

To The Graduate Council:

I am submitting herewith a thesis written by Stephen Byrnes Carmody entitled “Hunter/Gatherer Foraging Adaptations during the Middle Archaic Period at Dust Cave, Alabama.” I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Kandace R. Hollenbach, Major Professor

We have read this thesis
and recommend its acceptance:

David G. Anderson

Boyce N. Driskell

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

**Hunter/Gatherer Foraging Adaptations during the Middle Archaic
Period at Dust Cave, Alabama.**

A Thesis
Presented for the
Masters of Arts
Degree
The University of Tennessee, Knoxville

Stephen B. Carmody

December 2009

Abstract

Dust Cave, located in northern Alabama, was occupied seasonally for approximately 7,000 years, spanning five cultural occupations beginning with the Late Paleoindian period (12,650-11,200 cal B.P.) and extending into the Benton period (6,500-5,600 cal B.P.) (Sherwood et al. 2004). Due to the exceptional preservational environments found within the cave, the well preserved organic materials recovered from the site have provided a better understanding of both cultural and economic aspects of prehistoric life including subsistence strategies and mobility.

My research focuses on these aspects of life during the Eva/Morrow Mountain (8,400-6,000 cal B.P.) and Benton (6,500-5,600 cal B.P.) components at Dust Cave through the analysis of botanical remains. My objectives are to contribute to a better understanding of foraging adaptations and strategies used by hunter-gatherers in northern Alabama during the Middle Archaic period. Also, by further comparison of these materials to previously analyzed botanical materials from the site's earlier occupations I attempt to show that hunters-gatherers adapted their subsistence strategies in response to a changing environmental and cultural landscape. I do so through the application of a diet breadth model. Developed within evolutionary ecology, diet breadth models attempt to predict how changing environments affect resource selectivity and explain resource selectivity by assuming that individuals make choices to acquire the most valuable resources in terms of their energetic return rates (Bettinger 1987:132).

Results of this research show that through time hunter-gatherers foraged more efficiently by focusing their subsistence practices on more highly ranked food resources in terms of energetic return rates (kcal/hr). Evidence is provided by the absence of edible seeds, a lower

ranked resource, from the Middle Archaic diet as efforts were focused on more highly ranked food resources, like hickory nuts, in response to changing cultural and environmental conditions. More efficient foraging practices allowed individuals and groups living in resource rich areas to maximize their return rates and increase their genetic fitness by providing more time for individuals to participate in non-foraging activities, which would have provided these individuals with evolutionary advantages over individuals and groups that occupied less favorable environments.

Table of Contents

Chapter 1: Introduction	1
Chapter 2: Environmental and Cultural Background.....	4
The Natural Environment	4
Cultural Environment.....	7
The Paleoindian Period	7
The Archaic Period	10
Background History of Northern Alabama.....	15
Dust Cave Excavation.....	19
Previous Research.....	25
Lithic Technology.....	25
Faunal Analysis.....	29
Botanical Analysis	33
Features Analysis	39
Skeletal Analysis.....	42
Chapter 3: Methods.....	44
The Dust Cave Samples	46
Types of Analysis	50
Chapter 4: Results	54

Results from Column Samples.....	54
Results from Feature Samples	67
Conclusions from Middle Archaic Column and Feature Sample	73
Trends in Plant Use from the Late Paleoindian through the Benton Period at Dust Cave	74
Column Samples through Time	74
Feature Samples through Time	82
Trends through Time in Plant Exploitation at Dust Cave.....	94
Changes in Artifact Densities in Middle Archaic Column Samples.....	95
Chapter 5: Botanical Materials Discussion.....	104
Plant Remains Recovered from the Middle Archaic at Dust Cave.....	104
Nuts.....	106
Hickory	106
Acorn.....	109
Black Walnut	112
Hazelnuts.....	112
Fruits	113
Hackberry.....	113
Persimmon	114
Sumac.....	114

Wild Grapes	115
Greens	115
Purslane.....	116
Poke.....	116
Bedstraw	116
Squash.....	117
Summary	118
Chapter 6: Discussion	119
Evolutionary Ecology and the Diet Breadth Model.....	119
Application of Optimal Foraging Models.....	121
Diet Breadth Model.....	123
Application of the Diet Breadth Model to the Dust Cave Botanical Record.....	127
Increases in Foraging Efficiency	134
Environmental Changes	134
Technological Changes	141
Implications of Increased Foraging Efficiency: Time Minimization vs. Resource Maximization	146
Burials at Dust Cave	147
Lithics	148

Decrease in Lithics from Flotation Samples	149
Bifacial Technology.....	150
Raw Materials	151
Faunal Materials.....	151
Features	152
Logistical Organization.....	153
Chapter 7: Conclusion.....	154
References	158
Appendix.....	177
Vita.....	200

Table of Figures

Figure 2.1: Projectile points recovered from Dust Cave.....	16
Figure 2.2: Profile drawing of Dust Cave entrance chamber. Adapted from Sherwood et al.2004.	21
Figure 2.3: Percentages of animal use through time. LP-Late Paleoindian, ESN-Early Side- Notched, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton. NISP-Number of Individual Specimens Reconstructed from Walker 1998.	30
Figure 2.4: Aquatic vs. terrestrial resource use through time. LP-Late Paleoindian, ESN-Early Side-Notched, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton. NISP- Number of Individual Specimens. Reconstructed from Walker 1998.	32
Figure 3.1: Plan view of Dust Cave. Adapted from Sherwood et al.2004.....	48
Figure 4.1: Ratios of plant density in Middle Archaic column samples. A-Benton period, B- Eva/morrow Mountain period.....	61
Figure 4.2: Ratio of plant density per year for Dust Cave Middle Archaic column samples. A- Benton period, B-Eva/Morrow Mountain period.....	61
Figure 4.3: Relative density of wood in Middle Archaic column samples. A-Benton, B- Eva/Morrow Mountain.....	63
Figure 4.4: Relative Density of hickory in Middle Archaic column samples. A-Benton / B- Eva/Morrow Mountain.....	63
Figure 4.5: Relative density of fruit in Middle Archaic column samples. A - Benton, B - Eva/Morrow Mountain.....	64
Figure 4.6: Relative density of acorn in Middle Archaic column samples. A – Benton period/B- Eva/MorrowMountainperiod.	64
. 65	
Figure 4.7: Plant materials in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	68
Figure 4.8: Density of wood in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	69
Figure 4.9: Density of acorn in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	69
Figure 4.10: Density of hickory in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	70
Figure 4.11: Boxplot shows a comparison of the density of fruits between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	70
Figure 4.12: Comparison of relative density of wood between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	71
Figure 4.13: Comparison of the relative density of hickory between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	71
Figure 4.14: Comparison of the relative density of fruit between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.	72
Figure 4.15: Comparison of the relative density of acorn between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period	72

Figure 4.16: Changes in Plant Material Density through Time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	77
Figure 4.17: Plant Density per year in Dust Cave components. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	78
Figure 4.18: Relative density of hickory through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	79
Figure 4.19: Relative density of wood through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	79
Figure 4.20: Relative density of acorn through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	80
Figure 4.21: Relative density of walnut through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	80
Figure 4.22: Relative density of fruit through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	81
Figure 4.23: Relative density of edible seeds through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	82
Figure 4.24: Changes in plant density through time in Dust Cave feature samples. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	85
Figure 4.25: Changes in wood density through time in Dust Cave feature samples. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.....	85
Figure 4.26: Changes in density of hickory through time at Dust Cave from feature samples. A-Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.	86
Figure 4.27: Changes in density of acorn through time at Dust Cave from feature samples. A-Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.	87
Figure 4.28: Changes in density of black walnut through time at Dust Cave from feature samples. A-Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.	87
Figure 4.29: Changes in density of Hazelnut through time at Dust Cave from feature samples. A-Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	88

Figure 4.30: Changes in fruit density through time from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	89
Figure 4.31: Changes in edible seed density through time from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	89
Figure 4.32: Relative density of hickory through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	90
Figure 4.33: Relative density of acorn through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	91
Figure 4.34: Relative density of black walnut through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	91
Figure 4.35: Relative density of hazelnut through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	92
Figure 4.36: Changes in use of edible seeds through time at Dust Cave. . A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	93
Figure 4.37: Changes in the relative density of fruits through time at Dust Cave. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.	93
Figure 4.38: Density of shell recovered from Middle Archaic column samples. A - Benton / B- Eva/MorrowMountain.....	95
Figure 4.39: Lithic materials recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain.....	96
Figure 4.40: Density of bone recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain.....	96
Figure 4.41: Density of plant remains recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain period.....	97
Figure 4.42: Density of shell recovered from Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched/Kirk Stemmed mixed / E - Early Side-Notched / F – Paleoindian.....	98
Figure 4.43: Density of bone in Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched/Kirk Stemmed mixed / E - Early Side-Notched / F – Paleoindian.....	99
Figure 4.44: Density of lithic materials recovered from Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched / Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian	100
Figure 4.45: Density of plant remains in Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched / Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian	101

