	1.54
57	S10E10	10		B	0.00	0	0.00	3	0.26
68	S10E10	10		B	0.00	1	0.09	2	0.39
58	S10E10	11		B	0.00	0	0.00	0	0.00
85	S10E10	11		B	0.00	0	0.00	1	0.12
91	S10E10	11		B	0.00	0	0.00	0	0.00
77	S10E10	12		B	0.00	0	0.00	0	0.00
84	S10E10	12		B	0.00	0	0.00	0	0.00
61	S10E10	13		B	0.00	3	0.34	0	0.00
46	S10E10	10		C	0.00	0.00	0.00	0.00	0.00
75	S10E10	13		C	0.00	0	0.00	0	0.00
48	S10E10	14		C	0.00	0	0.00	0	0.00
52	S10E10	16		D	0.00	0	0.00	0	0.00
53	S10E10	16		D	0.00	0	0.00	1	0.16
55	S10E10	17		D	0.00	0	0.00	0	0.00

Table C.2 (continued). Artifactual Data from LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Shell Wt (g)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)
96	S10E10	15	42-45"	E	0.00	0	0.00	0	0.00
50	S10E10	19		E	0.00	0	0.00	0	0.00
40	S10E10	20		F	0.00	0	0.00	0	0.00
76	S10E11	12; "top"		C	0.00	0	0.00	0	0.00
87	S10E11	top		D	0.00	0	0.00	0	0.00
Flotation Samples:									
106	S10E10	14		B	0.00	0	0.00	8	0.13
107	S10E10	14		B	0.00	0	0.00	2	0.13
105	S10E10	15		C	0.00	0	0.00	0	0.00
104	S10E5	14		D	0.00	0	0.00	8	0.18
103	S10E5	15		D	0.00	0	0.00	7	0.09
101	S10E5	16		D	0.00	0	0.00	9	0.11
102	S10E5	16		D	0.00	0	0.00	29	0.56
99	S10E10	19		E	0.00	0	0.00	0	0.00
100	S10E10	19		E	0.00	0	0.00	0	0.00
98	S10E10	22		F	0.00	0	0.00	0	0.00

Table C.3. Plant Materials Recovered from LaGrange Bluff Shelter Paleoethnobotanical Samples. Note: Acorn, acorn meat, and persimmon include 1.40mm portion; items recovered from the 1.40mm screen are given in parentheses; items recovered from the 0.71mm screen are given in brackets.

Category: Catalog No.	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
Screen Samples:									
62	S5E11	10		B	4.69	2.24	acorn meat	1	0.12
							black walnut	2	0.21
							black walnut cf.	1	0.03
							hickory	38	2.00
							persimmon	1	0.03
							persimmon cf.	1	0.02
							unidentifiable	1	0.04
65	S5E11	11		B	2.65	2.06	hickory	10	0.59
71	S5E11	12	33-36"		1.00	0.49	hickory	7	0.51
70.5	S5E11	13	36-39"		0.04	0.04			
49	S5E11	15		D	0.27	0.27			
60	S10E5	10		B	0.31	0.17	hickory	3	0.14
69	S10E5	11		B	0.00	0.00			
86	S10E5	11		B	0.09	0.00	hickory	1	0.09
97	S10E5	12	33-36"	B	0.00	0.00			
47	S10E5	13		C	0.07	0.00	hickory	1	0.07
74	S10E5	13		C	0.01	0.00	black walnut	1	0.01
88	S10E5	14		D	0.24	0.00	black walnut	2	0.15
							hickory	1	0.09
89	S10E5	14		D	0.19	0.07			
78	S10E5	15		D	0.26	0.00	hickory	2	0.26
79	S10E5	15		D	0.06	0.06			
42	S10E5	16	45-48"	D	0.04	0.00	hickory	5	0.04
80	S10E5	16		D	0.12	0.00	black walnut	4	0.08
							hickory	1	0.04
81	S10E5	16		D	0.43	0.00	black walnut	4	0.11
							hickory	5	0.30
							Juglandaceae	3	0.02
54	S10E5	17		D	0.76	0.02	acorn meat	3	0.10
							black walnut	11	0.49
							hickory	5	0.15
82	S10E5	17		D	0.09	0.00	black walnut	3	0.08
							Juglandaceae	1	0.01
43	S10E5	18		D	0.39	0.00	black walnut	5	0.39
83	S10E5	18		D	0.00	0.00			
44	S10E5	16		E	0.35	0.00	black walnut	8	0.29
							hickory	2	0.03
							Juglandaceae	5	0.03

Table C.3 (continued). Plant Materials Recovered from LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
51	S10E5	17	48-51"	E	0.10	0.00	black walnut	4	0.05
							hickory	7	0.05
41	S10E9	15		D	0.94	0.00	black walnut	10	0.56
							hickory	15	0.38
57	S10E10	10		B	4.45	1.95	hickory	49	2.50
68	S10E10	10		B	12.53	7.86	hickory	83	4.67
58	S10E10	11		B	1.18	0.47	hickory	9	0.71
85	S10E10	11		B	0.28	0.00	hickory	3	0.28
91	S10E10	11		B	0.48	0.04	hickory	9	0.44
77	S10E10	12		B	0.50	0.07	hickory	6	0.43
84	S10E10	12		B	0.19	0.00	hickory	10	0.19
61	S10E10	13		B	0.40	0.00	black walnut	1	0.18
							hickory	5	0.22
46	S10E10	10		C	1.00	1.00			
75	S10E10	13		C	0.48	0.00	hickory	8	0.48
48	S10E10	14		C	0.49	0.00	black walnut	1	0.36
							hickory	3	0.13
52	S10E10	16		D	0.64	0.00	black walnut	4	0.21
							hickory	7	0.43
53	S10E10	16		D	0.31	0.00	hickory	7	0.30
							persimmon	1	0.01
55	S10E10	17		D	0.54	0.00	black walnut	2	0.04
							hickory	15	0.50
96	S10E10	15	42-45"	E	0.11	0.00	hickory	1	0.11
50	S10E10	19		E	0.07	0.00	hickory	1	0.07
40	S10E10	20		F	0.04	0.01	hickory	1	0.03
							pitch	1	0.01
76	S10E11	12; "top"		C	0.30	0.00	hickory	1	0.30
87	S10E11	top		D	0.21	0.00	hickory	2	0.21
Flotation Samples									
106	S10E10	14		B	0.32	0.04	acorn	(4)	0.00
							hickory	26	0.26
							unidentifiable	6	0.02
							unidentifiable seed coat	4	0.00
							wild legume	1	0.00
107	S10E10	14		B	0.51	0.03	acorn	(7)	0.00
							black walnut	2	0.03
							hickory	34	0.37
							Juglandaceae	7	0.07

Table C.3 (continued). Plant Materials Recovered from LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
							unidentifiable	1	0.01
105	S10E10	15		C	1.33	0.19	acorn	3	0.01
							Composite family cf.	1	0.00
							hickory	89	1.10
							Juglandaceae	(1)	0.01
							mulberry	1	0.00
							unidentifiable	2	0.02
							unidentifiable seed coat	2	0.00
104	S10E5	14		D	1.43	0.10	acorn	3	0.00
							acorn meat	6	0.13
							black walnut	34	0.67
							chenopod	1	0.00
							chenopod cf.	3	0.00
							grape	1	0.00
							hazelnut	(1)	0.00
							hickory	27	0.28
							Juglandaceae	10	0.11
							persimmon	12	0.14
							persimmon seed coat	3	0.00
							Strophostyles cf.	1	0.00
							sumac	1	0.00
							unidentifiable	7	0.02
							unidentifiable seed	1	0.00
							unidentifiable seed coat	6	0.00
							wild legume	7	0.00
103	S10E5	15		D	0.86	0.04	acorn	4	0.01
							black walnut	14	0.27
							chenopod	2	0.00
							chenopod cf.	1	0.00
							grape	1	0.00
							hickory	47	0.53
							hickory - partly carbonized	1	0.03
							Juglandaceae	1	0.00
							maypop cf.	1	0.00
							unidentifiable	2	0.01
							unidentifiable seed coat	1	0.00
							unidentified seed	1	0.00
							wild legume	5	0.00
101	S10E5	16		D	1.63	0.14	acorn	10	0.02

Table C.3 (continued). Plant Materials Recovered from LaGrange Bluff Shelter Paleoethnobotanical Samples.

Category: Catalog No.	Unit	Level	Depth	Zone	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
							black walnut	30	0.57
							chenopod	1	0.00
							hazel	(1)	0.00
							hickory	71	0.84
							Juglandaceae	6	0.06
							unidentifiable	16	0.04
							unidentifiable seed	2	0.00
							unidentifiable seed coat	5	0.00
							wild legume	4	0.00
102	S10E5	16		D	1.85	0.09	acorn	5	0.01
							black walnut	29	0.67
							chenopod cf.	2	0.00
							grape	2	0.00
							Grass family	1	0.00
							hazelnut	(1)	0.01
							hickory	92	0.92
							Juglandaceae	6	0.06
							persimmon	1	0.00
							sumac	1	0.00
							unidentifiable	9	0.09
							unidentifiable seed	6	0.00
99	S10E10	19		E	0.36	0.02	acorn	1	0.00
							black walnut	7	0.13
							Brassica family cf.	1	0.00
							hazelnut	1	0.01
							hickory	11	0.12
							Juglandaceae	4	0.07
							pitch	2	0.01
							sumac	1	0.00
							unidentifiable	2	0.00
							unidentifiable seed coat	3	0.00
							unidentified	1	0.01
100	S10E10	19		E	0.13	0.02	acorn	1	0.00
							black walnut	(1)	0.01
							hickory	12	0.09
							Juglandaceae	(2)	0.01
							pitch	(2)	0.01
							unidentifiable seed coat	5	0.00
98	S10E10	22		F	0.01	negligible	hickory	(5)	0.01
							wood	(1)	0.00

APPENDIX D

Table D.1. Detailed Data for Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
5176	N60W65	40	315	P2	4.5	283.57	11.95	0.74	214.76	0.31
5230	N60W65	42	325	P3e	8	350.56	8.16	0.73	303.54	0.03
5319	N60W65	44	335	P3e	6	549.16	6.03	1.70	287.70	0.05
5340	N60W65	46	345	P2	4	387.00	4.64	0.59	129.40	218.44
5512	N60W65	48	355	P14	1	29.77	0.86	0.04	25.01	0.00
5647	N60W65	50	365	Q4	0	333.31	0.55	0.02	290.00	0.49
5647.1	N60W65	50	365	Q4	0	147.60	1.28	0.04	131.26	0.00
6131	N60W65	54	385	R3	0.5	153.16	0.28	0.10	48.91	96.19
6152	N60W65	54	385	R3e	4.7	799.54	0.82	0.25	205.11	439.45
6159	N60W65	55	390	R3e	5.5	548.06	0.97	0.31	229.68	273.58
6192	N60W65	56	395	R3f	6	932.70	1.32	0.53	247.68	542.68
6212	N60W65	57	400	R3f	7.5	686.61	1.11	0.30	220.36	379.60
6296	N60W65	58	405	R3f	7	1235.01	0.61	0.16	176.21	835.79
6343	N60W65	59	410	R3f	8	768.85	0.54	0.26	176.00	481.63
6360	N60W65	60	415	R3f	6	525.66	0.53	0.22	113.60	364.14
6378	N60W65	61	420	R3f	8.3	706.19	0.39	0.22	115.57	540.27
6379	N60W65	61	420	T5	7.5	536.22	0.42	0.39	77.89	427.37
6401	N60W65	62	425	T5	4	272.74	0.13	0.11	29.25	232.41
6402	N60W65	62	425	U3	8	668.04	0.33	0.19	86.78	537.24
6431	N60W65	63	430	U3	12	289.08	0.53	0.17	58.07	193.41
6465	N60W65	64	435	U3	11	175.50	0.49	0.30	60.47	87.14
6502	N60W65	65	440	U8	13	286.41	0.77	0.56	122.01	134.81
6531	N60W65	66	445	U8	9	211.58	0.30	0.10	76.73	117.48
6551	N60W65	66	445	U6	7	196.79	0.14	0.01	51.78	124.92
6554	N60W65	67	450	U6	5	206.25	0.09	0.04	88.11	103.85
6557	N60W65	68	455	U6	6.5	122.89	0.00	0.00	45.73	44.09
6565	N62W62	50	320	P18	0	1657.84	2.40	0.28	511.09	470.52
6583	N62W62	51	325	P18	6	1519.44	1.52	0.15	606.34	858.91
6592	N62W62	52	330	P18	7	1010.66	0.91	0.06	527.08	452.22
6606	N62W62	53	335	Q5	8	1129.55	0.39	0.04	544.15	531.18
6647	N62W62	54	340	Q5	7	778.71	0.85	0.53	330.39	412.69
6690	N62W62	55	345	Q5	7	845.54	0.42	0.00	367.64	456.25
6695	N62W62	56	350	Q5	9	888.60	0.52	0.21	471.54	385.25
6716	N62W62	57	355	Q5	8.5	1266.18	1.56	0.23	452.65	635.91
6735	N62W62	58	360	Q5	8.5	703.29	0.45	0.06	362.95	307.53
6749	N62W62	59	365	R1	9	1071.66	0.58	0.14	525.41	515.79
6825	N62W62	60	370	R1	9	1993.16	0.69	0.06	542.23	1356.28
6854	N62W62	61	375	R1	1.5	266.22	0.23	0.12	114.20	122.22