Figure 4.46: Comparison of nutshell to debitage in Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain Phase	102
Figure 4.47: Comparison of nutshell to debitage in Dust Cave column samples. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian	102
Figure 6.1: Diet breadth model (adapted from MacArthur and Pianka 1966).....	126
Figure 6.2 : Increase in July temperatures from 15,000 to 5,000 years cal B.P. (adapted from Viau et al. 2006).....	136
Figure 6.3: Changes through time in surface area of features. Calculations were made using major and minor axis dimensions provided by Homsey (2004). A-Benton / B - Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and ESN / E-Early Side Notched / F-Late Paleoindian periods.	143
Figure 6.4: Changes in the surface area of expedient hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D- Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.	144
Figure 6.5: Changes in the surface area of pit hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D- Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.	144
Figure 6.6: Changes in the surface area of surface hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.	145

List of Tables

Table 2.1: Lithic Artifacts by Component (Reconstructed from Meeks 1994:88).	26
Table 2.2: Feature Types by Component.(Reconstructed from Homsey (2004:209).....	39
Table 2.3: Burials Exhibiting Evidence of Violence at Dust Cave.(Reconstructed from Davis 2004 and Turner 2006).....	43
Table 3.1: Column Samples Analyzed from Middle Archaic Components	52
Table 3.2: Features Analyzed From Middle Archaic Components	53
Table 4.1: Plant Remains Recovered from Eva/Morrow Mountain column samples.	55
Table 4.2: Plant Materials Recovered from Benton column samples. Weight in grams.	58
Table 4.3: Ubiquity Results from Middle Archaic Column Samples.	59
Table 4.4: Calculations for Plants per Year	62
Table 4.5: Plant Remains Recovered from Eva/Morrow Mountain Feature Samples.....	65
Table 4.6: Plant Remains Recovered from Benton Feature Samples.	66
Table 4.7: Ubiquity results for Middle Archaic Feature Samples	67
Table 4.8: Table of Ubiquity Results for column samples from Dust Cave.	75
Table 4.9: Ubiquity Values for Dust Cave Feature Samples.	83
Table 5.1: Seasonality of Plant Remains Recovered from Dust Cave Eva/Morrow Mountain and Benton Samples (adapted from Hollenbach 2005 and Scarry 2003).	105
Table 6.2: Food Resources Exploited through Time at Dust Cave.....	129
Table 6.3: Forest Productivity in Northern Alabama.....	139
Table 6.4: Forest Productivity per Person.....	140
A.1: Botanical Remains Recovered from Dust Cave Middle Archaic Column Samples (weights in grams).	178
A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).	188
A.3: Artifacts recovered from Dust Cave Middle Archaic Column samples (cont).....	194
A.4: Artifacts Data from Middle Archaic Feature Samples	198

Chapter 1: Introduction

Dust Cave (1LU496), located in Lauderdale County in northern Alabama, was occupied for ca. 7,000 years, from the Late Paleoindian through the Middle Archaic period. Discovered in 1984 by Dr. Richard Cobb, the cave was excavated between 1989 and 2002. By the conclusion of the excavation five cultural components were identified; Late Paleoindian (10,650-9,200 cal B.C.); Early Side-Notched (10,000-9,000 cal B.C.); Kirk Stemmed (8,200-5,800 cal B.C.); Eva/Morrow Mountain (6,400-4,000 cal B.C.); and Benton (4,500-3,600 cal B.C.). The well preserved organic remains found within the cave provide an extensive record of hunter-gatherer adaptations and subsistence practices during these time period. Research at Dust Cave has greatly contributed to our understanding of several aspects of prehistoric life through studies involving the regional chronology, human and dog burials, subsistence studies focused on plant and animal remains, technofunctional studies of lithics assemblage, and the form and function of features (Driskell 2009:240-247).

My objectives through this research are to identify and interpret the plant remains recovered from the Eva/Morrow Mountain and Benton components of the Middle Archaic period, and to compare the samples to previously analyzed plant remains from the Late Paleoindian, Early Side-Notched, and Kirk Stemmed components to explore how hunter-gatherers adapted their foraging practices through time in relationship to a changing cultural and physical environment. I do this through the application of optimal foraging theory, more specifically a diet breadth model. Through the examination and analysis of the botanical remains recovered from Middle Archaic contexts at Dust Cave, I hope to contribute to a better

understanding of foraging adaptations and strategies used by hunter-gatherers in northern Alabama and across the Midsouth during this time.

Optimal foraging theory, developed within evolutionary ecology, suggests that in areas such as diet choice, decisions are made in order to maximize the net rate of energy return (Bettinger 1991:84). Under these models behaviors are considered to be adaptive because they are conditioned by environmental variability and lead to increased fitness. Individuals who can maximize return rates through more efficient foraging will have an evolutionary advantage over those who cannot. Over time these individuals will become more established and be able to spend more time involved in non-foraging activities. Diet breadth models attempt to answer specific questions with regards to a forager's preference in food choice, such as which items will be included or excluded from a forager's diet upon encounter, the range of items included in a foragers diet, and how this is impacted by the environment, meaning which items will be dropped or added from a diet as environmental conditions change (Kaplan and Hill 1992; Winterhalder 1981:23). This is determined by calculating return rates in kcal/hr, factoring in processing costs and handling times.

The following chapters in my study are organized as follows. Chapter Two provides an environmental and cultural background of the Southeast from the Late Paleoindian period through the Middle Archaic period. Because behavior is considered to be influenced by the environment, the time depth of this study is important for recognizing patterns of behavior, or adaptations, to a changing environment, both physically and culturally. A review of the previous research conducted at Dust Cave is included in Chapter Two and incorporated throughout.

Chapter Three discusses the samples included in research. It included a discussion of how botanical remains enter the archaeological record, are recovered, and the quantitative methods used in their analysis.

Chapter Four explores the results of my analysis of the Middle Archaic botanical assemblage from Dust Cave. I discuss trends that are apparent during the Middle Archaic and then expand the discussion and analysis to include the botanical assemblage from previous occupations in order to explore larger trends that occur over the entire occupational sequence of the cave.

In Chapter Five I discuss each taxon recovered from the Middle Archaic samples in regards to their seasonality and the way that they were used by prehistoric populations.

Chapter Six discusses the application of the diet breadth model, my interpretations of the results, and the implications of its results. I discuss foraging efficiency in terms of the diet breadth model and explore the different factors believed to lead to increased foraging efficiency over time by the occupants of Dust Cave. I explore the role of the changing environment, and in turn resource base, and the effect that it had on foraging efficiency in northern Alabama.

In Chapter 7 I provide my interpretations of the results and this study and offer my conclusions.

Chapter 2: Environmental and Cultural Background

In order to understand the patterns that appear in the archaeological record over the 7,000 year occupation of Dust Cave, it is important to understand the environmental and cultural context from the time spanning the periods of occupation of the cave. Subsistence activities, mobility patterns, and the use of the surrounding landscape by prehistoric hunter-gatherers in eastern North America were all conditioned by responses to the local environment. Changes that occur in the archaeological record can be explored as a response to changes and fluctuations in the local natural and cultural environment.

The Natural Environment

The beginning of the Late Glacial interval (16,500-12,500 B.P.) corresponds with the retreat of the Laurentide Ice Sheet (Delcourt and Delcourt 1980:147). At the beginning of the Late Glacial in areas between 34 and 35 degrees north latitude, deciduous tree populations began to colonize habitats left vacant by boreal conifers, like the jack pine, that were unable to compete due to changing climatic conditions. In response to this episode of climatic warming spruce-jack pine forests replaced jack pine dominated forests in Kentucky and middle Tennessee, while in the mid-latitudes of the Southeast cool-temperate mixed conifer-northern hardwoods composed of hemlocks, pines, spruce, fir, oak, elm, birch, ash, ironwood, maple and beech trees replaced the jack pine-spruce forests, with oak-hickory-southern pine forests remaining stable in the deep South (Delcourt 1979; Delcourt and Delcourt 1980). During this time interval northern pine species were replaced by increasing numbers of mesic boreal and cool-temperate taxa like spruce and fir. This change reflects warming climatic conditions along with increases in rainfall during

the summer growing seasons. Oaks and hickories also increased in numbers due to increases in the length of growing seasons and an increase in the mean-annual temperatures.