Table D.1 (continued). Detailed Data for Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
6870	N62W62	62	380	Q5	6	457.93	0.08	0.05	266.25	178.26
6886	N62W62	63	385	Q5a	6	773.68	0.39	0.19	404.78	322.51
6983	N62W62	64	390	Q5a	6	689.15	0.38	0.05	363.90	245.58
7037	N62W62	65	395	T2h	12	1092.80	0.65	0.03	741.67	610.97
7095	N62W62	66	400	T2h	13	3447.99	3.36	0.07	694.62	1992.23
7135	N62W62	67	405	T10	9	2942.78	0.83	0.19	985.71	1763.85
7172	N62W62	68	410	T2g	4	691.83	0.51	0.12	249.45	362.83
7189	N62W62	69	415	T10b	7.5	1323.30	0.71	0.09	267.80	980.86
7250	N62W62	70	420	T10b	10	2661.76	1.19	0.01	500.97	1147.01
7288	N62W62	71	425	U1	10	2609.81	0.83	0.14	657.35	0.19
7314	N62W62	72	430	U1	9	4269.68	0.20	0.07	314.95	573.07
7356	N62W62	73	435	U2a	10	3166.22	0.89	0.07	765.47	1209.20
7396	N62W62	74	440	U2	3	448.35	0.20	0.04	98.57	331.88
7426	N62W62	75	445	U2a	7	1695.61	0.27	0.05	337.68	1309.90
7429	N62W62	75	445	U2	0.8	151.27	0.05	0.02	23.76	121.14
7443	N62W62	76	450	U2a	5.5	1494.68	0.11	0.01	189.89	376.67
7484	N62W62	76	455	U2a	10	1849.79	0.06	0.00	324.80	1441.69
7496	N62W62	78	460	U2c	2	353.00	0.00	0.00	94.23	250.61
944	N62W64	32	430	T1	10	637.91	0.57	0.16	129.49	345.38
965	N62W64	33	435	T1a	6	610.30	0.29	0.01	0.23	405.70
980	N62W64	34	440	T1a	6	700.78	0.48	0.02	210.46	347.71
981	N62W64	34	440	T1	13	641.50	0.25	0.08	103.57	517.61
989	N62W64	35	445	T1	14	748.86	1.46	0.13	113.98	562.24
999	N62W64	36	450	T1	14	492.20	0.17	0.07	164.15	264.29
1012	N62W64	37	455	T1	9	432.00	0.34	0.03	84.62	334.05
1022	N62W64	38	460	U	10	1717.43	1.99	0.10	280.30	1391.44
1036	N62W64	39	465	U2	8	875.75	0.32	0.04	315.73	530.13
1049	N62W64	40	470	U2	13	1266.16	0.03	0.01	213.71	1024.01
1049.1	N62W64	40	475	U2	12	119.29	0.06	0.01	299.44	860.81

Table D.2. Artifactual Data from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Shell Wt (g)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)
5176	N60W65	40	315	P2	4.5	7.58	118	6.52	275	11.74
5230	N60W65	42	325	P3e	8	19.95	70	5.06	291	13.25
5319	N60W65	44	335	P3e	6	27.91	52	4.44	357	8.51
5340	N60W65	46	345	P2	4	12.86	37	15.95	103	5.12
5512	N60W65	48	355	P14	1	0.20	0	0.00	44	3.70
5647	N60W65	50	365	Q4	0	16.64	152	12.23	377	13.22
5647.1	N60W65	50	365	Q4	0	2.18	105	5.84	262	7.02
6131	N60W65	54	385	R3	0.5	0.61	0	4.53	0	2.47
6152	N60W65	54	385	R3e	4.7	4.34	0	128.88	0	16.56
6159	N60W65	55	390	R3e	5.5	4.05		20.10	0	19.21
6192	N60W65	56	395	R3f	6	5.43		53.28	0	31.21
6212	N60W65	57	400	R3f	7.5	5.52	0	57.85		21.73
6296	N60W65	58	405	R3f	7	4.91		190.40	0	25.21
6343	N60W65	59	410	R3f	8	4.18	0	61.59	0	37.32
6360	N60W65	60	415	R3f	6	0.71		28.76		17.78
6378	N60W65	61	420	R3f	8.3	0.83	0	26.47	0	15.36
6379	N60W65	61	420	T5	7.5	0.10	0	22.61	0	7.91
6401	N60W65	62	425	T5	4	0.22	0	4.39	0	6.35
6402	N60W65	62	425	U3	8	0.19	0	22.98	0	20.32
6431	N60W65	63	430	U3	12	0.04	0	19.23	0	14.19
6465	N60W65	64	435	U3	11	0.15	0	1.68	0	21.10
6502	N60W65	65	440	U8	13	0.00	0	3.32	0	19.15
6531	N60W65	66	445	U8	9	0.00	0	5.99	0	10.85
6551	N60W65	66	445	U6	7	0.00	0	10.11	0	7.70
6554	N60W65	67	450	U6	5	0.03	0	2.82	0	11.29
6557	N60W65	68	455	U6	6.5	0.00		0.91	0	5.38
6565	N62W62	50	320	P18	0	33.72	52	3.57	291	7.28
6583	N62W62	51	325	P18	6	13.51	48	1.15	617	9.48
6592	N62W62	52	330	P18	7	12.73	40	2.39	590	11.50
6606	N62W62	53	335	Q5	8	6.42	48	30.03	474	11.49
6647	N62W62	54	340	Q5	7	4.08	65	4.55	352	24.15
6690	N62W62	55	345	Q5	7	2.38	96	9.44	376	14.40
6695	N62W62	56	350	Q5	9	3.93	218	14.79	472	17.34
6716	N62W62	57	355	Q5	8.5	8.80	408	21.97	1824	33.79
6735	N62W62	58	360	Q5	8.5	7.86	103	6.34	558	15.28
6749	N62W62	59	365	R1	9	6.68	168	105.76	398	10.55
6825	N62W62	60	370	R1	9	13.47	240	52.75	819	19.12
6854	N62W62	61	375	R1	1.5	25.10	26	0.99	95	2.41
6870	N62W62	62	380	Q5	6	4.28	35	1.61	102	1.75
6886	N62W62	63	385	Q5a	6	4.38	567	19.94	363	8.41
6983	N62W62	64	390	Q5a	6	3.16	320	18.00	471	9.80
7037	N62W62	65	395	T2h	12	6.25	878	77.65	1324	31.34

Table D.2 (continued). Artifactual Data from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Shell Wt (g)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)
7095	N62W62	66	400	T2h	13	9.99	632	75.45	2416	56.27
7135	N62W62	67	405	T10	9	10.42	360	83.36	1862	45.39
7172	N62W62	68	410	T2g	4	10.10	108	31.66	874	14.10
7189	N62W62	69	415	T10b	7.5	3.57	113	28.22	1167	17.29
7250	N62W62	70	420	T10b	10	2.26	136	11.28	1496	34.47
7288	N62W62	71	425	U1	10	1.29	140	6.18	1962	32.21
7314	N62W62	72	430	U1	9	0.37	58	2.65	972	15.98
7356	N62W62	73	435	U2a	10	0.62	243	16.97	1726	35.94
7396	N62W62	74	440	U2	3	0.02	37	0.92	446	6.89
7426	N62W62	75	445	U2a	7	0.00	29	1.27	2437	34.61
7429	N62W62	75	445	U2	0.8	0.06		0.13	979	5.54
7443	N62W62	76	450	U2a	5.5	0.05	29	0.74	4487	51.60
7484	N62W62	76	455	U2a	10	0.09	30	1.35	11525	69.96
7496	N62W62	78	460	U2c	2	0.02	1	0.01	305	3.27
944	N62W64	32	430	T1	10	0.56	131	60.63	370	21.56
965	N62W64	33	435	T1a	6	1.05	148	5.22	444	12.44
980	N62W64	34	440	T1a	6	1.25	79	5.30	129	5.38
981	N62W64	34	440	T1	13	0.07	148	14.50		24.30
989	N62W64	35	445	T1	14	0.00	70	17.50		16.01
999	N62W64	36	450	T1	14	0.01	66	11.84	177	8.44
1012	N62W64	37	455	T1	9	0.11	70	1.51	390	9.93
1022	N62W64	38	460	U	10	0.03	268	17.51	850	23.90
1036	N62W64	39	465	U2	8	0.33	89	3.49	708	19.25
1049	N62W64	40	470	U2	13	0.25	100	6.36	644	10.91
1049.1	N62W64	40	475	U2	12	0.07	213	11.74		16.14

Table D.3. Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples. Note: Acorn, acorn meat, and persimmon include 1.40mm portion; items recovered from the 1.40mm screen are given in parentheses; items recovered from the 0.71mm screen are given in brackets.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
5176	N60W65	40	315	P2	4.5	11.95	0.74	acorn	16	0.02
								chenopod	3	0.00
								hackberry	19	0.07
								hackberry - uncarbonized	13	0.12
								hackberry cf.	20	0.05
								hickory	980	11.01
								Juglandaceae nutmeat	16	0.06
								poke cf.	1	0.00
								unidentifiable	27	0.06
5230	N60W65	42	325	P3e	8	8.16	0.73	acorn	12	0.03
								hackberry	18	0.16
								hackberry - uncarbonized	6	0.08
								hackberry cf.	7	0.02
								hickory	1021	7.14
								persimmon	4	0.03
								sumac	4	0.00
								unidentifiable	12	0.07
								unidentifiable seed	6	0.00
								unidentifiable seed coat	7	0.00
5319	N60W65	44	335	P3e	6	6.03	1.70	acorn	9	0.02
								grape	1	0.00
								hackberry	7	0.04
								hackberry - uncarbonized	8	0.14
								hackberry cf.	9	0.13
								hickory	342	4.19
								unidentifiable	18	0.08
								unidentifiable seed	1	0.00
								wild legume	2	0.00
5340	N60W65	46	345	P2	4	4.64	0.59	acorn	46	0.10
								hackberry	5	0.04
								hackberry - uncarbonized	8	0.04
								hackberry cf.	1	0.00
								hazel	[1]	0.00
								hickory	285	3.90
								persimmon seed coat	1	0.00
								sumac	2	0.00
								unidentifiable	1	0.01
								unidentifiable seed	3	0.00
								unidentified seed	1	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentified seed coat	1	0.00
5512	N60W65	48	355	P14	1	0.86	0.04	acorn	10	0.01
	no light fraction							hackberry	1	0.00
								hackberry - uncarbonized	3	0.00
								hickory	70	0.81
								unidentifiable seed	1	0.00
								wild legume	2	0.00
5647	N60W65	50	365	Q4	0	0.55	0.02	acorn	12	0.02
								acorn cf.	[2]	0.00
								hackberry	29	0.11
								hackberry - uncarbonized	53	0.16
								hickory	50	0.40
								unidentifiable seed coat	1	0.00
5647.1	N60W65	50	365	Q4	0	1.28	0.04	acorn	12	0.03
	no light fraction							hackberry	5	0.03
								hackberry - uncarbonized	7	0.02
								hickory	71	1.17
								unidentifiable	2	0.01
6131	N60W65	54	385	R3	0.5	0.28	0.10	acorn	[1]	0.00
								hackberry	12	0.04
								hackberry - uncarbonized	11	0.05
								hickory	15	0.14
								thin hickory	1	0.00
								unidentifiable	8	0.00
6152	N60W65	54	385	R3e	4.7	0.82	0.25	acorn	8	0.02
								chenopod	7	0.00
								grape	2	0.00
								grape meat cf.	1	0.00
								hackberry	66	0.29
								hackberry - uncarbonized	11	0.07
								hickory	22	0.23
								thin hickory	2	0.00
								unidentifiable	50	0.03
6159	N60W65	55	390	R3e	5.5	0.97	0.31	acorn	7	0.02
								chenopod	5	0.00
								hackberry	58	0.35
								hackberry - uncarbonized	16	0.06
								hickory	21	0.23
								thin hickory	3	0.01
								unidentifiable	43	0.05
								unidentifiable seed	1	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentifiable seed coat	5	0.00
6192	N60W65	56	395	R3f	6	1.32	0.53	acorn	7	0.01
								bedstraw	3	0.00
								chenopod	2	0.00
								chenopod cf.	3	0.00
								hackberry	61	0.31
								hackberry - uncarbonized	12	0.05
								hickory	46	0.42
								unidentifiable	31	0.05
								unidentifiable seed	1	0.00
6212	N60W65	57	400	R3f	7.5	1.11	0.30	chenopod	5	0.00
								hackberry	57	0.41
								hackberry - uncarbonized	3	0.01
								hickory	36	0.28
								unidentifiable	54	0.12
6296	N60W65	58	405	R3f	7	0.61	0.16	acorn	[1]	0.00
								chenopod	7	0.00
								chenopod cf.	6	0.00
								hackberry	44	0.27
								hickory	14	0.08
								persimmon cf.	1	0.03
								sumac	1	0.00
								unidentifiable	35	0.07
6343	N60W65	59	410	R3f	8	0.54	0.26	acorn	5	0.01
								chenopod	4	0.00
								chenopod cf.	4	0.00
								hackberry	51	0.23
								hickory	3	0.01
								thin hickory	4	0.01
								unidentifiable	13	0.02
6360	N60W65	60	415	R3f	6	0.53	0.22	acorn	6	0.01
								chenopod	4	0.00
								chenopod cf.	4	0.00
								hackberry	35	0.25
								hickory	2	0.02
								unidentifiable	12	0.03
6378	N60W65	61	420	R3f	8.3	0.39	0.22	acorn	2	0.00
								chenopod	5	0.00
								chenopod cf.	4	0.00
								hackberry	22	0.11
								hickory	5	0.03

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								pine nut cf.	2	0.02
								unidentifiable	4	0.01
6379	N60W65	61	420	T5	7.5	0.42	0.39	chenopod	3	0.00
								chenopod cf.	2	0.00
								hackberry	5	0.02
								hickory	2	0.01
								poke cf.	3	0.00
								unidentifiable	3	0.00
6401	N60W65	62	425	T5	4	0.13	0.11	acorn	[1]	0.00
								chenopod	1	0.00
								chenopod cf.	8	0.00
								hackberry	2	0.01
								hickory	2	0.01
								yellow stargrass	1	0.00
								unidentifiable	2	0.00
								unidentifiable seed coat	1	0.00
6402	N60W65	62	425	U3	8	0.33	0.19	black walnut	1	0.01
								chenopod	2	0.00
								chenopod cf.	5	0.00
								hackberry	11	0.05
								hickory	8	0.07
								yellow stargrass	1	0.00
								unidentifiable	8	0.01
6431	N60W65	63	430	U3	12	0.53	0.17	acorn	4	0.01
								black walnut	11	0.16
								chenopod	3	0.00
								chenopod cf.	3	0.00
								hackberry	3	0.01
								hickory	23	0.17
								yellow stargrass	1	0.00
								unidentifiable	13	0.01
6465	N60W65	64	435	U3	11	0.49	0.30	black walnut	2	0.03
	no light fraction							hackberry - uncarbonized	2	0.01
								hickory	25	0.14
								unidentifiable	3	0.02
6502	N60W65	65	440	U8	13	0.77	0.56	chenopod	2	0.00
								hackberry - uncarbonized	2	0.01
								hickory	37	0.20
								unidentifiable	5	0.01
6531	N60W65	66	445	U8	9	0.30	0.10	acorn cf.	[1]	0.00
								acorn meat	1	0.01