The Pleistocene-Holocene transition, around 11,650 B.P., is associated with the end of the Younger Dryas cooling event (Anderson, Russo, and Sassaman 2007; Sherwood et al. 2004:544). Changing environmental conditions resulted in temperate plant communities replacing boreal plant communities as conditions became less tolerable for boreal forest species (Delcourt and Delcourt 1985:19; Klippel and Parmalee 1974). This transition also resulted in the restructuring of the animal community. Mammalian communities present during the Pleistocene were composed of animals that would today be “ecologically incompatible” due to changing climatic conditions (Graham and Mead 1987:371). Though some of these taxa are extinct their remains provide important information regarding past environments. The end of the Pleistocene is also associated with a major extinction episode of large mammals, 32 genera in North America alone, that were more reliant on cooler climates, like the American mastodon, camel, mammoth, ground sloth, and large cats (Bonnichsen et al. 1987:419; Graham and Mead 1987:386; Wright 1986, 1991:525). Indications from the archaeological remains of smaller mammals recovered from the Midsouth also provide strong evidence to support the changing climate across the region at the end of the Late Pleistocene (Klippel 1987; Klippel and Parmalee 1982; Parmalee and Klippel 1981). Assemblages recovered from Russell Cave, Alabama, and Cheek Bend Cave, Tennessee, suggest that vertebrate fauna from the Early Holocene are essentially the same as modern fauna (Graham and Mead 1987:387; Klippel and Parmalee 1982).

During the Early-Holocene interval (12,500-8,500 B.P.), cool-temperate mesic species expanded throughout the mid-latitudes of the Southeast. Oak and hickory trees formed the most

abundant type of vegetation in the forests of the southeastern United States during this time (Jacobson et al 1987:282). Between 34 and 37 degrees north latitude, cooler climates favored the expansion of the mixed hardwood forests (Delcourt and Delcourt 1979, 1980). Based on information from sites with sedimentation records that span the Early Holocene interval, the forest communities of the Early Holocene differ greatly from those that developed during the later Middle and Late Holocene (Delcourt and Delcourt 1985).

The transition from the Early Holocene to the Mid Holocene at approximately 8,900 B.P is marked by the Hypsithermal warming episode (Anderson, Russo, and Sassaman 2007; Deevey and Flint 1958; Sherwood et al. 2004:548). During this period of changing environmental conditions the climate became warmer and drier. Major vegetation changes occurred over the Southeast during the Mid-Holocene interval (8,500-4,000 B.P). As a result the hardwood forests of the initial Holocene were replaced by oak-hickory, mixed hardwoods, and southern pine forests (Delcourt et al 1983; Delcourt and Delcourt 1985; Sherwood et al. 2004:548). By 5,000 B.P, coastal plain forests, which had been previously dominated by xeric species of oak and hickory trees, were replaced by southern pine forests. Oak-hickory-southern pine forests became restricted to the Piedmont and the Ozarks (Delcourt and Delcourt 1980). Oak-chestnut forests became dominant in the central and southern Appalachian Mountains (Delcourt and Delcourt 1980:150; Delcourt and Delcourt 1985).

In addition to changes in vegetation, low energy meandering rivers replaced the braided stream systems of the Early Holocene. Floodplains were stabilized as rising sea levels diminished channel sinuosity (Schuldenrein 1996:9). Enhanced floodplains and shoal environments resulting from warming and drying trends made riverine environments favorable

for extended occupation and frequent reoccupation (Anderson, Russo, and Sassaman 2007; Dye 1996; Smith 1986:22). The species that compose the faunal assemblages from the southeastern United States during the Middle Holocene are virtually the same as modern species (Graham and Mead 1987:392; Walker 1998).

Cultural Environment

The southeastern United States was initially occupied during the Late Pleistocene by groups of highly mobile hunter/gatherers, known as Paleoindians (Anderson et al 1996:3). These earliest populations were believed to have been small bands of hunter-gatherers who shifted their residences in response to available food resources (Steponaitis 1986:370). Paleoindian sites are identified by the presence of lanceolate-shaped, fluted projectile points (Anderson et al. 1996:7). The Southeast has the largest collection of Paleoindian points in North America with the largest concentrations found in the lower Cumberland, the central Tennessee, and the central Ohio valleys (Anderson et al. 2005). However, the majority of these points lack accurate contextual information, making the timing and dating of early Paleoindian sites a fluid process that changes as new sites are discovered and excavated (Sherwood et al 2004:542). The Paleoindian period has been divided into Early, Middle, and Late subperiods, distinguished by differences in sociopolitical organization, technology, and material culture (Anderson and Sassaman 1996; Bense 1994:3).

The Paleoindian Period

The initial colonization of the southeastern U.S. occurred during the Early Paleoindian period by groups of highly mobile bands of hunter-gatherers, prior to 12,900 cal B.P. (Anderson

2001:154; Sherwood et al. 2004:542). Early Paleoindian sites are distinguished by the presence of widespread Clovis style lanceolate projectile points, which are accompanied by a small toolkit comprised of lithic tools made from high-quality cherts that were highly portable and efficient for the butchering and processing of large game animals (Bense 1994:47).

The Middle Paleoindian period in the Southeast dates from 12,900 to 12,000 cal B.P. (Sherwood et al. 2004:544). These sites are identified by a series of fluted and unfluted projectile points including the Suwannee, Simpson, Clovis Variant, and Cumberland points. While Beaver Lake, Quad, and Cumberland points have been classified as transitional Middle/Late Paleoindian points by some (Anderson et al. 1996:11), they have been classified as Middle Paleoindian points in the middle Tennessee Valley (Sherwood et al. 2004:544). The stylistic differences in projectile points during the Middle Paleoindian period are attributed to regional diversity resulting from adaptations to different environments, the fragmentation of the previous Clovis tradition, and a rapid population increase (Anderson 2001:155; Bense 1994:51). Evidence of regionalization can also be witnessed by the increase in the use of local lithic resources also during this time period.

The Late Paleoindian begins ca. 12,000 cal B.P., and lasted until 11,200 cal B.P. Sites are identified by the presence of Dalton and Hardaway Side-Notched point types (Sherwood et al. 2004:544). Similarities exist in the land-use patterns and lithic technologies between Dalton and earlier Paleoindian cultures (heavy resharpening and serrated edges attributed to changing subsistence strategies resulting from changing climatic conditions), justifying its inclusion as a Late Paleoindian tradition (Anderson et al. 1996:13). Also, based on radiocarbon dates, the occurrence of Dalton points (12,000 -11,200 cal B.P.) during and shortly following the Younger

Dryas, from ca. 12,900 until 11,650 cal B.P., further justifies the placement of the Dalton traditions within the Late Paleoindian period (Sherwood et al. 2004:545). The change in point styles during the Late Paleoindian period, from lanceolate to notched, is thought to be indicative of a shift from large to small game procurement and processing strategies (Anderson 2001:156; Bense 1994:51). The appearance of these new point styles is also accompanied by a changing lithic toolkit that shifted from specialized hunting and processing tools towards tools that could be used for a greater variety of tasks.

The return to colder conditions brought about by the Younger Dryas would have contributed to subsistence stress among populations during the Paleoindian period. Environmental changes during the Paleoindian period resulted in the replacement of late Pleistocene plants and animals in favor of modern species (Anderson et al. 1996:13). The extinction of megafauna would have forced populations to focus on hunting smaller game animals, such as deer and birds (Anderson 2001:156). Anderson (2001) suggests that an increase in the use of plant foods that occurred during the Late Paleoindian was possibly a response to the decrease in prey sizes, but possibly as a result of familiarity with the local environment (Anderson 2001:156). Others, however, suggest that the lack of plant remains from earlier Paleoindian sites is more indicative of preservational issues, arguing that plant food was just as important during previous Paleoindian periods but is rarely recovered archaeologically. Food remains recovered from Late Paleoindian sites suggest that modern plants and animals made up the diet of Late Paleoindian populations. Remains of terrestrial mammals, fish and turtle, and deer, elk, and bison have been recovered from sites containing Late Paleoindian components, while hickory and black walnut indicate a reliance of plant foods (Bense 1994:56; Hollenbach

2005). An increase in population is also believed to have occurred during the Late Paleoindian period, which resulted in shifts in the location and number of settlement sites identified in the region (Anderson 2001:156; Bense 1994:55).

The Archaic Period

The Archaic period represents the longest stage of cultural developments in the Southeast, lasting from approximately 11,500 until 3,000 cal B.P. (Anderson 2001:156; Bense 1994:62). As with the earlier Paleoindian period, projectile points remain the most significant temporal indicators. Archaic sites are identified by the presence of stemmed and notched projectile points. While chipped stone toolkits were not expanded greatly, new tools were produced by improved ground and polished stone techniques. Axes, celts, and ornamental items were all made using these new technologies (Caldwell 1968:12; Griffin 1952, 1967:178). Other technological innovations are also used to identify Archaic sites such as ceramics during the Late Archaic, wood and stone containers, and shell tools and ornaments (Bense 1994:62). Long distance exchange networks, mounds and earthen works all appear and help identify the Archaic period in the Southeast (Bense 1994:62; Johnson and Brookes 1989; Meeks 1998). An increase in the number of sites during the Archaic period indicates that Archaic populations had successfully spread into almost all areas of the region. Plant and animal remains indicate that a diverse range of food resources was being exploited by Archaic populations. Settlement patterns closely resemble those used previously by Dalton populations in the central Mississippi Valley; involving seasonal base camps and special purpose camps. Similar to the preceding Paleoindian period, the Archaic period is also broken into three sub periods, the Early, Middle, and Late Archaic (Anderson and Sassaman 1996, 2004; Caldwell 1958:17).

The Early Archaic period begins at approximately 11,500 cal B.P. at the boundary of the Pleistocene-Holocene transition, and ends at approximately 8,900 cal B.P. with the onset of the Hypsithermal warming event (Anderson 2001; Anderson and Hanson 1988; Anderson et al. 1996:15, 2007). Side-notched, corner-notched, and bifurcate based projectile points are used to identify Early Archaic sites across the Southeast. Big Sandy, Palmer, Kirk Corner-Notched, MacCorkle, and LeCroy types are examples of Early Archaic point types (Anderson et al. 1996:15). In the Middle Tennessee Valley, Early Archaic sites are identified by Early Side-Notched, Kirk Corner-Notched, and bifurcate forms of projectile points including LeCroy and Kanawha (Sherwood et al. 2004:546; Walthall 1980:54). Projectile points manufactured during the Early Archaic were notched, smaller and more triangular than the earlier Paleoindian points, but were more similar to those made and used by Dalton peoples (Bense 1994:65). An increase in the number of sites and artifacts discovered around the Southeast suggests population rapidly expanded during the Early Archaic period. As population increased and mobility decreased, it is believed that range size decreased from river valleys to smaller portions of single drainage systems. Small family groups were believed to have occupied river valleys for most of the year, congregating into larger groups during periods of resource abundance (Anderson 2001:157; Bense 1994:72).

Seen as a time of “dramatic cultural change in Eastern North America”, the Middle Archaic period lasted from ca. 8,900 until 5,700 cal B.P. (Anderson 2001:158, 2007; Kidder and Sassaman 2009:667). The appearance of shell and earthen mounds, long distance trade networks, new tool forms, and evidence for interpersonal violence indicate that local cultures were growing in both scale and complexity (Anderson 2001:158, 2002, 2004:270, 2007;

Caldwell 1958:14; Ford and Willey 1941:335; Kidder and Sassaman 2009:667; Jefferies 1995, 1996, 1997; Lewis and Kneberg 1959:161; Sassaman 2005; Walthall 1980:38). Early Archaic notched projectile points were replaced regionally with stemmed projectile points during the Middle Archaic period. In the Middle Tennessee Valley, Middle Archaic sites are identified by the presence of Kirk Stemmed/Serrated, Eva/Morrow Mountain, Sykes/White Mountain, and Benton projectile points (Sherwood et al 2004:548; Walthall 1980:58). Projectile points from this period were heavily resharpened and also transformed into drills and endscrapers. Three interrelated trends mark the beginning of the Middle Archaic period: the Hypsithermal warming event; increased territoriality and regional diversity of projectile points; and new innovations in technology involving groundstone, bone, and antler tools (Walthall 1980:58).

The Hypsithermal refers to a climatic event when post glacial warming trends peaked and seasonal temperature extremes were greater (Anderson 2001:158; Bense 1994:74; Deevey and Flint 1957). The hot and dry weather conditions resulting from the Hypsithermal climatic event caused a change in the composition of the forests in the Southeast and a change in the hydrology of river valley floodplains (Anderson 2003; Bense 1994:74). Decreased rainfall stabilized river channels in regions above 34 degrees north latitude. This stabilization resulted in the expansion of floodplains and the creation of oxbow lakes and swamps that stayed wet most of the year, in areas outside of the main river channels (Bense 1994:74; Smith 1986).

As a result of river channel stabilization, backwater swamps, oxbow lakes, active streams, and shallow water and shoal habitats along mid-latitude river systems were created providing favorable environments for shellfish exploitation by humans (Dye 1996; Smith 1986:22). Shellfish became a major constituent of the Middle Archaic diet and were collected in

large numbers from shoal environments in the Southeast, which could have helped to situate populations near southeastern river valleys (Anderson 2001:160; Ford and Willey 1941:332; Griffin 1952; Klippel and Morey 1986; Styles and Klippel 1996; Sassaman 2005:88; Smith 1986:22). During the Middle Holocene several new species of shallow water mollusks were incorporated into the diet of populations living along the Tennessee River, as well as other major river systems in the Southeast (Anderson 2001:159; Smith 1986:22;). While they provide a poor source of food energy and meat, they are rich in vitamins and minerals such as iron and calcium (Klippel and Morey 1986:808-809; Klippel and Parmalee 1974).

Increased population during the Middle Archaic period resulted in restricted group mobility over much of the Southeast, forcing people to live closer on the landscape and creating an environment for exchange and competition (Anderson 2001:160; Jefferies 1995, 1996, 1997; Meeks 1998). Increased territoriality can be witnessed in both mobility patterns and lithic technologies. Constraints on mobility fueled by increasing populations led to a reliance on local raw materials and regional stylistic diversity of lithic toolkits (Amick and Carr 1996:44; Meeks 1998:115; Sassaman 1995:179; Walthall 1980:58). The changes in lithic technologies that occurred during the Middle Archaic reflect large scale behavioral and organizational changes that affected the way people operated on the landscape. Lithic technologies in the Middle Archaic show a shift away from the heavily curated lithic technologies of the Paleoindian and Early Archaic lithic toolkits, towards a more expedient lithic toolkit. This shift has been attributed to a move from logistical mobility towards residential mobility (Carr and Amick 1996:43-44).

The Middle Archaic is also viewed as a time of great technological innovations based on the significant advances made in groundstone tool technologies (Griffin 1967:156 Kidder and Sassaman 2009:671; Smith 1986:18). Smith (1986) considers the amount of labor involved in producing a new groundstone tool technology to be evidence of the growing importance of plant resources, as well as evidence of a diversifying economic base. Grooved axes and other formal woodworking tools were introduced into the toolkit. Atlatl weights, which allowed the spears to be thrown farther and harder, were an important development, as well as netsinkers, which were used to keep fish nets and traps underwater (Bense 1994:75; Griffin 1952). The heat treatment of lithic material also became widespread during the Middle Archaic period, in an attempt to extend the utility of available lithic resources by making the material more glass-like and easier to work (Amick and Carr 1996:45). Beads, pendants and ornaments made of shell, bone, and stone also became popular during the Middle Archaic period as indicated by long distance trade networks that were developed as a means to acquire ornaments, raw materials, and other materials sought as symbols of high status (Bense 1994:75; Ford and Willey 1941:333; Johnson and Brookes 1989; Meeks 1998).

Human burials in significant numbers are found at sites for the first time in the Southeast during the Middle Archaic period (Anderson, Russo, and Sassaman 2007; Bense 1994:78). The burials reveal information not only about the individual but also about the social organization of Middle Archaic populations. Grave goods have been recovered from burial sites across the Southeast during the Middle Archaic period, mainly utilitarian items and personal adornments such as shell beads, pendants, and projectile points. Most of the human remains are found in the flexed position but extended burials and cremations have been found as well (Bense 1994:79).

Human remains recovered with imbedded projectile points from the Mulberry Creek site in the Middle Tennessee River Valley show early evidence of violence in the archaeological record in the Southeast (Shields 2003).

Organizational changes evident in the Middle Archaic also emerge in the form of shell midden sites at approximately 7,500 cal B.P. in the Midsouth (Lewis and Kneberg 1959; Russo 1996; Sassaman 2005:88). These sites are composed of dense layers of midden, called midden mounds, and appear in the Tennessee River Valley, the Upper Tombigbee Valley, and in the eastern Florida Peninsula. These sites contain numerous domestic-style pit and hearth features as well as burials and show a marked difference in the use of the landscape during this time period (Bense 1994:82). Some believe that these accumulations of shell are representative of a mortuary tradition that used shell as a medium for burials, while other argue that many of the accumulations lack human burials and are simply midden deposits (Sassaman 2005:89).

Background History of Northern Alabama

In northern Alabama, archaeological excavations have provided valuable information about the Paleoindian period for the region. Though few dates older than 11,000 cal B.P. have been produced from excavated contexts, the number of fluted points found in the Tennessee River Valley makes it one of the richest regions in regards to Paleoindian sites in the United States (Anderson 2001; Meyer 1995; Sherwood et al. 2004). Paleoindians in northern Alabama are thought to have been highly mobile bands that lived in the river floodplains and in higher elevations near sinkholes (Meyer 1995:30). Major Paleoindian sites in northern Alabama include Dust Cave, Stanfield-Worley, Mulberry Creek, and the Quad site.