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								black walnut	2	0.02
								chenopod	1	0.00
								hackberry - uncarbonized	5	0.02
								hickory	26	0.17
								unidentifiable seed coat	1	0.00
6551	N60W65	66	445	U6	7	0.14	0.01	acorn	[1]	0.00
								chenopod	1	0.00
								chenopod cf.	1	0.00
								hackberry	[1]	0.00
								hickory	16	0.13
6554	N60W65	67	450	U6	5	0.09	0.04	acorn	[2]	0.00
								chenopod	1	0.00
								chenopod cf.	2	0.00
								hickory	8	0.05
								nightshade cf.	1	0.00
								poke cf.	1	0.00
								unidentifiable	1	0.00
6557	N60W65	68	455	U6	6.5	0.00	0.00	hickory	(1)	0.00
6565	N62W62	50	320	P18	0	2.40	0.28	acorn	2	0.00
								grape	1	0.00
								hackberry	21	0.16
								hackberry - uncarbonized	23	0.43
								hickory	149	1.93
								persimmon	1	0.01
								pine cone	1	0.01
								sumac	1	0.00
								unidentifiable	7	0.01
								unidentified seed coat	8	0.00
								wild legume	1	0.00
6583	N62W62	51	325	P18	6	1.52	0.15	acorn	10	0.01
								hackberry	20	0.14
								hackberry - uncarbonized	74	0.51
								hackberry cf.	2	0.00
								hazel	1	0.00
								hickory	113	1.20
								unidentifiable	5	0.02
								unidentifiable seed coat	1	0.00
6592	N62W62	52	330	P18	7	0.91	0.06	acorn	1	0.00
								acorn meat	3	0.02
								Fagaceae shell	(1)	0.00
								hackberry	19	0.15

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								hackberry - uncarbonized	37	0.25
								hickory	70	0.46
								Juglans nutmeat	14	0.21
								unidentifiable	3	0.01
6606	N62W62	53	335	Q5	8	0.39	0.04	acorn	[7]	0.00
								black walnut	3	0.03
								chenopod cf.	1	0.00
								hackberry	12	0.13
								hackberry - uncarbonized	63	0.36
								hickory	28	0.18
								persimmon	1	0.00
								pitch	1	0.01
								unidentifiable seed coat	1	0.00
								unidentifiable	2	0.00
								wild legume	3	0.00
6647	N62W62	54	340	Q5	7	0.85	0.53	acorn	[1]	0.00
								acorn meat	7	0.01
								cheno-am	1	0.00
								hackberry	17	0.08
								hackberry - uncarbonized	45	0.26
								hickory	24	0.21
								unidentifiable	2	0.02
								unidentifiable seed coat	3	0.00
6690	N62W62	55	345	Q5	7	0.42	0.00	acorn	[5]	0.00
								hackberry	14	0.05
								hackberry - uncarbonized	48	0.22
								hackberry cf.	4	0.03
								hickory	7	0.05
								unidentifiable	1	0.00
6695	N62W62	56	350	Q5	9	0.52	0.21	acorn	4	0.01
								acorn meat	4	0.02
								grape	5	0.00
								hackberry	44	0.19
								hackberry - uncarbonized	91	0.32
								hickory	6	0.07
								pitch	1	0.01
								yellow stargrass - uncarbonized	1	0.00
								thin hickory	2	0.01
								unidentifiable seed coat	7	0.00
								unidentifiable seed	1	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentified seed	1	0.00
6716	N62W62	57	355	Q5	8.5	1.56	0.23	acorn	9	0.01
								black walnut	10	0.13
								black walnut cf.	2	0.03
								cheno-am	4	0.00
								chenopod	10	0.00
								grape	3	0.00
								hackberry	63	0.35
								hackberry - uncarbonized	82	0.37
								hackberry cf.	1	0.00
								hickory	131	0.76
								pitch	2	0.00
								unidentifiable seed coat	22	0.00
								unidentifiable	29	0.04
6735	N62W62	58	360	Q5	8.5	0.45	0.06	acorn	14	0.01
								acorn cf.	[1]	0.00
								acorn meat	7	0.06
								chenopod	1	0.00
								hackberry	27	0.11
								hackberry - uncarbonized	39	0.18
								hickory	24	0.13
								Juglandaceae nutmeat	6	0.05
								pitch	5	0.02
								sumac cf.	1	0.00
								unidentifiable	30	0.01
								unidentifiable seed coat	1	0.00
6749	N62W62	59	365	R1	9	0.58	0.14	acorn	[14]	0.01
								acorn cf.	2	0.00
								chenopod - uncarbonized	1	0.00
								chenopod cf.	2	0.00
								hackberry	89	0.42
								hackberry - uncarbonized	83	0.32
								hackberry cf.	8	0.04
								hickory	3	0.01
								yellow stargrass - uncarbonized	1	0.00
								thin hickory	2	0.00
								unidentifiable	10	0.00
								unidentifiable - burnt food?	4	0.00
								unidentifiable seed coat	11	0.00
6825	N62W62	60	370	R1	9	0.69	0.06	acorn	1	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								acorn meat	5	0.03
								chenopod	3	0.00
								chenopod cf.	2	0.00
								grape - uncarbonized	1	0.01
								hackberry	93	0.49
								hackberry - uncarbonized	82	0.31
								hackberry cf.	18	0.09
								hickory	11	0.04
								pitch	9	0.07
								thin hickory	(2)	0.00
								unidentifiable	1	0.00
6854	N62W62	61	375	R1	1.5	0.23	0.12	acorn	1	0.00
								chenopod cf.	1	0.00
								hackberry	20	0.10
								hackberry - uncarbonized	19	0.15
								hickory	1	0.01
								unidentifiable	1	0.00
6870	N62W62	62	380	Q5	6	0.08	0.05	acorn	4	0.01
								acorn meat	1	0.00
								chenopod cf.	1	0.00
								hackberry	6	0.02
								hackberry - uncarbonized	2	0.02
								hickory	(1)	0.00
								unidentifiable	1	0.00
								unidentifiable seed coat	10	0.00
6886	N62W62	63	385	Q5a	6	0.39	0.19	acorn	6	0.00
								Fagaceae shell	10	0.00
								hackberry	47	0.20
								hackberry - uncarbonized	25	0.21
								hackberry cf.	1	0.00
								hickory	(4)	0.00
								pitch	1	0.00
								unidentifiable	12	0.00
6983	N62W62	64	390	Q5a	6	0.38	0.05	acorn	1	0.00
								chenopod cf.	4	0.00
								hackberry	64	0.31
								hackberry - uncarbonized	49	0.23
								hackberry cf.	1	0.01
								hickory	(2)	0.00
								pine cone	2	0.01
								poke	3	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								poke cf. - uncarbonized	1	0.00
								unidentifiable	25	0.01
								unidentifiable seed coat	19	0.00
								unidentifiable seed	2	0.00
7037	N62W62	65	395	T2h	12	0.65	0.03	acorn	3	0.00
								cheno-am	1	0.00
								chenopod	5	0.00
								hackberry	119	0.57
								hackberry - uncarbonized	107	0.43
								hackberry cf.	9	0.06
								hickory	6	0.04
								pitch	3	0.00
								purslane	1	0.00
								unidentifiable	18	0.01
								unidentifiable seed coat	14	0.00
								unidentifiable seed	2	0.01
7095	N62W62	66	400	T2h	13	3.36	0.07	acorn	[3]	0.00
								cheno-am	1	0.00
								chenopod	1	0.00
								hackberry	222	3.26
								hackberry - uncarbonized	112	0.51
								hackberry cf.	14	0.07
								hickory	(5)	0.01
								pitch	4	0.02
								unidentifiable	3	0.00
								unidentifiable seed coat	3	0.00
7135	N62W62	67	405	T10	9	0.83	0.19	acorn	[5]	0.00
								chenopod	17	0.00
								chenopod cf.	15	0.00
								hackberry	131	0.60
								hackberry - uncarbonized	33	0.14
								hackberry cf.	11	0.05
								hickory	4	0.02
								Juglandaceae nutmeat	3	0.02
								smartweed	2	0.00
								thin hickory	1	0.00
								unidentifiable	27	0.00
								unidentifiable seed coat	8	0.00
7172	N62W62	68	410	T2g	4	0.51	0.12	acorn	4	0.00
								hackberry	52	0.29
								hackberry - uncarbonized	15	0.07

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								hackberry cf.	3	0.01
								hazel	5	0.02
								hickory	6	0.04
								Juglandaceae nutmeat	5	0.04
								unidentifiable	4	0.00
7189	N62W62	69	415	T10b	7.5	0.71	0.09	acorn	[1]	0.00
								bedstraw	1	0.00
								chenopod	1	0.00
								hackberry	90	0.56
								hackberry - uncarbonized	8	0.05
								hackberry cf.	16	0.06
								hazel	4	0.01
								hickory	9	0.03
								pitch	3	0.01
								unidentifiable	8	0.01
								unidentifiable seed coat	2	0.00
								unidentified seed	2	0.00
7250	N62W62	70	420	T10b	10	1.19	0.01	acorn	[4]	0.00
								hackberry	140	0.94
								hackberry - uncarbonized	25	0.19
								hackberry cf.	49	0.16
								hazel	(8)	0.02
								hickory	8	0.10
								pitch	1	0.00
								Juglandaceae nutmeat	29	0.06
								unidentifiable	26	0.06
								unidentified seed	3	0.00
								unidentifiable seed	1	0.00
								unidentifiable seed coat	1	0.00
7288	N62W62	71	425	U1	10	0.83	0.14	chenopod	1	0.00
								grape	1	0.00
								hackberry	48	0.40
								hackberry - uncarbonized	18	0.12
								hackberry cf.	32	0.11
								hazel	17	0.13
								hickory	19	0.16
								pitch	1	0.00
								unidentifiable	6	0.00
								unidentifiable seed coat	1	0.00
								unidentified seed	1	0.00
7314	N62W62	72	430	U1	9	0.20	0.07	acorn	6	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
	*hole in bag - slight loss of materials							acorn meat	[1]	0.00
								acorn meat cf.	1	0.00
								chenopod	1	0.00
								hackberry	8	0.03
								hackberry - uncarbonized	8	0.02
								hackberry cf.	7	0.02
								hazel	1	0.00
								hickory	4	0.04
								pitch	7	0.05
								unidentifiable	8	0.01
								unidentifiable seed	1	0.00
								unidentifiable seed coat	6	0.00
								unidentified seed	1	0.00
7356	N62W62	73	435	U2a	10	0.89	0.07	acorn	8	0.00
								black walnut	1	0.02
								chenopod	2	0.00
								hackberry	56	0.38
								hackberry - uncarbonized	6	0.04
								hackberry cf.	2	0.01
								hazel	(1)	0.00
								hickory	29	0.34
								pitch	8	0.05
								unidentifiable	11	0.02
								unidentifiable seed	4	0.00
								unidentifiable seed coat	6	0.00
								unidentified seed	2	0.01
7396	N62W62	74	440	U2	3	0.20	0.04	black walnut	2	0.02
								chenopod - uncarbonized	1	0.00
								hackberry	6	0.02
								hazel cf.	1	0.00
								hickory	16	0.11
								pitch	3	0.01
								unidentifiable seed coat	7	0.00
7426	N62W62	75	445	U2a	7	0.27	0.05	black walnut	2	0.15
								chenopod	2	0.00
								chenopod cf.	15	0.00
								hackberry	3	0.02
								hackberry - uncarbonized	1	0.00
								hackberry cf.	1	0.00
								hickory	6	0.05
								pitch	(1)	0.00

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentifiable	1	0.00
								unidentifiable seed coat	3	0.00
								wild legume	1	0.00
7429	N62W62	75	445	U2	0.8	0.05	0.02	black walnut	1	0.01
								chenopod	1	0.00
								chenopod cf.	1	0.00
								hackberry - uncarbonized	1	0.00
								hickory	3	0.02
7443	N62W62	76	450	U2a	5.5	0.11	0.01	black walnut	2	0.05
								chenopod	4	0.00
								chenopod cf.	8	0.00
								hackberry	2	0.01
								hackberry - uncarbonized	1	0.07
								hackberry cf.	1	0.00
								hickory	6	0.04
								unidentifiable	1	0.00
								unidentifiable seed	1	0.00
7484	N62W62	76	455	U2a	10	0.06	0.00	black walnut	1	0.01
								chenopod cf.	10	0.00
								hackberry	2	0.01
								hackberry - uncarbonized	6	0.02
								hackberry cf.	3	0.01
								hickory	7	0.04
								purslane - uncarbonized	1	0.00
7496	N62W62	78	460	U2c	2	0.00	0.00	hickory	[3]	0.00
								unidentifiable	2	0.00
								unidentifiable seed coat	1	0.00
944	N62W64	32	430	T1	10	0.57	0.16	black walnut	1	0.03
								chenopod	5	0.00
								grape cf.	1	0.01
								hackberry	69	0.25
								hickory	10	0.05
								thin hickory cf.	(1)	0.00
								unidentifiable	17	0.04
								unidentifiable - starchy	1	0.03
								unidentifiable seed	2	0.00
								unidentifiable seed coat	1	0.00
965	N62W64	33	435	T1a	6	0.29	0.01	acorn cf.	[1]	0.00
								hackberry	290	0.26
								hickory	(8)	0.00
								pitch	3	0.02

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								thin hickory	(1)	0.00
								unidentifiable seed coat	15	0.00
980	N62W64	34	440	T1a	6	0.48	0.02	hackberry	116	0.36
								hickory	(2)	0.00
								unidentifiable	20	0.10
								unidentifiable seed coat	2	0.00
981	N62W64	34	440	T1	13	0.25	0.08	black walnut	1	0.01
								hackberry	44	0.05
								hackberry - uncarbonized	4	0.02
								hickory	11	0.06
								pitch	4	0.04
								poke cf.	12	0.00
								unidentifiable	4	0.01
								unidentifiable seed coat	5	0.00
989	N62W64	35	445	T1	14	1.46	0.13	acorn	1	0.00
	not all of HF scanned							hazel	1	0.01
								hickory	107	1.32
								unidentifiable	1	0.00
999	N62W64	36	450	T1	14	0.17	0.07	hickory	15	0.10
								thin hickory	(2)	0.00
								purslane cf.	1	0.00
								unidentifiable seed coat	3	0.00
								unidentified	2	0.00
1012	N62W64	37	455	T1	9	0.34	0.03	bark/pine cone	4	0.00
								hackberry	10	0.01
								hickory	37	0.28
								pitch	1	0.01
								poke cf.	7	0.00
								unidentfiable	4	0.01
								unidentifiable seed	1	0.00
1022	N62W64	38	460	U	10	1.99	0.10	black walnut	39	0.93
								hackberry	12	0.01
								hickory	93	0.92
								pitch	3	0.03
								yellow stargrass	1	0.00
								unidentifiable	1	0.00
								unidentifiable seed coat	40	0.00
1036	N62W64	39	465	U2	8	0.32	0.04	acorn	1	0.00
								Fagaceae shell	(1)	0.00
								hackberry	152	0.23
								hickory	4	0.02

Table D.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Column Samples.

Bag Number	Unit	Level	Depth (cm)	Zone	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								pitch	1	0.03
								unidentifiable seed coat	3	0.00
1049	N62W64	40	470	U2	13	0.03	0.01	hackberry	3	0.00
								hackberry - uncarbonized	9	0.02
								hickory	4	0.02
								pitch	(1)	0.00
								poke cf.	9	0.00
								unidentifiable seed coat	2	0.00
1049.1	N62W64	40	475	U2	12	0.06	0.01	chenopod	1	0.00
								hackberry	6	0.01
								hackberry - uncarbonized	4	0.00
								hackberry cf.	10	0.00
								hickory	4	0.03
								pitch	2	0.01
								unidentifiable seed coat	5	0.00

APPENDIX E

Table E.1. Detailed Data for Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
293	N62W64	32		37	0.8	159.88	0.03	0.01	93.97	54.57
1001	N62W64	37		99	1	280.40	0.31	0.06	53.29	220.65
1509	N60W64	42	375	111	16	2384.26	1.60	0.25	867.37	1335.40
1702	N63W64	38	355	114	14	991.09	7.04	3.59	384.56	521.71
1751	N59W64	51	420	115	3.5	328.30	0.67	0.21	144.85	171.88
1761	N60W64	50		116	1	111.95	0.28	0.22	57.56	38.65
1900	N60W64	58		118	2	137.37	0.52	0.01	33.25	85.52
4395	N60W68	53	380	330	3.5	273.31	1.12	0.83	39.71	77.03
5209	N61W65	48	355	350	6	795.47	11.06	0.69	123.74	627.24
5444	N63W66	45	340	358	3	386.73	6.07	1.08	144.96	166.19
5469	N62W65	52	375	360	1	346.54	0.35	0.09	50.93	64.84
5630	N60W66	44	335	368	4.5	619.84	8.55	4.77	278.02	284.83
5649	N60W65	50	365	363a	3.5	468.38	4.28	0.93	90.13	357.70
5700	N60W66	45	340	375	4.5	556.36	14.81	2.93	302.78	248.34
5706	N63W65	56	385	377		557.95	1.92	0.99	69.83	424.77
5732	N63W65	57	395	380	2	170.61	0.51	0.14	39.78	103.63
5747	N62W65	56	390	382	5	866.77	0.41	0.21	37.94	691.16
5790	N62W66	57	395	384	1	403.81	0.27	0.06	31.25	211.54
5826	N62W65	61	415	387	3	404.46	3.47	3.42	21.86	364.60
5967	N63W66	47	350	389	2	755.55	1.23	0.14	101.18	519.83
6082	N60W66	52	375	397	4	9.19	0.04	0.02	4.34	4.49
6099	N60W65	53	380	402	1	407.49	2.10	0.81	106.83	236.23
6111	N60W66	53	380	405	1.5	408.43	3.12	0.36	74.75	226.19
6118	N60W65	53	380	406	3	480.88	1.91	0.48	152.11	184.66
6129	N60W65	53	380	410	1.5	454.20	0.58	0.18	65.81	337.59
6144	N60W66	55	390	413	4.5	594.93	1.18	0.25	234.81	281.23
6144.1	N60W66	55	390	413	1.3	192.38	1.50	0.26	92.98	75.87
6283	N60W66	58	405	420	2.5	279.17	0.26	0.18	30.43	206.53
6308	N60W66	59	410	423	7	1260.59	0.80	0.26	169.82	1014.45
6308.1	N60W65	59	410	423	3	49.28	0.07	0.03	8.55	22.76
6326	N60W65	59	410	117	8	1242.91	0.94	0.25	684.89	458.66
6493	N60W66	66	445	438	4	49.04	0.11	0.04	16.08	25.39
6572	N62W62	50	320	444	1.5	306.46	1.65	1.32	115.90	184.91
6600	N62W62	52	330	448	1	109.15	0.23	0.06	52.25	55.77
6622	N62W62	53	335	450	8	1795.49	3.36	0.40	562.88	1150.29
6652	N60W62	49	315	451	8	1183.33	8.57	5.70	560.95	562.97
6874	N61W62	53	375	458		393.82	0.15	0.11	61.74	296.88
6875	N60W62	59	365	459	13.5	2323.02	1.39	0.73	249.43	1022.64

Table E.1 (continued). Detailed Data for Dust Cave Paleoethnobotanical Feature Samples.

Table E.1 (continued). Detailed Data for Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Sample Wt (g)	Plant Wt (g)	Wood Wt (g)	Residue Wt (g)	Contaminant Wt (g)
6943	N62W62	64	390	462	4	697.21	2.72	1.97	426.66	242.22
6972	N60W62	65	395	467	1	167.84	0.03	0.01	68.67	80.97
7068	N62W62	66	400	473	8	1232.65	0.75	0.23	495.04	613.92
7076	N62W62	66	400	474	4	628.75	0.47	0.13	268.87	318.63
7438	N61W62	66	445	486	2	585.41	0.21	negligible	114.09	455.85
5898	N60W66	66	440	386		221.04	1.01	0.12	72.58	180.87

Table E.2. Artifactual Data from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)	Shell Wt (g)
293	N62W64	32		37	0.8	20	0.74	167	4.31	0.04
1001	N62W64	37		99	1	14	0.60	141	4.11	0.02
1509	N60W64	42	375	111	16	420	49.07	1469	41.51	76.20
1702	N63W64	38	355	114	14	215	12.56	1162	28.40	33.91
1751	N59W64	51	420	115	3.5	92	2.45	283	7.09	0.76
1761	N60W64	50		116	1	28	8.84	83	2.32	1.34
1900	N60W64	58		118	2	63	3.87	127	3.99	0.02
4395	N60W68	53	380	330	3.5	115	7.45	359	11.01	136.74
5209	N61W65	48	355	350	6	72	3.14	595	11.78	18.71
5444	N63W66	45	340	358	3	39	19.87	248	9.26	39.43
5469	N62W65	52	375	360	1	116	6.62	693	18.10	3.03
5630	N60W66	44	335	368	4.5	38	17.48	416	14.98	13.30
5649	N60W65	50	365	363a	3.5	43	4.07	161	4.79	6.99
5700	N60W66	45	340	375	4.5	49	10.78	303	8.71	14.39
5706	N63W65	56	385	377		220	31.04	1104	26.24	2.15
5732	N63W65	57	395	380	2	151	17.19	488	7.00	2.17
5747	N62W65	56	390	382	5	103	109.23	540	25.14	2.72
5790	N62W66	57	395	384	1	124	149.46	356	10.51	0.55
5826	N62W65	61	415	387	3	67	8.32	229	6.05	0.07
5967	N63W66	47	350	389	2	58	7.24	403	9.69	29.72
6082	N60W66	52	375	397	4	2	0.00	22	0.29	0.01
6099	N60W65	53	380	402	1	59	17.67	326	24.49	17.55
6111	N60W66	53	380	405	1.5		69.34		23.61	10.43
6118	N60W65	53	380	406	3		76.71		17.22	48.04
6129	N60W65	53	380	410	1.5	114	18.70	394	14.56	15.82
6144	N60W66	55	390	413	4.5	471	42.89	878	24.99	9.34
6144.1	N60W66	55	390	413	1.3		11.67		8.37	1.58
6283	N60W66	58	405	420	2.5	130	31.33	300	10.14	0.42
6308	N60W66	59	410	423	7	59	52.12	1084	29.39	6.87
6308.1	N60W65	59	410	423	3	7	0.22	14	0.30	0.01
6326	N60W65	59	410	117	8	225	25.44	1365	29.57	2.21
6493	N60W66	66	445	438	4	23	2.92	169	4.53	0.00
6572	N62W62	50	320	444	1.5	12	0.31	50	0.85	1.58
6600	N62W62	52	330	448	1	0	0.00	20	0.51	0.09
6622	N62W62	53	335	450	8	127	21.27	997	22.83	27.70
6652	N60W62	49	315	451	8	58	11.80	218	7.58	25.26
6874	N61W62	53	375	458		24	23.27	317	7.10	4.34
6875	N60W62	59	365	459	13.5	312	56.72	2090	100.34	889.08
6943	N62W62	64	390	462	4	126	6.83	519	10.25	1.94
6972	N60W62	65	395	467	1	32	10.69	123	6.50	0.47
7068	N62W62	66	400	473	8	293	53.74	740	21.85	8.82
7076	N62W62	66	400	474	4	131	19.78	317	13.68	0.79

Table E.2 (continued). Artifactual Data from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Lithic Count	Lithic Wt (g)	Bone Count	Bone Wt (g)	Shell Wt (g)
7438	N61W62	66	445	486	2	45	1.61	306	9.04	0.02
5898	N60W66	66	440	386		34	8.32	290	9.65	9.68

Table E.3. Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples. Note: Acorn, acorn meat, and persimmon include 1.40mm portion; items recovered from the 1.40mm screen are given in parentheses; items recovered from the 0.71mm screen are given in brackets.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
293	N62W64	32		37	0.8	0.03	0.01	chenopod	1	0.00
								grape cf.	14	0.00
								hackberry	8	0.01
								hickory	(26)	0.01
								pitch	(8)	0.00
								unidentifiable seed coat	6	0.00
								unidentified	(1)	0.00
1001	N62W64	37		99	1	0.31	0.06	acorn	8	0.00
								chenopod	1	0.00
								hackberry	5	0.03
								hickory	22	0.20
								pitch	1	0.02
								poke cf.	1	0.00
								unidentifiable seed coat	2	0.00
1509	N60W64	42	375	111	16	1.60	0.25	acorn	15	0.04
								acorn cf.	1	0.00
								ash	4	0.02
								black walnut	(1)	0.01
								gall/pitch	1	0.01
								hackberry	59	0.36
								hackberry - uncarbonized	79	0.36
								hackberry cf.	10	0.03
								hickory	142	0.88
								pine cone	1	0.00
								pitch	5	0.05
								unidentifiable	3	0.01
								unidentifiable seed	3	0.00
								unidentifiable seed coat	5	0.00
1702	N63W64	38	355	114	14	7.04	3.59	acorn	44	0.09
								hackberry	37	0.15
								hackberry - uncarbonized	11	0.03
								hackberry cf.	4	0.01
								hickory	352	3.04
								persimmon	2	0.01
								pine cone	1	0.00
								pitch	13	0.11
								thin hickory	(1)	0.00
								unidentifiable	14	0.05
								wild legume	1	0.00
1751	N59W64	51	420	115	3.5	0.67	0.21	acorn	12	0.03

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								chenopod cf.	1	0.00
								hackberry	44	0.29
								hackberry - uncarbonized	4	0.02
								hickory	3	0.02
								pitch	7	0.10
								unidentifiable	3	0.00
								unidentifiable - burnt food?	2	0.02
								unidentifiable seed coat	6	0.00
1761	N60W64	50		116	1	0.28	0.22	acorn	5	0.00
								hackberry	36	0.03
								hickory	4	0.03
								pitch	1	0.00
								unidentified seed coat	1	0.00
1900	N60W64	58		118	2	0.52	0.01	black gum cf.	(1)	0.00
								black walnut	5	0.14
								hickory	39	0.37
								pitch	(22)	0.00
								unidentifiable seed coat	15	0.00
4395	N60W68	53	380	330	3.5	1.12	0.83	acorn	2	0.00
								acorn cf.	1	0.00
								gall	2	0.00
								hackberry	10	0.04
								hickory	24	0.22
								persimmon	1	0.01
								thin hickory	(5)	0.01
								unidentifiable	4	0.01
								unidentifiable seed coat	1	0.00
5209	N61W65	48	355	350	6	11.06	0.69	acorn	505	1.08
								acorn cf.	1	0.00
								acorn meat	9	0.04
								ash	6	0.04
								hackberry	20	0.10
								hackberry - uncarbonized	16	0.05
								hackberry cf.	1	0.01
								hazel	1	0.00
								hickory	716	8.99
								persimmon	16	0.04
								pitch	1	0.00
								sumac	2	0.00
								unidentifiable	11	0.11

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentifiable - burnt food?	6	0.01
								unidentifiable seed	1	0.00
								unidentifiable seed coat	4	0.00
								wild legume	8	0.00
5444	N63W66	45	340	358	3	6.07	1.08	acorn	3	0.00
								chenopod cf.	1	0.00
								hackberry	9	0.06
								hackberry - uncarbonized	2	0.01
								hickory	390	4.89
								unidentifiable	9	0.04
								unidentifiable seed	1	0.00
5469	N62W65	52	375	360	1	0.35	0.09	acorn	2	0.01
								grape	1	0.00
								hackberry	23	0.10
								hackberry - uncarbonized	3	0.02
								hackberry cf.	1	0.00
								hazel cf.	1	0.00
								hickory	17	0.13
								pitch	1	0.01
								thin hickory	1	0.01
								unidentifiable	7	0.00
5630	N60W66	44	335	368	4.5	8.55	4.77	acorn	16	0.07
								acorn meat	13	0.08
								ash	9	0.08
								hackberry	18	0.17
								hackberry - uncarbonized	12	0.14
								hackberry cf.	3	0.01
								hazel	[1]	0.00
								hickory	250	3.31
								pitch	4	0.03
								unidentifiable	14	0.12
								unidentifiable seed	1	0.00
								unidentifiable seed coat	6	0.00
5649	N60W65	50	365	363a	3.5	4.28	0.93	acorn	1063	1.89
								ash	3	0.02
								hackberry	8	0.07
								hackberry - uncarbonized	9	0.06
								hickory	172	1.34
								pitch	2	0.01
								sumac	2	0.00