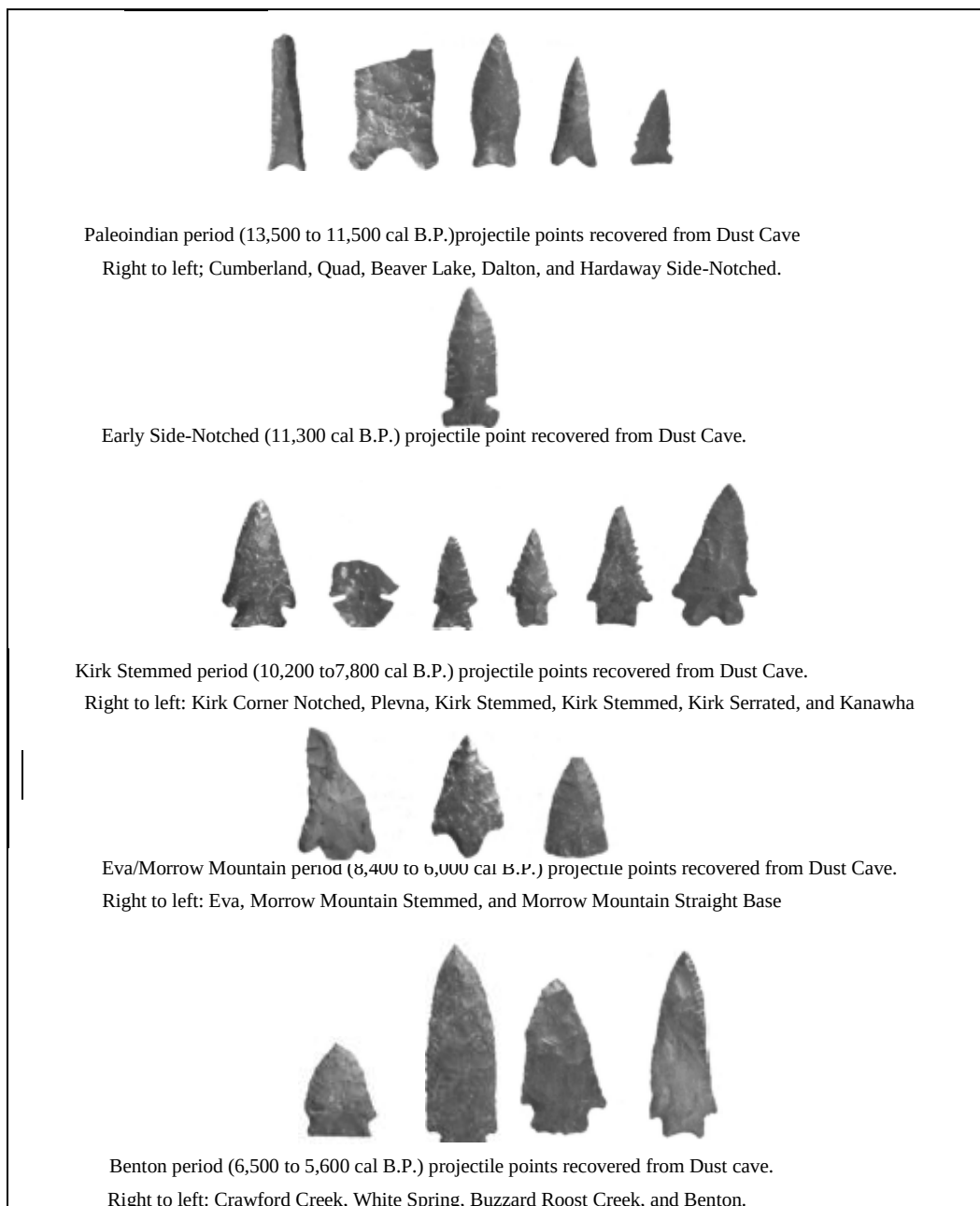


Figure 2.1: Projectile points recovered from Dust Cave.

The Early Paleoindian period (prior to 12,000 BP) in northern Alabama is identified by the presence of lanceolate, fluted Clovis type projectile points and other tools produced on blades from prepared cores (Futato 1983; Meyer 1995). Middle Paleoindian (12,000-11,000 B.P.) sites are identified by Cumberland and Redstone projectile points (Futato 1983). Late Paleoindian sites (11,000-10,000 B.P.) are identified by Quad, Dalton, and various other types of unfluted lanceolate points (Figure 2.1) (Futato 1983). The vast number of points found from these time periods made primarily of blue-grey Fort Payne chert which outcrops in the main channel of the Tennessee River near present-day Florence, Al. suggests that the major drainages were used for movement of both people and lithic materials (Futato 1983:297; Meyer et al. 1995:28).

Paleoindian sites in northern Alabama have also provided great insight into the diet and gathering activities of groups during the Late Paleoindian period, demonstrating the importance of nuts, fruits, and herbaceous plants. While hickory dominates the plant assemblages, black walnut, acorn and hazelnuts are also represented. Persimmon, grape, sumac, and hackberry are prevalent in sites across northern Alabama, as well as across the Southeast. Seeds of chenopodium, smartweed, purslane, pokeweed, bedstraw, amaranth, and wild legumes were recovered from sites as well. While most of the seeds would have added to the diets of hunter-gatherers during late summer/early fall, all of the leafy greens and shoots could have been used in early spring (Hollenbach 2005). Hollenbach (2005) suggests that the lack of plant remains associated with most Late Paleoindian sites, excluding nuts, is more attributable to sampling and preservation issues rather than a shift in gathering practices.

The Early Archaic period is defined by Big Sandy (9,500-9,000 B.P.), Kirk (9,000-8,500 B.P.), and the Bifurcate (8,500-8,000 B.P.) style projectile points (Fig. 2.1) (Futato 1983).

During the Early Archaic, bands of hunter-gatherers in northern Alabama are believed to have practiced seasonal movement patterns, which included periods of dispersion and aggregation (Futato 1983; Meyer et al. 1995:32). Sites are found in floodplains, uplands, and caves and rockshelters (Walthall 1998).

Faunal evidence suggests an emphasis on white-tailed deer hunting, which was supplemented by smaller animals like squirrel, raccoon, porcupine, passenger pigeon, and box turtle (DeJarnette et al. 1962; Meyer et al. 1995:31; Walker 1998). Plant assemblages indicate that while there was an increase in the use of hickory towards the end of the Early Archaic and possibly a decrease in the use of chenopod and black walnut, few real changes occurred in plant use between the Late Paleoindian period and the Early Archaic, with evidence supporting greater similarities between the two periods than differences (Hollenbach 2005:359).

Middle Archaic sites in northern Alabama are defined by the presence of Eva/Morrow Mountain (7,000-6,000 B.P.), Sykes/White Springs/Crawford Creek (7,000-6,000 B.P.), and Benton projectile points (5,600-5000 B.P.) (Fig.2.1) (DeJarnette et al. 1962; Driskell 1994; Futato 1983). While a number of major changes occurred during this period including long distance trade networks, evidence of intrapersonal conflict, and increased number of burials, the large scale exploitation of shellfish leading to the emergence of shell mounds is one of the most visible (DeJarnette et al. 1962; Meyer et al 1995:33; Shields 2003). While hickory use dominates botanical assemblages from Middle Archaic components, acorn, black walnut, beech, grape, persimmon, pokeweed, plum, and yellow star-grass seeds have also been recovered (Futato 1983).

Dust Cave Excavation

Dust Cave (1LU496) is located in the Tennessee River Valley region of northwestern Alabama in the karstic, limestone bluffs overlooking Coffee Slough, a tributary of the Tennessee River, in an area identified as the Highland Rim (Goldman-Finn and Driskell 1994:1; Johnson and Meeks 1994:67). The proximity of the cave to aquatic, floodplain, and upland resources provided excellent conditions for human occupation for over 7,000 years (Sherwood et al. 2004:533). As a result of river downcutting through Mississippian age rocks, Dust Cave became habitable approximately 10,600 B.P. as dropping water tables flushed river sediments that once filled the cave and buried the entrance between 17,000 to 15,000 B.P. (Collins et al. 1994:50; Sherwood et al. 2004:540).