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								unidentifiable	9	0.04
								unidentifiable - burnt food?	2	0.00
								wild legume	1	0.00
5700	N60W66	45	340	375	4.5	14.81	2.93	acorn	59	0.14
								acorn meat	1	0.04
								bedstraw	1	0.00
								black walnut	5	0.23
								chenopod cf.	2	0.00
								hackberry	19	0.12
								hackberry - uncarbonized	33	0.27
								hackberry cf.	3	0.02
								hickory	932	11.09
								persimmon	8	0.04
								pitch	6	0.03
								unidentifiable	22	0.15
								unidentifiable - burnt food?	5	0.04
								unidentifiable seed coat	3	0.00
5706	N63W65	56	385	377		1.92	0.99	acorn	109	0.20
								black walnut	7	0.19
								gall	2	0.00
								hackberry	35	0.19
								hickory	33	0.23
								Juglandaceae	1	0.00
								persimmon	5	0.01
								pitch	3	0.01
								thin hickory	3	0.01
								unidentifiable	11	0.03
								unidentifiable - burnt food?	12	0.06
5732	N63W65	57	395	380	2	0.51	0.14	acorn	1	0.00
								acorn meat	8	0.07
								bark	1	0.01
								hackberry	34	0.22
								hackberry - uncarbonized	1	0.01
								hickory	9	0.05
								pitch	1	0.01
								thin hickory	(1)	0.00
								unidentifiable	2	0.01
								unidentifiable seed	1	0.00
5747	N62W65	56	390	382	5	0.41	0.21	acorn	[3]	0.00

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								acorn cf.	4	0.00
								hackberry	11	0.05
								hickory	18	0.14
								thin hickory	(3)	0.00
								unidentifiable	2	0.00
								unidentifiable - burnt food?	11	0.01
5790	N62W66	57	395	384	1	0.27	0.06	acorn	2	0.00
								hackberry	12	0.07
								hackberry - uncarbonized	1	0.00
								hickory	17	0.13
								pitch	(3)	0.01
								unidentifiable	(2)	0.00
5826	N62W65	61	415	387	3	3.47	3.42	acorn	[1]	0.00
								bedstraw	1	0.00
								gall	4	0.01
								hackberry	[2]	0.00
								hackberry - uncarbonized	[1]	0.00
								hickory	(8)	0.02
								persimmon	7	0.01
								unidentifiable	(1)	0.00
								unidentifiable - burnt food?	13	0.02
5967	N63W66	47	350	389	2	1.23	0.14	acorn	48	0.09
								hackberry	24	0.20
								hackberry - uncarbonized	4	0.02
								hackberry cf.	2	0.01
								hazel	1	0.00
								hickory	107	0.73
								persimmon	3	0.02
								pitch	(1)	0.00
								poke	1	0.00
								unidentifiable	9	0.03
								unidentifiable - burnt food?	2	0.02
								unidentifiable seed	1	0.00
								unidentifiable seed coat	2	0.00
								wild legume	11	0.02
6082	N60W66	52	375	397	4	0.04	0.02	acorn	[6]	0.00
								black walnut	(1)	0.00
								hackberry	[5]	0.01
								hackberry - uncarbonized	[1]	0.00

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								hickory	2	0.01
								unidentifiable	[1]	0.00
6099	N60W65 no light fraction	53	380	402	1	2.10	0.81	acorn	[2]	0.00
								black walnut	7	0.22
								hackberry	14	0.07
								hackberry - uncarbonized	14	0.07
								hackberry cf.	1	0.00
								hickory	109	1.00
								unidentifiable seed coat	3	0.00
6111	N60W66	53	380	405	1.5	3.12	0.36	black walnut	51	0.72
								hackberry	25	0.10
								hackberry - uncarbonized	10	0.05
								hickory	225	1.85
								persimmon fruit	7	0.08
								unidentifiable	3	0.01
6118	N60W65	53	380	406	3	1.91	0.48	black walnut	6	0.32
								hackberry	24	0.09
								hackberry - uncarbonized	16	0.10
								hickory	96	1.00
								unidentifiable	3	0.02
								unidentifiable seed coat	1	0.00
6129	N60W65	53	380	410	1.5	0.58	0.18	acorn	[2]	0.00
								black walnut cf.	(1)	0.01
								chenopod	1	0.00
								hackberry	34	0.15
								hackberry - uncarbonized	15	0.04
								hickory	33	0.17
								pine cone	1	0.01
								pitch	[5]	0.00
								pitch/pine cone	1	0.01
								thin hickory	5	0.03
								unidentifiable	4	0.02
6144	N60W66	55	390	413	4.5	1.18	0.25	acorn	[1]	0.00
								acorn cf.	1	0.00
								ash	5	0.05
								hackberry	86	0.35
								hackberry - uncarbonized	33	0.12
								hickory	83	0.54
								persimmon	1	0.00
								pitch	3	0.02

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								sumac	1	0.00
								unidentifiable	12	0.01
								unidentifiable - burnt food?	2	0.02
								unidentifiable seed coat	1	0.00
6144.1	N60W66	55	390	413	1.3	1.50	0.26	black walnut	3	0.29
								hackberry	16	0.07
								hackberry - uncarbonized	17	0.06
								hickory	90	0.87
								unidentifiable	4	0.01
6283	N60W66	58	405	420	2.5	0.26	0.18	acorn	2	0.00
								bedstraw	1	0.00
								chenopod	1	0.00
								hackberry	3	0.01
								hickory	4	0.04
								pitch	3	0.02
								unidentifiable	8	0.01
								unidentifiable seed coat	5	0.00
6308	N60W66	59	410	423	7	0.80	0.26	acorn	[7]	0.01
								chenopod	4	0.00
								chenopod cf.	6	0.00
								hackberry	44	0.24
								hackberry - uncarbonized	1	0.01
								hickory	31	0.26
								pitch	5	0.03
								unidentifiable seed coat	18	0.00
6308.1	N60W65	59	410	423	3	0.07	0.03	acorn	[1]	0.00
								chenopod	1	0.00
								chenopod cf.	5	0.00
								hackberry	[6]	0.01
								hackberry - uncarbonized	[1]	0.00
								hickory	(6)	0.02
								pitch	(2)	0.01
								unidentifiable	[2]	0.00
								unidentifiable seed coat	5	0.00
6326	N60W65	59	410	117	8	0.94	0.25	acorn	1	0.00
								ash	4	0.03
								chenopod	1	0.00
								chenopod cf.	3	0.00
								hackberry	64	0.32
								hackberry - uncarbonized	4	0.02

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								hackberry cf.	1	0.01
								hickory	(28)	0.06
								hickory cf.	(1)	0.00
								pitch	25	0.29
								unidentifiable - burnt food?	2	0.02
								unidentifiable seed	1	0.00
								unidentifiable seed coat	30	0.00
6493	N60W66	66	445	438	4	0.11	0.04	hackberry - uncarbonized	3	0.02
								hickory	9	0.07
								thin hickory	[1]	0.00
6572	N62W62	50	320	444	1.5	1.65	1.32	acorn	1	0.00
								hackberry - uncarbonized	1	0.00
								hickory	33	0.33
								unidentifiable	1	0.00
6600	N62W62	52	330	448	1	0.23	0.06	acorn	1	0.01
								hackberry	5	0.04
								hackberry - uncarbonized	2	0.01
								hickory	7	0.07
								persimmon	11	0.05
								unidentifiable seed	1	0.00
6622	N62W62	53	335	450	8	3.36	0.40	acorn	2	0.01
								ash	13	0.14
								black walnut	1	0.02
								hackberry	22	0.14
								hackberry - uncarbonized	35	0.24
								hackberry cf.	1	0.01
								hickory	242	2.78
								unidentifiable	1	0.01
								unidentifiable seed coat	1	0.00
6652	N60W62	49	315	451	8	8.57	5.70	acorn	4	0.01
								acorn meat	5	0.02
								chenopod	2	0.00
								hackberry	11	0.08
								hackberry - uncarbonized	63	0.39
								hackberry cf.	3	0.02
								hickory	211	2.72
								unidentifiable	6	0.04
								unidentifiable seed	1	0.00
								unidentifiable seed coat	1	0.00
								unidentified seed	1	0.00

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
6874	N61W62	53	375	458		0.15	0.11	acorn	1	0.00
								hackberry	8	0.03
								hackberry - uncarbonized	18	0.10
								hickory	(3)	0.01
6875	N60W62	59	365	459	13.5	1.39	0.73	acorn	6	0.01
								black walnut	(1)	0.01
								black walnut cf.	1	0.01
								grape	1	0.00
								hackberry	36	0.15
								hackberry - uncarbonized	111	0.55
								hickory	75	0.46
								persimmon	4	0.01
								unidentifiable	2	0.01
								unidentifiable seed coat	1	0.00
6943	N62W62	64	390	462	4	2.72	1.97	acorn	226	0.45
								acorn cf.	1	0.00
								chenopod	1	0.00
								hackberry	36	0.24
								hackberry - uncarbonized	30	0.10
								hackberry cf.	1	0.01
								hickory	4	0.03
								pitch	1	0.01
								unidentifiable	2	0.00
								unidentifiable - burnt food?	3	0.02
								unidentifiable seed coat	4	0.00
6972	N60W62	65	395	467	1	0.03	0.01	acorn	[1]	0.00
								hackberry	3	0.01
								hackberry - uncarbonized	5	0.03
								hickory	(1)	0.00
								pitch	6	0.01
								poke	2	0.00
								unidentifiable	1	0.00
								unidentifiable seed coat	9	0.00
7068	N62W62	66	400	473	8	0.75	0.23	acorn	6	0.01
								cheno-am	1	0.00
								chenopod	5	0.00
								hackberry	69	0.37
								hackberry - uncarbonized	17	0.07
								hackberry cf.	3	0.01
								hickory	13	0.12

Table E.3 (continued). Plant Materials Recovered from Dust Cave Paleoethnobotanical Feature Samples.

Bag Number	Unit	Level	Depth	Feature	Volume (L)	Plant Wt (g)	Wood Wt (g)	Common Name	Count	Weight (g)
								yellow stargrass	1	0.00
								unidentifiable	8	0.02
								unidentifiable seed	1	0.00
								unidentifiable seed coat	115	0.02
7076	N62W62	66	400	474	4	0.47	0.13	acorn	2	0.00
								cheno-am	1	0.00
								cheno-am – uncarbonized	2	0.00
								chenopod	9	0.00
								chenopod cf.	21	0.00
								hackberry	46	0.27
								hackberry - uncarbonized	13	0.06
								hickory	3	0.06
								morninglory cf.	1	0.00
								pitch/pine cone	59	0.00
								thin hickory	1	0.00
								unidentifiable	3	0.01
7438	N61W62	66	445	486	2	0.21	negligible	acorn cf.	[2]	0.00
								black walnut cf.	1	0.02
								hackberry	[3]	0.00
								hickory	18	0.19
								unidentifiable	2	0.00
								wild legume	1	0.00
5898	N60W66	66	440	386		1.01	0.12	acorn	17	0.03
								black walnut	2	0.02
								hackberry	2	0.01
								hackberry - uncarbonized	12	0.06
								hazel	3	0.03
								hickory	116	0.79
								unidentifiable	3	0.01
								unidentified	5	0.00

APPENDIX F

Table F.1. Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
CT11	ARCH	KIRK CN	15	520	330	250
CT125	ARCH	BIFURCATE	228	660	0	0
CT125	ARCH	BIG SANDY	228	660	0	0
CT125	ARCH	KIRK CN	228	660	0	0
CT125	PALEO	DALTON	228	660	0	0
CT125	PALEO	CUMBERLAND	228	660	0	0
CT128	ARCH	BIG SANDY	20	520	0	0
CT128	ARCH	KIRK CN	20	520	0	0
CT128	PALEO	GREENBRIER	20	520	0	0
CT129	ARCH	KIRK CN	61	560	91	55
CT130	ARCH	BIFURCATE	91	545	0	0
CT130	ARCH	BIG SANDY	91	545	0	0
CT130	ARCH	KIRK CN	91	545	0	0
CT130	PALEO	DALTON	91	545	0	0
CT131	ARCH	BIG SANDY	30	490	0	0
CT131	ARCH	KIRK CN	30	490	0	0
CT134	ARCH	KIRK CN	100	530	0	0
CT134	PALEO	DALTON	100	530	0	0
CT142	PALEO	DALTON	-1	-1	0	0
CT148	ARCH	KIRK CN	170	430	165	50
CT157	ARCH	KIRK CN	600	500	275	140
CT160	ARCH	BIG SANDY	243	560	180	100
CT160	ARCH	KIRK CN	243	560	180	100
CT160	PALEO	CLOVIS	243	560	180	100
CT160	PALEO	CUMBERLAND	243	560	180	100
CT161	ARCH	BIG SANDY	80	555	0	0
CT161	PALEO	DALTON	80	555	0	0
CT161	PALEO	UNID	80	555	0	0
CT162	PALEO	UNID	180	560	0	0
CT163	ARCH	KIRK CN	606	565	120	110
CT163	PALEO	UNID	606	565	120	110
CT167	ARCH	BIG SANDY	303	440	0	0
CT188	PALEO	CUMBERLAND	40	420	0	0
CT190	ARCH	BIFURCATE	60	430	70	70
CT190	ARCH	BIG SANDY	60	430	70	70
CT190	ARCH	KIRK CN	60	430	70	70
CT190	PALEO	DALTON	60	430	70	70
CT190	PALEO	CUMBERLAND	60	430	70	70
CT191	ARCH	BIG SANDY	80	545	140	60
CT191	ARCH	KIRK CN	80	545	140	60
CT192	ARCH	BIG SANDY	20	570	220	80
CT192	ARCH	KIRK CN	20	570	220	80
CT195	ARCH	BIG SANDY	180	560	100	100
CT195	ARCH	KIRK CN	180	560	100	100
CT195	PALEO	DALTON	180	560	100	100

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
CT195	PALEO	GREENBRIER	180	560	100	100
CT195	PALEO	QUAD	180	560	100	100
CT195	PALEO	CUMBERLAND	180	560	100	100
CT196	ARCH	BIG SANDY	70	540	260	100
CT196	PALEO	GREENBRIER	70	540	260	100
CT197	PALEO	CLOVIS	400	550	180	90
CT198	ARCH	BIG SANDY	10	520	200	100
CT198	ARCH	KIRK CN	10	520	200	100
CT199	ARCH	KIRK CN	10	520	150	50
CT201	ARCH	KIRK CN	100	525	160	100
CT201	PALEO	CLOVIS	100	525	160	100
CT202	ARCH	BIG SANDY	8	520	260	80
CT202	ARCH	KIRK CN	8	520	260	80
CT203	PALEO	QUAD	70	550	180	100
CT204	ARCH	BIG SANDY	140	530	200	60
CT204	ARCH	KIRK CN	140	530	200	60
CT204	PALEO	CLOVIS	140	530	200	60
CT204	PALEO	CUMBERLAND	140	530	200	60
CT205	ARCH	BIG SANDY	8	530	250	80
CT205	ARCH	KIRK CN	8	530	250	80
CT205	PALEO	CLOVIS	8	530	250	80
CT205	PALEO	CUMBERLAND	8	530	250	80
CT206	ARCH	BIG SANDY	10	570	170	100
CT206	ARCH	KIRK CN	10	570	170	100
CT206	PALEO	CLOVIS	10	570	170	100
CT206	PALEO	DALTON	10	570	170	100
CT206	PALEO	QUAD	10	570	170	100
CT206	PALEO	CUMBERLAND	10	570	170	100
CT207	ARCH	BIG SANDY	1	520	200	110
CT207	ARCH	KIRK CN	1	520	200	110
CT207	PALEO	CLOVIS	1	520	200	110
CT207	PALEO	DALTON	1	520	200	110
CT207	PALEO	GREENBRIER	1	520	200	110
CT207	PALEO	QUAD	1	520	200	110
CT207	PALEO	CUMBERLAND	1	520	200	110
CT208	ARCH	KIRK CN	8	530	340	90
CT209	ARCH	KIRK CN	30	560	250	100
CT210	ARCH	BIG SANDY	120	530	150	60
CT210	ARCH	KIRK CN	120	530	150	60
CT210	PALEO	CLOVIS	120	530	150	60
CT211	ARCH	BIG SANDY	80	570	250	100
CT211	ARCH	KIRK CN	80	570	250	100
CT212	ARCH	BIG SANDY	70	585	300	150
CT212	ARCH	KIRK CN	70	585	300	150
CT212	PALEO	DALTON	70	585	300	150
CT212	PALEO	QUAD	70	585	300	150
CT213	ARCH	BIFURCATE	60	580	100	40
CT213	ARCH	BIG SANDY	60	580	100	40
CT213	ARCH	KIRK CN	60	580	100	40

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
CT214	ARCH	BIG SANDY	180	590	150	100
CT214	ARCH	KIRK CN	180	590	150	100
CT215	ARCH	KIRK CN	320	570	140	90
CT216	ARCH	BIG SANDY	140	570	140	120
CT219	ARCH	BIG SANDY	40	560	200	100
CT219	ARCH	KIRK CN	40	560	200	100
CT219	PALEO	CLOVIS	40	560	200	100
CT219	PALEO	QUAD	40	560	200	100
CT220	ARCH	KIRK CN	140	560	140	50
CT221	ARCH	BIG SANDY	180	560	100	60
CT221	ARCH	KIRK CN	180	560	100	60
CT222	ARCH	BIG SANDY	420	560	180	100
CT222	ARCH	KIRK CN	420	560	180	100
CT227	ARCH	BIG SANDY	400	560	185	160
CT227	ARCH	KIRK CN	400	560	185	160
CT227	PALEO	DALTON	400	560	185	160
CT227	PALEO	GREENBRIER	400	560	185	160
CT227	PALEO	QUAD	400	560	185	160
CT236	ARCH	BIG SANDY	61	540	100	100
CT236	ARCH	KIRK CN	61	540	100	100
CT266	ARCH	KIRK CN	150	415	300	200
CT285	ARCH	BIG SANDY	30	415	100	75
CT285	ARCH	KIRK CN	30	415	100	75
CT286	ARCH	BIG SANDY	1	415	100	9
CT286	ARCH	KIRK CN	1	415	100	9
CT286	PALEO	DALTON	1	415	100	9
CT287	ARCH	BIG SANDY	1	415	25	25
CT289	ARCH	BIG SANDY	1	420	100	40
CT289	ARCH	KIRK CN	1	420	100	40
CT292	ARCH	KIRK CN	15	414	50	50
CT292	PALEO	CUMBERLAND	15	414	50	50
CT297	ARCH	BIG SANDY	998	520	100	50
CT297	ARCH	KIRK CN	998	520	100	50
CT297	PALEO	CLOVIS	998	520	100	50
CT297	PALEO	DALTON	998	520	100	50
CT297	PALEO	CUMBERLAND	998	520	100	50
CT363	ARCH	KIRK CN	15	530	0	0
CT382	ARCH	KIRK CN	50	530	35	25
CT406	ARCH	BIFURCATE	25	490	75	55
CT417	ARCH	KIRK CN	100	580	85	70
CT44	ARCH	KIRK CN	30	440	0	0
CT45	ARCH	KIRK CN	30	430	0	0
CT459	PALEO	CLOVIS	300	500	30	20
CT459	ARCH	KIRK CN	300	500	30	20
CT525	PALEO	UNID	10	560	50	25
CT525	PALEO	DALTON	10	560	50	25
CT525	ARCH	BIG SANDY	10	560	50	25
CT526	ARCH	BIG SANDY	50	570	100	100
CT527	PALEO	UNID	70	570	70	30

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
CT528	PALEO	DALTON	10	560	50	50
CT529	PALEO	CUMBERLAND	0	560	100	50
CT529	PALEO	WHEELER PPK	0	560	100	50
CT529	PALEO	DALTON	0	560	100	50
CT529	ARCH	BIG SANDY	0	560	100	50
CT532	PALEO	UNID	0	550	60	60
CT533	PALEO	UNID	25	570	100	100
CT534	PALEO	UNID	50	560	100	50
CT535	PALEO	UNID	30	560	60	60
CT536	PALEO	UNID	10	560	50	20
CT90	ARCH	BIG SANDY	360	800	12	5
CT90	ARCH	KIRK CN	360	800	12	5
FR124	PALEO	GREENBRIER	240	630	0	0
FR14	ARCH	BIG SANDY	100	820	30	20
FR224	ARCH	KIRK CN	50	610	0	0
FR271	ARCH	KIRK CN	150	640	150	100
FR272	ARCH	BIG SANDY	170	660	90	50
FR300	ARCH	KIRK CN	60	580	0	0
FR307	ARCH	KIRK CN	30	540	30	15
FR31	ARCH	BIG SANDY	30	570	0	0
FR31	ARCH	KIRK CN	30	570	0	0
FR310	ARCH	BIFURCATE	100	560	0	0
FR310	ARCH	BIG SANDY	100	560	0	0
FR310	PALEO	CLOVIS	100	560	0	0
FR310	PALEO	GREENBRIER	100	560	0	0
FR310	PALEO	CUMBERLAND	100	560	0	0
FR311	ARCH	BIFURCATE	45	540	0	0
FR311	ARCH	BIG SANDY	45	540	0	0
FR311	ARCH	KIRK CN	45	540	0	0
FR311	PALEO	CLOVIS	45	540	0	0
FR311	PALEO	DALTON	45	540	0	0
FR315	PALEO	DALTON	100	560	61	30
FR316	ARCH	KIRK CN	121	580	0	0
FR319	ARCH	KIRK CN	61	590	0	0
FR321	ARCH	BIG SANDY	91	780	60	60
FR323	ARCH	BIG SANDY	303	800	26	10
FR323	ARCH	KIRK CN	303	800	26	10
FR323	PALEO	DALTON	303	800	26	10
FR323	PALEO	GREENBRIER	303	800	26	10
FR323	PALEO	QUAD	303	800	26	10
FR329	PALEO	GREENBRIER	30	580	0	0
FR33	ARCH	KIRK CN	30	580	0	0
FR331	ARCH	BIFURCATE	30	560	0	0
FR331	ARCH	BIG SANDY	30	560	0	0
FR331	ARCH	KIRK CN	30	560	0	0
FR331	PALEO	DALTON	30	560	0	0
FR331	PALEO	GREENBRIER	30	560	0	0
FR335	ARCH	KIRK CN	20	600	30	20
FR361	PALEO	DALTON	40	590	90	40

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
FR5	ARCH	BIFURCATE	820	530	61	61
FR506	ARCH	BIG SANDY	91	560	100	100
FR506	ARCH	KIRK CN	91	560	100	100
FR507	ARCH	KIRK CN	121	560	100	100
FR507	PALEO	GREENBRIER	121	560	100	100
FR512	ARCH	BIG SANDY	45	560	61	30
FR593	ARCH	KIRK CN	45	780	0	0
FR631	ARCH	BIG SANDY	80	590	0	0
FR64	ARCH	KIRK CN	210	610	0	0
FR654	ARCH	BIG SANDY	212	640	0	0
FR654	PALEO	DALTON	212	640	0	0
FR669	ARCH	KIRK CN	233	560	0	0
FR678	ARCH	BIG SANDY	150	580	15	15
FR94	ARCH	KIRK CN	80	600	0	0
FR94	PALEO	QUAD	80	600	0	0
LU129	ARCH	BIFURCATE	30	540	303	61
LU131	PALEO	DALTON	170	510	0	0
LU154	PALEO	CUMBERLAND	10	580	455	91
LU174	ARCH	KIRK CN	45	520	121	61
LU183	ARCH	KIRK CN	394	650	125	75
LU214	PALEO	GREENBRIER	1	414	0	0
LU220	ARCH	BIG SANDY	30	420	1700	25
LU221	ARCH	KIRK CN	160	408	210	50
LU222	ARCH	BIFURCATE	160	408	330	100
LU222	ARCH	BIG SANDY	160	408	330	100
LU222	ARCH	KIRK CN	160	408	330	100
LU222	PALEO	CLOVIS	160	408	330	100
LU223	ARCH	BIG SANDY	200	420	540	60
LU223	ARCH	KIRK CN	200	420	540	60
LU223	PALEO	CUMBERLAND	200	420	540	60
LU227	ARCH	KIRK CN	1	420	0	0
LU228	ARCH	KIRK CN	1	420	200	30
LU228	PALEO	GREENBRIER	1	420	200	30
LU231	ARCH	BIG SANDY	200	420	0	0
LU237	ARCH	KIRK CN	100	-1	110	25
LU240	ARCH	BIFURCATE	1	413	170	50
LU240	ARCH	BIG SANDY	1	413	170	50
LU240	ARCH	KIRK CN	1	413	170	50
LU240	PALEO	GREENBRIER	1	413	170	50
LU241	ARCH	BIFURCATE	1	413	70	50
LU241	ARCH	BIG SANDY	1	413	70	50
LU241	ARCH	KIRK CN	1	413	70	50
LU241	PALEO	GREENBRIER	1	413	70	50
LU241	PALEO	CUMBERLAND	1	413	70	50
LU244	PALEO	CUMBERLAND	100	480	0	0
LU246	PALEO	CLOVIS	200	500	0	0
LU253	ARCH	KIRK CN	300	414	150	40
LU254	ARCH	BIG SANDY	100	-1	250	30
LU254	ARCH	KIRK CN	100	-1	250	30

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU255	ARCH	KIRK CN	300	-1	80	40
LU310	ARCH	KIRK CN	60	440	100	60
LU319	PALEO	CUMBERLAND	200	420	210	75
LU324	PALEO	UNID	200	420	65	10
LU356	ARCH	BIG SANDY	10	420	375	110
LU356	PALEO	DALTON	10	420	375	110
LU366	ARCH	BIG SANDY	300	420	0	0
LU366	PALEO	CLOVIS	300	420	0	0
LU366	PALEO	QUAD	300	420	0	0
LU367	PALEO	QUAD	100	420	0	0
LU369	PALEO	CLOVIS	100	420	5000	175
LU369	PALEO	DALTON	100	420	5000	175
LU369	PALEO	QUAD	100	420	5000	175
LU369	PALEO	CUMBERLAND	100	420	5000	175
LU404	ARCH	KIRK CN	10	550	170	130
LU405	ARCH	KIRK CN	30	590	100	80
LU405	PALEO	DALTON	30	590	100	80
LU406	ARCH	KIRK CN	400	500	110	60
LU406	PALEO	CUMBERLAND	400	500	110	60
LU407	ARCH	KIRK CN	9	500	130	100
LU407	PALEO	DALTON	9	500	130	100
LU408	ARCH	BIG SANDY	40	485	270	120
LU408	ARCH	KIRK CN	40	485	270	120
LU408	PALEO	QUAD	40	485	270	120
LU409	ARCH	BIFURCATE	50	500	140	80
LU409	ARCH	KIRK CN	50	500	140	80
LU409	PALEO	DALTON	50	500	140	80
LU409	PALEO	GREENBRIER	50	500	140	80
LU409	PALEO	QUAD	50	500	140	80
LU409	PALEO	CUMBERLAND	50	500	140	80
LU410	ARCH	KIRK CN	9	490	160	60
LU411	ARCH	BIFURCATE	9	485	220	100
LU411	ARCH	BIG SANDY	9	485	220	100
LU411	ARCH	KIRK CN	9	485	220	100
LU411	PALEO	DALTON	9	485	220	100
LU411	PALEO	GREENBRIER	9	485	220	100
LU411	PALEO	CUMBERLAND	9	485	220	100
LU412	ARCH	KIRK CN	9	485	140	100
LU412	PALEO	CUMBERLAND	9	485	140	100
LU413	ARCH	KIRK CN	9	520	240	120
LU414	ARCH	KIRK CN	9	500	200	180
LU415	ARCH	KIRK CN	9	490	100	60
LU415	PALEO	CUMBERLAND	9	490	100	60
LU416	ARCH	BIG SANDY	9	490	280	100
LU416	ARCH	KIRK CN	9	490	280	100
LU416	PALEO	CUMBERLAND	9	490	280	100
LU417	ARCH	KIRK CN	9	480	220	100
LU418	ARCH	BIFURCATE	300	510	210	130
LU418	ARCH	BIG SANDY	300	510	210	130