Dr. Richard Cobb discovered Dust Cave in 1984 while recreationally exploring caves in the region (Driskell 2009:236). Bone and lithic debris recovered by Dr. Cobb from the inner chamber of the cave helped to identify its potential cultural significance. In 1989 it was determined that Dust Cave, as well as other caves in the Pickwick Basin had suffered from the adverse affects of the flooding of the Tennessee River floodplain. As such the cave was examined as part of a cultural resource assessment of caves for TVA (Sherwood et al. 2004:535). Dust Cave was initially excavated in 1989 under the supervision of Dr. Boyce Driskell from the University of Alabama during a summer field season. Five 30-x-30-cm test units were excavated no deeper than one meter. Upon the discovery of lithic debris from Test Units A and D, Test Unit A was expanded to 50 x 100 cm and eventually to a 2-x-2-m square (Driskell 2009:237; Goldman-Finn and Driskell 1994:5-6). Test Unit A was excavated to approximately 160 cm by the end of the 1989 field season, revealing a “complexly layered matrix” that included both

human and dog burials associated with the Seven Mile Island phase of the Middle Archaic (Goldman-Finn and Driskell 1994:6).

The excavation continued and was expanded during the 1990 and 1991 field seasons (Sherwood et al. 2004). During this time seven test units (A through G) were excavated down to bedrock (Sherwood et al. 2004:536). During the 1992 through 1994 field seasons a 2-x-12-m trench was excavated, revealing the stratigraphic composition of the cave (Sherwood et al. 2004:536). The excavations continued between 1996 and 2002, with the 2002 field season concluding the excavations. Dug in 5-cm levels, the excavation yielded a comprehensive stratigraphic profile using zones, subzones, and lenses within the subzones (Sherwood et al. 2004:536). The zones are labeled A through Y, with A being the youngest and Y, determined to have been Pleistocene residuum, being the oldest. The zones are associated with five archaeological components. Figure 2.2 below depicts the stratigraphic profile showing breaks between cultural periods.

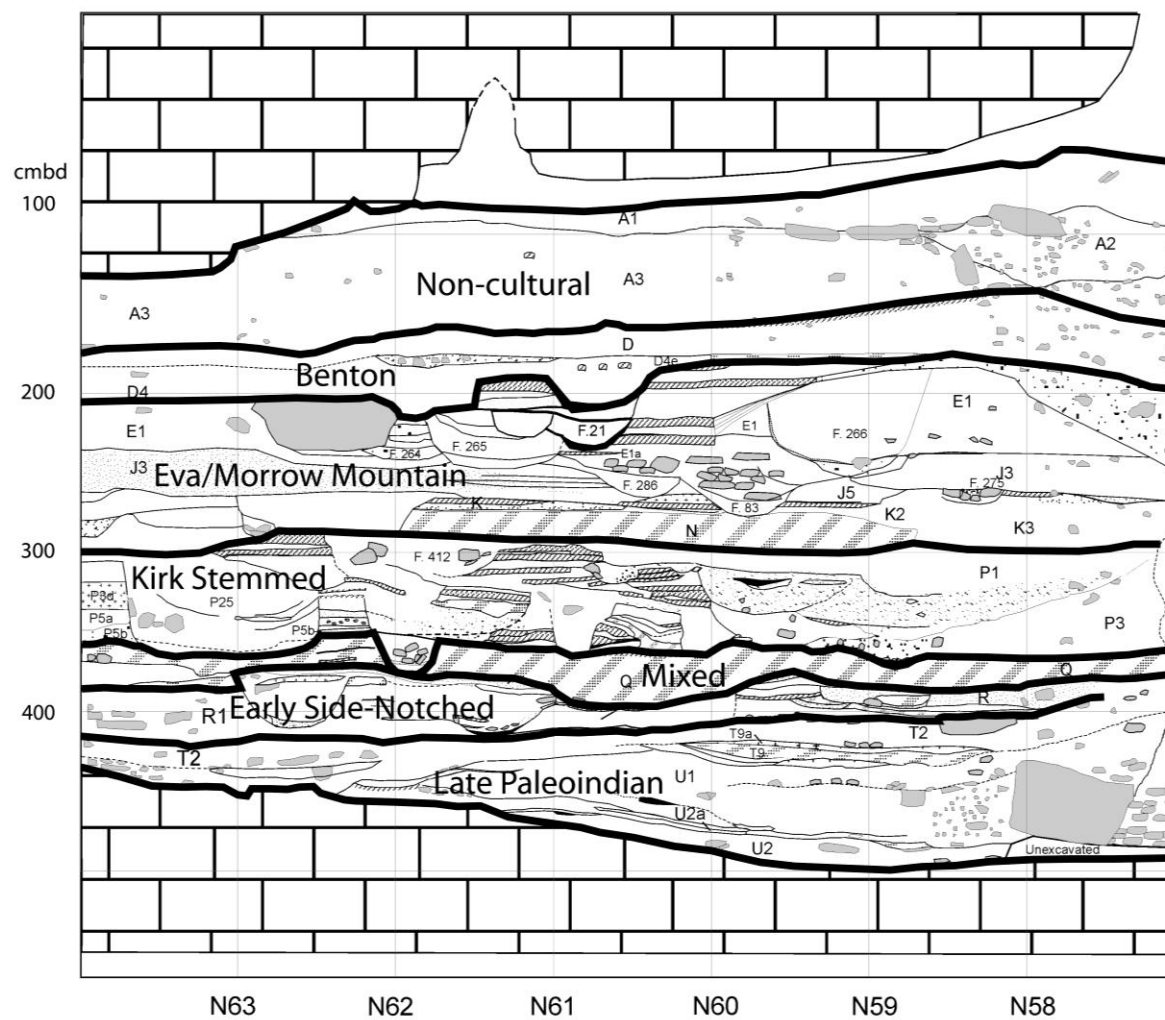


Figure 2.2: Profile drawing of Dust Cave entrance chamber. Adapted from Sherwood et al.2004.

The Late Paleoindian component is found in Zones T and U. The earliest radiocarbon date returned from Zone U suggests that the initial occupation of the cave occurred ca. 12,650 cal B.P. (Sherwood et al. 2004:544). Seventeen radiocarbon dates from Zones T and U place the dates of the Paleoindian occupation at Dust Cave between 12,650 and 11,200 cal B.P. (Sherwood et al. 2004:544). One reworked Cumberland point, Quad, Beaver Lake, Hardaway Side-Notched, and Dalton projectile points were excavated from these levels and make up the Paleoindian assemblage (Figure. 2.1) (Driskell 1994:26; Sherwood et al. 2004:544). The inclusion of Dalton into the Paleoindian component at Dust Cave is based on extant radiocarbon dates that place the Dalton component occurring both prior to, and immediately following, the Younger Dryas (Sherwood et al. 2004:544).

The Early Side-Notched component is found primarily within Zone R, and is identified by distinctive Early Side-Notched projectile points (Driskell 1994:26; Sherwood et al. 2004:546). These projectile points are similar to the Big Sandy type distributed throughout the Midsouth, with great frequency in the Tennessee Valley of Alabama and Tennessee (Driskell 1994:26). These points are associated with a shift in technology indicating a decrease in a reliance on “core-derived blade technology” from the previous Paleoindian traditions, while showing an increase in bifacial technologies (Sherwood et al. 2004:547). Radiocarbon dates place this occupation between 12,000 and 11,000 cal B.P. (Sherwood et al. 2004:546). Human activity is marked by prepared surfaces and small pits during this time period.

The upper boundary of the Early Side-Notched component, Zone R, is truncated (Sherwood et al. 2004:547). The disconformity lies between Zone R and the Kirk Stemmed component which lies above, potentially erasing a time span ranging from 10,800 to 10,000 cal

B.P. (Sherwood et al. 2004:547). Sherwood and colleagues (2004) suggest that this episode is the probable result of erosion, such as a fluvial event that would have washed sediments from the cave, based on the abrupt changes in the character of sediments, the sharp boundary, and the near absence at the site of Kirk Corner-Notched projectile points that are found commonly in the region.

Zone Q contains a mixture of artifacts from the Early Side-Notched and Kirk Stemmed components and dates to approximately 10,200 to 9,800 cal B.P. (Sherwood et al. 2004:548). The mixture of the two artifact types further suggests an erosional event mixed artifacts from Zone R and a Kirk Corner Notched component. The surface of this zone is covered with a layer of charcoal that suggests a major burning episode occurred (Sherwood et al. 2004:548).

The Kirk Stemmed horizon is represented by Zone P. While most of the points reflect the serrated variety of the Kirk Stemmed cluster, two Kanawha bifurcated-base projectile points were also recovered from this level (Driskell 1994:2). Formal nutting stones appear in the cave for the first time during this component (Sherwood et al. 2004:548). Radiocarbon dates place this occupation between 10,200 and 7,800 cal B.P. (Sherwood et al. 2004:548). Human activity from this period is marked by stacked prepared surfaces, large amounts of sedimentation as a result of burning, and abnormal amounts of fire place rake-out (Sherwood et al. 2004:549). The absence of river alluvium in the sediments in Zone P suggests that the stabilization of the floodplain had occurred by this time (Sherwood et al. 2004:546).