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU418	ARCH	KIRK CN	300	510	210	130
LU418	PALEO	CLOVIS	300	510	210	130
LU418	PALEO	DALTON	300	510	210	130
LU418	PALEO	QUAD	300	510	210	130
LU419	ARCH	BIG SANDY	200	510	160	100
LU419	ARCH	KIRK CN	200	510	160	100
LU419	PALEO	DALTON	200	510	160	100
LU419	PALEO	QUAD	200	510	160	100
LU420	ARCH	BIFURCATE	9	510	320	100
LU420	ARCH	KIRK CN	9	510	320	100
LU420	PALEO	QUAD	9	510	320	100
LU420	PALEO	CUMBERLAND	9	510	320	100
LU421	ARCH	BIFURCATE	20	530	220	80
LU421	ARCH	KIRK CN	20	530	220	80
LU421	PALEO	CLOVIS	20	530	220	80
LU421	PALEO	QUAD	20	530	220	80
LU421	PALEO	CUMBERLAND	20	530	220	80
LU422	ARCH	BIFURCATE	20	520	140	120
LU422	ARCH	KIRK CN	20	520	140	120
LU422	PALEO	CLOVIS	20	520	140	120
LU422	PALEO	DALTON	20	520	140	120
LU422	PALEO	QUAD	20	520	140	120
LU422	PALEO	CUMBERLAND	20	520	140	120
LU423	ARCH	BIFURCATE	200	530	200	100
LU423	ARCH	BIG SANDY	200	530	200	100
LU423	ARCH	KIRK CN	200	530	200	100
LU423	PALEO	CUMBERLAND	200	530	200	100
LU424	ARCH	BIFURCATE	80	560	180	130
LU424	ARCH	KIRK CN	80	560	180	130
LU424	PALEO	GREENBRIER	80	560	180	130
LU424	PALEO	QUAD	80	560	180	130
LU425	ARCH	KIRK CN	250	570	110	60
LU425	PALEO	CLOVIS	250	570	110	60
LU425	PALEO	GREENBRIER	250	570	110	60
LU425	PALEO	QUAD	250	570	110	60
LU425	PALEO	CUMBERLAND	250	570	110	60
LU426	ARCH	BIFURCATE	200	570	120	90
LU426	ARCH	KIRK CN	200	570	120	90
LU426	PALEO	CLOVIS	200	570	120	90
LU426	PALEO	DALTON	200	570	120	90
LU426	PALEO	GREENBRIER	200	570	120	90
LU426	PALEO	QUAD	200	570	120	90
LU426	PALEO	CUMBERLAND	200	570	120	90
LU427	ARCH	BIFURCATE	60	560	130	80
LU427	ARCH	BIG SANDY	60	560	130	80
LU427	ARCH	KIRK CN	60	560	130	80
LU427	PALEO	CLOVIS	60	560	130	80
LU427	PALEO	GREENBRIER	60	560	130	80
LU427	PALEO	CUMBERLAND	60	560	130	80

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU428	ARCH	KIRK CN	300	570	50	50
LU429	ARCH	BIFURCATE	30	560	230	90
LU429	ARCH	BIG SANDY	30	560	230	90
LU429	ARCH	KIRK CN	30	560	230	90
LU429	PALEO	DALTON	30	560	230	90
LU429	PALEO	GREENBRIER	30	560	230	90
LU430	ARCH	BIFURCATE	30	555	80	60
LU430	ARCH	KIRK CN	30	555	80	60
LU430	PALEO	QUAD	30	555	80	60
LU431	ARCH	BIFURCATE	160	570	200	120
LU431	ARCH	BIG SANDY	160	570	200	120
LU431	ARCH	KIRK CN	160	570	200	120
LU431	PALEO	CLOVIS	160	570	200	120
LU431	PALEO	DALTON	160	570	200	120
LU431	PALEO	GREENBRIER	160	570	200	120
LU431	PALEO	QUAD	160	570	200	120
LU432	ARCH	BIFURCATE	40	560	160	150
LU432	ARCH	KIRK CN	40	560	160	150
LU432	PALEO	CLOVIS	40	560	160	150
LU432	PALEO	DALTON	40	560	160	150
LU432	PALEO	QUAD	40	560	160	150
LU432	PALEO	CUMBERLAND	40	560	160	150
LU433	ARCH	KIRK CN	130	520	60	25
LU434	ARCH	BIFURCATE	100	520	260	80
LU434	ARCH	KIRK CN	100	520	260	80
LU434	PALEO	CUMBERLAND	100	520	260	80
LU435	ARCH	BIFURCATE	130	560	140	110
LU435	ARCH	BIG SANDY	130	560	140	110
LU435	ARCH	KIRK CN	130	560	140	110
LU435	PALEO	CLOVIS	130	560	140	110
LU435	PALEO	CUMBERLAND	130	560	140	110
LU436	ARCH	BIG SANDY	200	560	190	120
LU436	ARCH	KIRK CN	200	560	190	120
LU436	PALEO	GREENBRIER	200	560	190	120
LU437	ARCH	BIFURCATE	10	555	300	120
LU437	ARCH	KIRK CN	10	555	300	120
LU437	PALEO	CLOVIS	10	555	300	120
LU437	PALEO	DALTON	10	555	300	120
LU437	PALEO	QUAD	10	555	300	120
LU437	PALEO	CUMBERLAND	10	555	300	120
LU438	ARCH	BIFURCATE	200	560	160	120
LU438	ARCH	KIRK CN	200	560	160	120
LU438	PALEO	CLOVIS	200	560	160	120
LU439	ARCH	BIFURCATE	20	560	310	160
LU439	ARCH	KIRK CN	20	560	310	160
LU439	PALEO	DALTON	20	560	310	160
LU439	PALEO	QUAD	20	560	310	160
LU439	PALEO	CUMBERLAND	20	560	310	160
LU440	ARCH	BIFURCATE	10	550	120	90

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU440	ARCH	KIRK CN	10	550	120	90
LU440	PALEO	CLOVIS	10	550	120	90
LU440	PALEO	DALTON	10	550	120	90
LU440	PALEO	QUAD	10	550	120	90
LU440	PALEO	CUMBERLAND	10	550	120	90
LU441	PALEO	DALTON	10	560	620	330
LU441	PALEO	QUAD	10	560	620	330
LU441	PALEO	CUMBERLAND	10	560	620	330
LU442	PALEO	CLOVIS	100	560	160	120
LU442	PALEO	DALTON	100	560	160	120
LU442	PALEO	GREENBRIER	100	560	160	120
LU442	PALEO	CUMBERLAND	100	560	160	120
LU443	PALEO	CLOVIS	150	560	270	150
LU443	PALEO	DALTON	150	560	270	150
LU443	PALEO	QUAD	150	560	270	150
LU443	PALEO	CUMBERLAND	150	560	270	150
LU444	PALEO	CLOVIS	120	570	230	180
LU444	PALEO	DALTON	120	570	230	180
LU444	PALEO	QUAD	120	570	230	180
LU444	PALEO	CUMBERLAND	120	570	230	180
LU445	PALEO	CUMBERLAND	9	409	180	80
LU446	PALEO	CUMBERLAND	200	430	150	60
LU450	ARCH	BIG SANDY	100	450	80	30
LU450	ARCH	KIRK CN	100	450	80	30
LU450	PALEO	CUMBERLAND	100	450	80	30
LU451	ARCH	BIFURCATE	9	490	500	100
LU451	ARCH	KIRK CN	9	490	500	100
LU451	PALEO	CLOVIS	9	490	500	100
LU453	PALEO	CUMBERLAND	10	530	360	100
LU454	PALEO	CUMBERLAND	60	550	300	80
LU455	ARCH	KIRK CN	100	550	160	70
LU456	ARCH	BIG SANDY	60	510	130	100
LU456	ARCH	KIRK CN	60	510	130	100
LU457	ARCH	BIG SANDY	230	560	120	70
LU457	PALEO	CUMBERLAND	230	560	120	70
LU458	ARCH	KIRK CN	100	560	300	70
LU458	PALEO	CLOVIS	100	560	300	70
LU459	ARCH	KIRK CN	100	570	170	70
LU459	PALEO	CLOVIS	100	570	170	70
LU460	ARCH	BIG SANDY	250	570	310	110
LU460	ARCH	KIRK CN	250	570	310	110
LU460	PALEO	CLOVIS	250	570	310	110
LU460	PALEO	DALTON	250	570	310	110
LU460	PALEO	CUMBERLAND	250	570	310	110
LU461	ARCH	KIRK CN	100	560	160	140
LU461	PALEO	DALTON	100	560	160	140
LU462	ARCH	BIFURCATE	300	410	180	30
LU462	ARCH	BIG SANDY	300	410	180	30
LU462	ARCH	KIRK CN	300	410	180	30

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU464	ARCH	KIRK CN	9	500	250	80
LU464	PALEO	CUMBERLAND	9	500	250	80
LU466	ARCH	KIRK CN	100	480	110	80
LU466	PALEO	CLOVIS	100	480	110	80
LU467	ARCH	KIRK CN	10	520	360	150
LU468	ARCH	BIG SANDY	140	500	280	180
LU468	ARCH	KIRK CN	140	500	280	180
LU470	ARCH	KIRK CN	200	640	180	60
LU472	ARCH	BIFURCATE	10	420	200	40
LU472	ARCH	BIG SANDY	10	420	200	40
LU472	ARCH	KIRK CN	10	420	200	40
LU472	PALEO	CLOVIS	10	420	200	40
LU472	PALEO	DALTON	10	420	200	40
LU472	PALEO	QUAD	10	420	200	40
LU472	PALEO	CUMBERLAND	10	420	200	40
LU474	ARCH	BIFURCATE	60	500	125	75
LU474	ARCH	KIRK CN	60	500	125	75
LU475	ARCH	KIRK CN	30	560	100	60
LU476	ARCH	BIFURCATE	150	550	280	100
LU476	ARCH	KIRK CN	150	550	280	100
LU477	ARCH	KIRK CN	160	540	350	140
LU477	PALEO	CLOVIS	160	540	350	140
LU477	PALEO	DALTON	160	540	350	140
LU477	PALEO	QUAD	160	540	350	140
LU478	ARCH	KIRK CN	100	570	80	60
LU479	ARCH	KIRK CN	90	550	80	60
LU481	ARCH	KIRK CN	180	630	210	110
LU481	PALEO	DALTON	180	630	210	110
LU482	ARCH	KIRK CN	230	630	250	130
LU485	ARCH	KIRK CN	280	590	170	70
LU486	PALEO	DALTON	260	610	300	160
LU488	ARCH	BIG SANDY	230	580	100	80
LU488	ARCH	KIRK CN	230	580	100	80
LU488	PALEO	CLOVIS	230	580	100	80
LU489	PALEO	DALTON	8	590	100	50
LU490	ARCH	KIRK CN	10	570	50	10
LU491	ARCH	BIG SANDY	20	560	40	30
LU491	ARCH	KIRK CN	20	560	40	30
LU492	PALEO	DALTON	250	540	220	170
LU496	ARCH	BIG SANDY	200	445	40	12
LU496	PALEO	DALTON	200	445	40	12
LU501	ARCH	KIRK CN	60	520	180	120
LU501	PALEO	CLOVIS	60	520	180	120
LU501	PALEO	DALTON	60	520	180	120
LU501	PALEO	QUAD	60	520	180	120
LU502	ARCH	KIRK CN	10	510	325	120
LU504	ARCH	BIFURCATE	80	555	160	100
LU504	ARCH	KIRK CN	80	555	160	100
LU505	ARCH	BIG SANDY	10	530	170	60

Table F.1 (continued). Quantitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Distance to Water	Elevation (ft)	Major Axis (ft)	Minor Axis (ft)
LU505	ARCH	KIRK CN	10	530	170	60
LU507	ARCH	BIG SANDY	30	620	140	60
LU507	ARCH	KIRK CN	30	620	140	60
LU507	PALEO	DALTON	30	620	140	60
LU509	PALEO	CUMBERLAND	200	420	0	0
LU512	PALEO	DALTON	1	460	0	0
LU513	ARCH	BIG SANDY	100	420	0	0
LU514	PALEO	CLOVIS	100	415	20	20
LU518	ARCH	BIG SANDY	100	420	0	0
LU518	ARCH	KIRK CN	100	420	0	0
LU518	PALEO	CUMBERLAND	100	420	0	0
LU534	PALEO	CLOVIS	75	580	75	50
LU562	ARCH	KIRK CN	75	550	260	140
LU574	ARCH	KIRK CN	680	540	380	190
LU574	PALEO	GREENBRIER	680	540	380	190
LU576	ARCH	KIRK CN	770	570	230	150
LU580	ARCH	KIRK CN	999	550	260	110
LU586	PALEO	CUMBERLAND	530	520	550	130
LU587	ARCH	KIRK CN	225	530	220	200
LU592	ARCH	KIRK CN	460	540	300	210
LU603	ARCH	BIFURCATE	650	570	320	210
LU634	ARCH	BIG SANDY	1	590	200	100
LU634	ARCH	KIRK CN	1	590	200	100
LU65	ARCH	BIG SANDY	60	419	83	45
LU65	PALEO	CUMBERLAND	60	419	83	45
LU74	ARCH	KIRK CN	121	-1	60	60
LU80	ARCH	BIG SANDY	364	570	0	0
LU80	ARCH	KIRK CN	364	570	0	0
LU85	ARCH	KIRK CN	1	-1	273	91

Table F.2. Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
CT11	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UPLAND BASE
CT125	ARCH	BIFURCATE	SECOND	LITTLE	HIGHLAND	UPLAND SLOPE
CT125	ARCH	BIG SANDY	SECOND	LITTLE	HIGHLAND	UPLAND SLOPE
CT125	ARCH	KIRK CN	SECOND	LITTLE	HIGHLAND	UPLAND SLOPE
CT125	PALEO	DALTON	SECOND	LITTLE	HIGHLAND	UPLAND SLOPE
CT125	PALEO	CUMBERLAND	SECOND	LITTLE	HIGHLAND	UPLAND SLOPE
CT128	ARCH	BIG SANDY	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT128	ARCH	KIRK CN	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT128	PALEO	GREENBRIER	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT129	ARCH	KIRK CN	MAJOR	LITTLE	HIGHLAND	FLOOD PLAIN
CT130	ARCH	BIFURCATE	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT130	ARCH	BIG SANDY	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT130	ARCH	KIRK CN	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT130	PALEO	DALTON	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT131	ARCH	BIG SANDY	SECOND	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT131	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT134	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	TERRACE
CT134	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	TERRACE
CT142	PALEO	DALTON	UNAVAIL.	LITTLE	HIGHLAND	UNAVAILABLE
CT148	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT157	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT160	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT160	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT160	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT160	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT161	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT161	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT161	PALEO	UNID	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT162	PALEO	UNID	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT163	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT163	PALEO	UNID	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT167	ARCH	BIG SANDY	FOURTH	FALL	COASTAL	TERRACE
CT188	PALEO	CUMBERLAND	RIVER	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT190	ARCH	BIFURCATE	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT190	ARCH	BIG SANDY	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT190	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT190	PALEO	DALTON	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT190	PALEO	CUMBERLAND	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT191	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT191	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT192	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT192	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	PALEO	GREENBRIER	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	PALEO	QUAD	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT195	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT196	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
CT196	PALEO	GREENBRIER	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
CT197	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT198	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT198	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT199	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT201	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT201	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT202	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT202	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT203	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT204	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT204	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT204	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT204	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT205	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT205	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT205	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT205	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT206	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT206	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT206	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT206	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT206	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT206	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT207	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	PALEO	GREENBRIER	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	PALEO	QUAD	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT207	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT208	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT209	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT210	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
CT210	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
CT210	PALEO	CLOVIS	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
CT211	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT211	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT212	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT212	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT212	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT212	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT213	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT213	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT213	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT214	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT214	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT215	ARCH	KIRK CN	LAKE	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT216	ARCH	BIG SANDY	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
CT219	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT219	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT219	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT219	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT220	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT221	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT221	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT222	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT222	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT227	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT227	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT227	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT227	PALEO	GREENBRIER	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT227	PALEO	QUAD	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT236	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT236	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
CT266	ARCH	KIRK CN	MAJOR	TENNESSEE	HIGHLAND	TERRACE
CT285	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT285	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT286	ARCH	BIG SANDY	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT286	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT286	PALEO	DALTON	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT287	ARCH	BIG SANDY	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT289	ARCH	BIG SANDY	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT289	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT292	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT292	PALEO	CUMBERLAND	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
CT297	ARCH	BIG SANDY	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
CT297	ARCH	KIRK CN	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
CT297	PALEO	CLOVIS	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
CT297	PALEO	DALTON	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
CT297	PALEO	CUMBERLAND	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
CT363	ARCH	KIRK CN	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT382	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT406	ARCH	BIFURCATE	FIRST	TENNESSEE	HIGHLAND	UPLAND BASE
CT417	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
CT44	ARCH	KIRK CN	FIRST	FALL	COASTAL	TERRACE
CT45	ARCH	KIRK CN	FOURTH	FALL	COASTAL	FLOOD PLAIN
CT459	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT459	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
CT525	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT525	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT525	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT526	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT527	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT528	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT529	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT529	PALEO	WHEELER PPK	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT529	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND BASE