Immediately following the Kirk Stemmed component it appears that the cave was used primarily as a location for human burials. The majority of burials found during this time

originate at the boundary of Zones P and N and intrude into Zone P, which is associated with the preceding Kirk Stemmed component. Based on the deposition and sediments comprising Zone N there appears to have been limited human activity during and shortly following the period of human burials inside of the cave. The occupation layers directly above Zone N, Zones K, J, and E, indicate that there were intensive occupations at Dust Cave following the initial Kirk Stemmed phase, and throughout the remaining Middle Archaic period based on the increases in anthropogenic sedimentation (Sherwood et al. 2004:549).

The Eva/Morrow Mountain component is represented by Zones E, J, K and N. These zones have been identified by the presence of Eva and Morrow Mountain projectile points and date between 8,400 and 6,000 cal B.P. (Driskell 1994:24; Sherwood et al. 2004:549). While the stratigraphy has been compromised by the digging of both utilitarian pits and human and dog burials, Zone J is seen as potentially the period of the most intense human activity in the cave (Homsey 2004). Zone E is also considered to have been a time of great activity within the cave and represents the last occupation during the Eva/Morrow Mountain phase (Sherwood et al. 2004:549). Prepared clay surfaces, small pits, and sediment accumulation associated with burning events represent the activities of Dust Cave's occupants during this early Middle Archaic component (Sherwood et al. 2004:548).

The Seven Mile Island/Benton component is found in Zone D. Radiocarbon dates place this occupation between 6,500 and 5,600 cal B.P. (Sherwood et al. 2004:549). The component is identified by the presence of Benton stemmed projectile points, which are found primarily in the Cumberland Plateau and surrounding areas of the Midsouth (Driskell 1994:22). Buzzard Roost Creek, Crawford Creek, Sykes/White Springs, and Morrow Mountain projectile points were also

recovered from this component (Driskell 1994:22; Sherwood et al. 2004:550). Zone D represents the last evidence of human activity within Dust Cave. Sediment buildup during the formation of Zone D greatly limited the amount of living space available, focusing human activity near the mouth of the cave. The zones above Zone D were deposited after Dust Cave had been abandoned (Sherwood et al. 2004:550).

Previous Research

Lithic Technology

Initial lithic analysis was conducted on 130 chipped stone tools recovered from Test Unit F (Meeks 1994). The unit was selected for analysis because it had been excavated to bedrock and included representation from all five cultural components. Twenty-eight diagnostic hafted bifaces were recovered from Test Unit F. One Quad, one Cumberland, one Hardaway Side-Notched, and one Dalton projectile point were recovered from Paleoindian components. Nine hafted bifaces were recovered from the Early Side-Notched component that are similar to the Big Sandy type found in Alabama and Tennessee. One Kanawha type from the Bifurcate tradition was also recovered from this component. Five diagnostic bifaces were recovered from the Kirk Stemmed components: two Kirk Stemmed, two Kirk Serrated, and one Cave Springs point. Two Eva points were recovered along with six Benton and one Crawford Creek point from the Middle Archaic components (Meeks 1994). The sample also contained unifacial tools, drills, preforms, and blanks (Table 2.1).

Table 2.1: Lithic Artifacts by Component (Reconstructed from Meeks 1994:88).

Artifact Type	Paleoindian	Early Side-Notched	Kirk Stemmed	Eva/Morrow Mountain	Benton	Total
Preforms	2	1	1	2	2	8
Bifaces	2	14	8	6	8	38
Drill/Drill Frag.	0	0	1	2	1	4
Hafted Biface/Frag.	10	14	7	5	9	45
Blade	8	0	0	0	0	8
Graver	5	0	0	0	0	5
Graver on Blade	1	0	0	0	0	1
Hafted End Scraper	5	3	2	0	0	10
Hafted Side Scraper.	1	0	0	0	0	1
Side Scraper/Frag.	10	0	0	0	0	10
Total	44	32	19	15	20	130

Though the sample size is small there are points of interest found within the sample. Late stage bifaces, as opposed to early stage bifaces and preforms, dominate the assemblages, suggesting that the initial reduction took place elsewhere, a trend that continues through the Middle Archaic components (Meeks 1994:85; Randall 2001, 2003). This idea is also supported by debitage analysis (Meeks 1994:93). Also of note is the preponderance unifacial blades, scrapers and graters that were recovered from this component (Meeks 1994:88; Randall 2001; Sherwood et al. 2004:544). Over 70 percent of the unifaces analyzed by Randall (2001) and 85 percent of those analyzed by Meeks (1994) are associated with the Late Paleoindian components. Randall (2001) attributes the higher frequencies of hafted unifacial tools recovered from Late Paleoindian contexts to reflect an emphasis on the exploitation of resources found further distances from the cave in which maximum utility would have been necessary.

Debitage analysis was also conducted on 21,311 flakes recovered from Test Unit F. Forty-two percent of thedebitage was recovered between 350 and 300 cm below datum, levels assigned to the Early Side-Notched component by diagnostic artifacts (Meeks 1994:91). Randall (2001) suggests that the increase in the number of flakes and an increase in the number of cortical flakes found in Early Side-Notched components reflect an increase in the reduction of cores at Dust Cave during this time period. It has been suggested that the Early Side-Notched component could represent the most intense period of occupation at Dust Cave based on the amounts ofdebitage as well as bifaces, expedient flakes, and unhafted scrapers recovered (Meeks 1994; Randall 2001).

Seventy-five chipped stone tools from the Late Paleoindian components were sorted into functional activity groups. Two-thirds of the groups analyzed were associated with hunting and butchering activities. The importance of butchering and processing to inhabitants of Dust Cave during the Paleoindian period was confirmed by microwear analysis conducted on a portion of the same sample. Microwear analysis was conducted on 33 of the 75 chipped stone tools from Paleoindian components. Twenty-one of these tools exhibited some evidence of use, eleven of which showed evidence of cutting/scraping of bone or meat, activities associated with butchering and processing activities (Walker et al. 2001).

Patterns of lithic raw material useage have also been examined. Over 97 percent of the lithics analyzed from Dust Cave are made from blue-gray Fort Payne chert, which was one of the region's best raw material sources and in close proximity to the site (Randall 2001). While 85 percent of the stage bifaces recovered from the Paleoindian and Early Side-Notched components were made of blue-gray Fort Payne chert, there is an increase in the number of hafted bifaces

made from blue-gray Fort Payne chert during the Early Side-Notched component, 93 percent up from 80 percent in the Late Paleoindian component. Randall (2001) attributes this to increased mobility or wider ranging settlement patterns during the Late Paleoindian period. All of the hafted bifaces from the Kirk Stemmed component were made of blue/gray Fort Payne chert, while 80 percent of those from the Morrow Mountain component and 82 percent of those from the Benton components were made of blue-gray Fort Payne chert (Johnson and Meeks 1994; Randall 2003). Only one of the 156 unifacial samples selected was not made of blue/gray Fort Payne chert. Ninety-five percent of the 130 tools analyzed by Meeks (1994, 1998:92) were made from Fort Payne chert, suggesting that raw material procurement and subsistence strategies were closely related. Over 97 percent of the debitage analyzed from the Late Paleoindian and the Early Side-Notched components were also from blue-gray Fort Payne chert (Randall 2001).

In addition to chipped stone tools, bone tools were recovered from every component at Dust Cave. Through 1998, four bone awls and one perforated tooth were recovered from the Late Paleoindian component. From the Early Side-Notched component three awls, one needle, one bead, one projectile point, and one antler tine were recovered. Eight awls, one fish hook, two needles, one perforated tooth, and three polished turtle carapace fragments were recovered from the Kirk Stemmed component. Thirteen awls, one bead, three antler tines, and one spatula were recovered from the Eva/Morrow Mountain components. The largest assemblage of bone tools came from the Benton component. Twenty-four awls, one point/awl, three needles, three projectile points, three spatulas, six antler tines, and one wedge were found (Goldman-Finn and Walker 1994; Walker 1998:163-164).

Faunal Analysis

While traditional views of Clovis subsistence have focused on the exploitation of large game, analysis of the well preserved faunal and botanical remains from Dust Cave have indicated that a more generalized subsistence strategy was practiced during this time period, in which a wider variety of both plant and animal resources were exploited than previously considered (Walker et al. 2001). Results of 2,413 faunal specimens analyzed from the Late Paleoindian component show the importance of birds in subsistence strategies during this period. Sixty-nine percent of the total remains examined are avian remains, with 47 percent of those remains belonging to waterfowl (Figure 2.3). The next largest group is mammals (19 percent), followed by fish (9 percent), reptiles (2 percent), and amphibians (1 percent) (Walker 1998:136). Aquatic resources make up 62 percent of the total remains, represented most strongly by waterfowl, muskrat, swamp rabbit, and pond turtles (Walker 1998:139). Walker (1998:143) suggests that the greater reliance on aquatic resources indicates that resources were in closer proximity to the cave as a result of the colder and wetter climatic conditions present during the Late Paleoindian period.