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
CT529	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT532	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT533	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT534	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT535	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT536	PALEO	UNID	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
CT90	ARCH	BIG SANDY	FIRST	LITTLE	HIGHLAND	UPLAND SLOPE
CT90	ARCH	KIRK CN	FIRST	LITTLE	HIGHLAND	UPLAND SLOPE
FR124	PALEO	GREENBRIER	FOURTH	FALL	COASTAL	UPLAND SLOPE
FR14	ARCH	BIG SANDY	FIRST	WARRIOR	CUMBERLAND	UPLAND CREST
FR224	ARCH	KIRK CN	SECOND	FALL	COASTAL	UPLAND SLOPE
FR271	ARCH	KIRK CN	SECOND	FALL	COASTAL	UPLAND SLOPE
FR272	ARCH	BIG SANDY	SECOND	FALL	COASTAL	UPLAND SLOPE
FR300	ARCH	KIRK CN	MAJOR	WARRIOR	CUMBERLAND	UPLAND SLOPE
FR307	ARCH	KIRK CN	MAJOR	FALL	COASTAL	UPLAND SLOPE
FR31	ARCH	BIG SANDY	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR31	ARCH	KIRK CN	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR310	ARCH	BIFURCATE	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR310	ARCH	BIG SANDY	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR310	PALEO	CLOVIS	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR310	PALEO	GREENBRIER	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR310	PALEO	CUMBERLAND	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR311	ARCH	BIFURCATE	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR311	ARCH	BIG SANDY	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR311	ARCH	KIRK CN	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR311	PALEO	CLOVIS	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR311	PALEO	DALTON	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR315	PALEO	DALTON	FOURTH	FALL	COASTAL	TERRACE
FR316	ARCH	KIRK CN	FOURTH	FALL	COASTAL	TERRACE
FR319	ARCH	KIRK CN	FOURTH	FALL	COASTAL	TERRACE
FR321	ARCH	BIG SANDY	FOURTH	WARRIOR	CUMBERLAND	FLOOD PLAIN
FR323	ARCH	BIG SANDY	SECOND	FALL	COASTAL	UPLAND SLOPE
FR323	ARCH	KIRK CN	SECOND	FALL	COASTAL	UPLAND SLOPE
FR323	PALEO	DALTON	SECOND	FALL	COASTAL	UPLAND SLOPE
FR323	PALEO	GREENBRIER	SECOND	FALL	COASTAL	UPLAND SLOPE
FR323	PALEO	QUAD	SECOND	FALL	COASTAL	UPLAND SLOPE
FR329	PALEO	GREENBRIER	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR33	ARCH	KIRK CN	THIRD	MOULTON	HIGHLAND	FLOOD PLAIN
FR331	ARCH	BIFURCATE	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR331	ARCH	BIG SANDY	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR331	ARCH	KIRK CN	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR331	PALEO	DALTON	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR331	PALEO	GREENBRIER	FOURTH	MOULTON	HIGHLAND	FLOOD PLAIN
FR335	ARCH	KIRK CN	THIRD	FALL	COASTAL	UPLAND SLOPE
FR361	PALEO	DALTON	MAJOR	FALL	COASTAL	FLOOD PLAIN
FR5	ARCH	BIFURCATE	SECOND	FALL	COASTAL	TERRACE
FR506	ARCH	BIG SANDY	FOURTH	FALL	COASTAL	TERRACE
FR506	ARCH	KIRK CN	FOURTH	FALL	COASTAL	TERRACE
FR507	ARCH	KIRK CN	FOURTH	FALL	COASTAL	FLOOD PLAIN

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
FR507	PALEO	GREENBRIER	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR512	ARCH	BIG SANDY	FOURTH	FALL	COASTAL	FLOOD PLAIN
FR593	ARCH	KIRK CN	THIRD	WARRIOR	CUMBERLAND	FLOOD PLAIN
FR631	ARCH	BIG SANDY	MAJOR	FALL	COASTAL	UPLAND SLOPE
FR64	ARCH	KIRK CN	THIRD	FALL	COASTAL	UPLAND CREST
FR654	ARCH	BIG SANDY	THIRD	FALL	COASTAL	UPLAND CREST
FR654	PALEO	DALTON	THIRD	FALL	COASTAL	UPLAND CREST
FR669	ARCH	KIRK CN	SECOND	FALL	COASTAL	FLOOD PLAIN
FR678	ARCH	BIG SANDY	MAJOR	MOULTON	HIGHLAND	TERRACE
FR94	ARCH	KIRK CN	THIRD	FALL	COASTAL	UPLAND SLOPE
FR94	PALEO	QUAD	THIRD	FALL	COASTAL	UPLAND SLOPE
LU129	ARCH	BIFURCATE	MAJOR	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU131	PALEO	DALTON	RIVER	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU154	PALEO	CUMBERLAND	FOURTH	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU174	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU183	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU214	PALEO	GREENBRIER	RIVER	TENNESSEE	HIGHLAND	UNAVAILABLE
LU220	ARCH	BIG SANDY	RIVER	TENNESSEE	HIGHLAND	TERRACE
LU221	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU222	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU222	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU222	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU222	PALEO	CLOVIS	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU223	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU223	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU223	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU227	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	TERRACE
LU228	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU228	PALEO	GREENBRIER	RIVER	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU231	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU237	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU240	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU240	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU240	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU240	PALEO	GREENBRIER	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU241	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU241	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU241	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU241	PALEO	GREENBRIER	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU241	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU244	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU246	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU253	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU254	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU254	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU255	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UNAVAILABLE
LU310	ARCH	KIRK CN	SECOND	FALL	COASTAL	FLOOD PLAIN
LU319	PALEO	CUMBERLAND	RIVER	TENNESSEE	HIGHLAND	ISLAND
LU324	PALEO	UNID	THIRD	TENNESSEE	HIGHLAND	FLOOD PLAIN

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU356	ARCH	BIG SANDY	MAJOR	TENNESSEE	HIGHLAND	TERRACE
LU356	PALEO	DALTON	MAJOR	TENNESSEE	HIGHLAND	TERRACE
LU366	ARCH	BIG SANDY	SECOND	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU366	PALEO	CLOVIS	SECOND	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU366	PALEO	QUAD	SECOND	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU367	PALEO	QUAD	SECOND	TENNESSEE	HIGHLAND	UNAVAILABLE
LU369	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	TERRACE
LU369	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	TERRACE
LU369	PALEO	QUAD	FIRST	TENNESSEE	HIGHLAND	TERRACE
LU369	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	TERRACE
LU404	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU405	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU405	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU406	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU406	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU407	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU407	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU408	ARCH	BIG SANDY	SWAMP	TENNESSEE	HIGHLAND	UPLAND CREST
LU408	ARCH	KIRK CN	SWAMP	TENNESSEE	HIGHLAND	UPLAND CREST
LU408	PALEO	QUAD	SWAMP	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU409	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU410	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND BASE
LU411	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU411	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU411	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU411	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU411	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU411	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU412	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU412	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU413	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU414	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU415	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU415	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU416	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU416	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU416	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU417	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU418	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU418	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU418	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU418	PALEO	CLOVIS	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU418	PALEO	DALTON	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU418	PALEO	QUAD	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU419	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU419	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU419	PALEO	DALTON	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU419	PALEO	QUAD	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU420	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU420	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU420	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU420	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU421	ARCH	BIFURCATE	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU421	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU421	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU421	PALEO	QUAD	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU421	PALEO	CUMBERLAND	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU422	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU423	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU423	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU423	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU423	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU424	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU424	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU424	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU424	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU425	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU425	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU425	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU425	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU425	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU426	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU426	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU427	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU428	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU429	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU429	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU429	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU429	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU429	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU430	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU430	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU430	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU431	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU432	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU433	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU434	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU434	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU434	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU435	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU435	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU435	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU435	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU435	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU436	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU436	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU436	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU437	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU438	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU438	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU438	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU439	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU439	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU439	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU439	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU439	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU440	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU440	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU440	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU440	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU440	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU440	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU441	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU441	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU441	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU442	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU442	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU442	PALEO	GREENBRIER	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU442	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU443	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU443	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU443	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU443	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU444	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU444	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU444	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU444	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU445	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU446	PALEO	CUMBERLAND	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU450	ARCH	BIG SANDY	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU450	ARCH	KIRK CN	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU450	PALEO	CUMBERLAND	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU451	ARCH	BIFURCATE	SWAMP	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU451	ARCH	KIRK CN	SWAMP	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU451	PALEO	CLOVIS	SWAMP	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU453	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU454	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU455	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU456	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU456	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU457	ARCH	BIG SANDY	MAJOR	TENNESSEE	HIGHLAND	UPLAND CREST
LU457	PALEO	CUMBERLAND	MAJOR	TENNESSEE	HIGHLAND	UPLAND CREST
LU458	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU458	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU459	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU459	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU460	ARCH	BIG SANDY	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU460	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU460	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU460	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU460	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU461	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	UPLAND CREST
LU461	PALEO	DALTON	SECOND	TENNESSEE	HIGHLAND	UPLAND CREST
LU462	ARCH	BIFURCATE	SECOND	TENNESSEE	HIGHLAND	UNAVAILABLE
LU462	ARCH	BIG SANDY	SECOND	TENNESSEE	HIGHLAND	UNAVAILABLE
LU462	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	UNAVAILABLE
LU464	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU464	PALEO	CUMBERLAND	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU466	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	UPLAND CREST
LU466	PALEO	CLOVIS	SECOND	TENNESSEE	HIGHLAND	UPLAND CREST

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU467	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU468	ARCH	BIG SANDY	SWAMP	TENNESSEE	HIGHLAND	UPLAND CREST
LU468	ARCH	KIRK CN	SWAMP	TENNESSEE	HIGHLAND	UPLAND CREST
LU470	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU472	ARCH	BIFURCATE	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	ARCH	BIG SANDY	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	ARCH	KIRK CN	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	PALEO	CLOVIS	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	PALEO	DALTON	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	PALEO	QUAD	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU472	PALEO	CUMBERLAND	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU474	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU474	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU475	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU476	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU476	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU477	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU477	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU477	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU477	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU478	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU479	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU481	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU481	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU482	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU485	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU486	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU488	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU488	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU488	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU489	PALEO	DALTON	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU490	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU491	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU491	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU492	PALEO	DALTON	SECOND	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU496	ARCH	BIG SANDY	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU496	PALEO	DALTON	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU501	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU501	PALEO	CLOVIS	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU501	PALEO	DALTON	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU501	PALEO	QUAD	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU502	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU504	ARCH	BIFURCATE	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU504	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU505	ARCH	BIG SANDY	SPRING	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU505	ARCH	KIRK CN	SPRING	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU507	ARCH	BIG SANDY	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU507	ARCH	KIRK CN	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU507	PALEO	DALTON	SPRING	TENNESSEE	HIGHLAND	UPLAND SLOPE

Table F.2 (continued). Qualitative Alabama Site File Data for Sites in the Project Area.

Site	Stage	Phase	Nearest Water	Physiographic District	Physiographic Section	Topographic Association
LU509	PALEO	CUMBERLAND	SECOND	TENNESSEE	HIGHLAND	TERRACE
LU512	PALEO	DALTON	FIRST	FALL	COASTAL	UPLAND SLOPE
LU513	ARCH	BIG SANDY	THIRD	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU514	PALEO	CLOVIS	SECOND	TENNESSEE	HIGHLAND	UNAVAILABLE
LU518	ARCH	BIG SANDY	SPRING	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU518	ARCH	KIRK CN	SPRING	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU518	PALEO	CUMBERLAND	SPRING	TENNESSEE	HIGHLAND	FLOOD PLAIN
LU534	PALEO	CLOVIS	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU562	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU574	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU574	PALEO	GREENBRIER	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU576	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND CREST
LU580	ARCH	KIRK CN	SINK	TENNESSEE	HIGHLAND	UPLAND CREST
LU586	PALEO	CUMBERLAND	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU587	ARCH	KIRK CN	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU592	ARCH	KIRK CN	LAKE	TENNESSEE	HIGHLAND	UPLAND CREST
LU603	ARCH	BIFURCATE	THIRD	TENNESSEE	HIGHLAND	UPLAND CREST
LU634	ARCH	BIG SANDY	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU634	ARCH	KIRK CN	FIRST	TENNESSEE	HIGHLAND	UPLAND SLOPE
LU65	ARCH	BIG SANDY	SECOND	FALL	COASTAL	UNAVAILABLE
LU65	PALEO	CUMBERLAND	SECOND	FALL	COASTAL	UNAVAILABLE
LU74	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UNAVAILABLE
LU80	ARCH	BIG SANDY	RIVER	TENNESSEE	HIGHLAND	UPLAND BASE
LU80	ARCH	KIRK CN	RIVER	TENNESSEE	HIGHLAND	UPLAND BASE
LU85	ARCH	KIRK CN	MAJOR	TENNESSEE	HIGHLAND	UNAVAILABLE

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