Aquatic resources remained important during the Early Side-Notched occupation, making up 76 percent of the analyzed remains. Though bird remains drop to 38 percent of the assemblage, it is still heavily comprised of waterfowl. Fish comprise the second largest group at 32 percent, represented most heavily by suckers, freshwater drum, sunfish, and catfish, while mammals make up 24 percent of the assemblage represented most heavily by squirrel and white-tailed deer. Reptiles comprise 5 percent of the assemblage and amphibians make up the remaining 1 percent (Walker 1998:138).

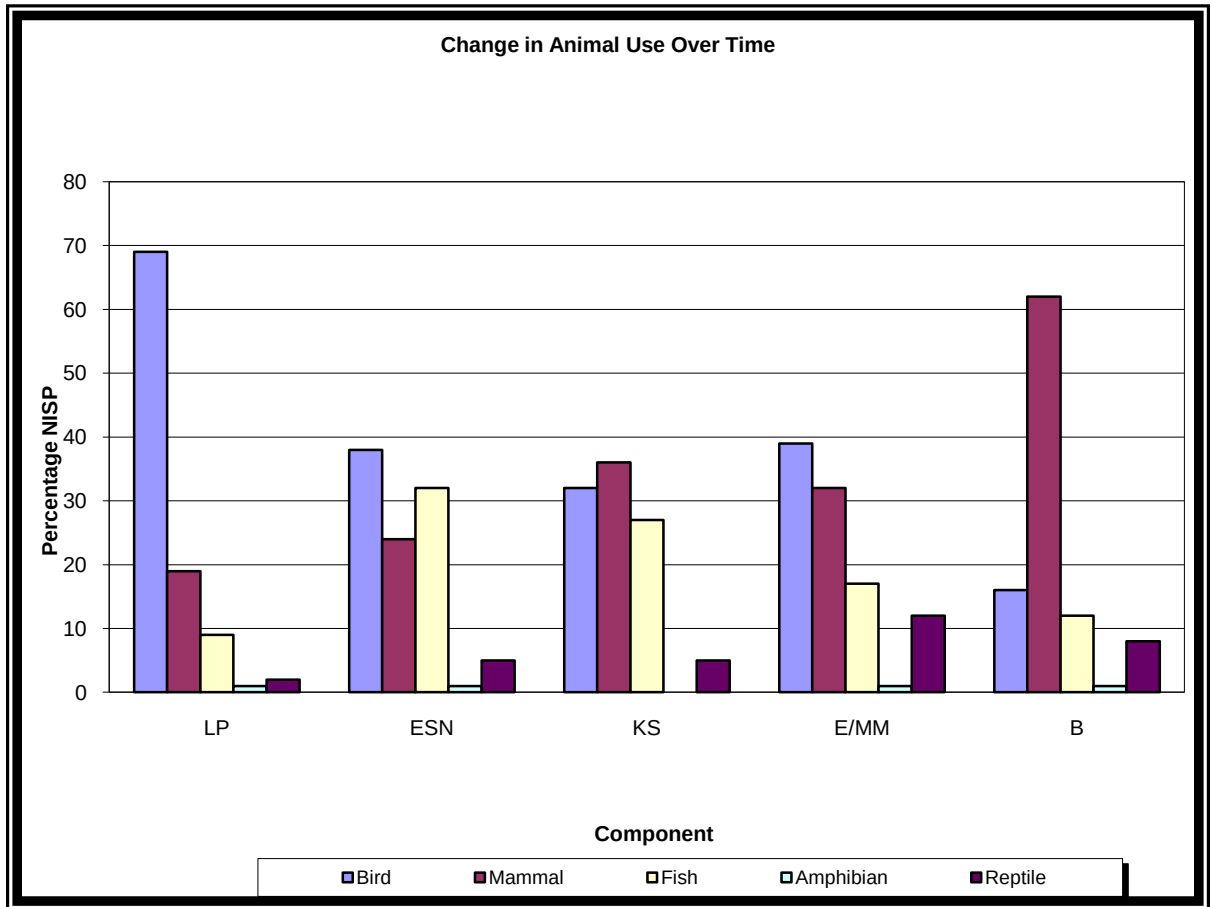


Figure 2.3: Percentages of animal use through time. LP-Late Paleoindian, ESN-Early Side-Notched, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton. NISP-Number of Individual Specimens Reconstructed from Walker 1998.

The exploitation of mammals increased during the Kirk Stemmed occupation with mammal remains making up 36 percent of the total assemblage, heavily represented by both gray squirrel and white-tailed deer. The use of bird and fish both decreased, bird from 38 percent to 32 percent, and fish from 32 percent to 27 percent. Reptiles make up 5 percent of the assemblage and no amphibian remains were recovered. Sixty-five percent of the remains analyzed from the Kirk Stemmed period are aquatic species once again emphasizing the importance of these resources (Walker 1998).

The reliance on aquatic resources shifted during the Eva/Morrow Mountain occupation (Figure 2.4). The percentage of aquatic resources drops to 48 percent with terrestrial remains making up 52 percent, the first time terrestrial remains exceed aquatic remains. While bird remains make up 39 percent of the total assemblage, 72 percent of those are remains of terrestrial birds (turkey, bobwhite, grackle, and passenger pigeon). Walker (1998:143) suggests that this shift towards terrestrial resources was the result of disappearing marshes and drier weather making terrestrial resources more reliable. Mammal remains make up 32 percent of the total assemblage, represented most strongly by gray squirrel and white-tailed deer. Fish comprise 17 percent of the remaining species, reptiles 12 percent, and amphibians make up the remaining 1 percent (Walker 1998).

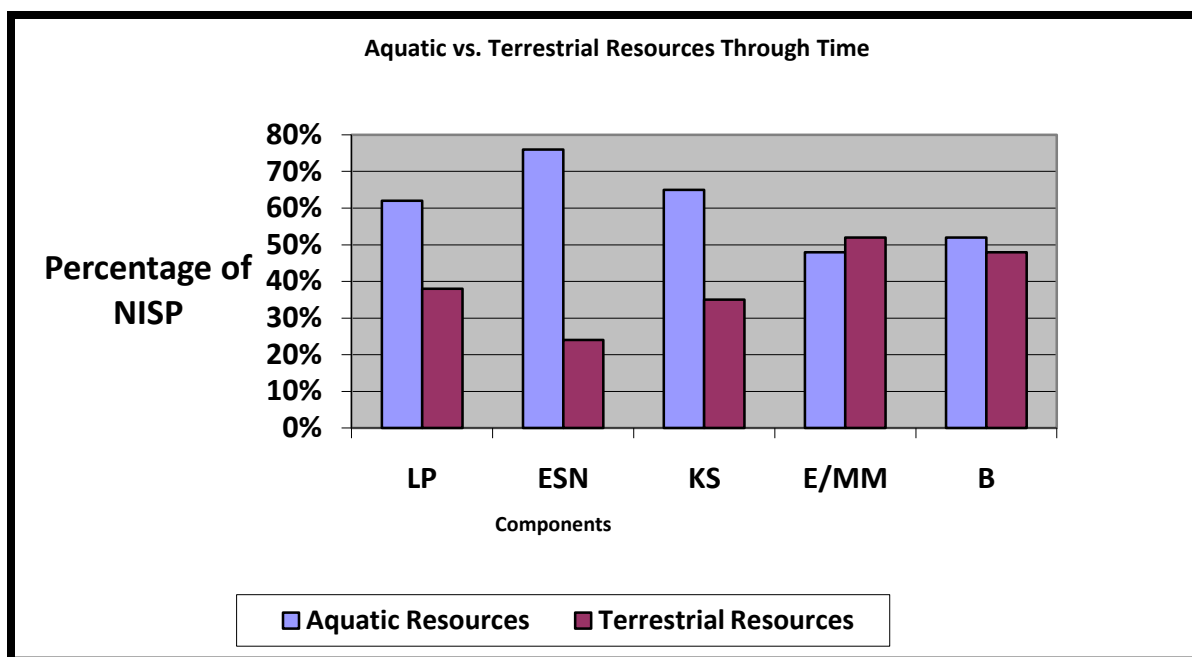


Figure 2.4: Aquatic vs. terrestrial resource use through time. LP-Late Paleoindian, ESN-Early Side-Notched, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton. NISP-Number of Individual Specimens. Reconstructed from Walker 1998.

During the Benton component, aquatic resources make up the majority of remains again, but decrease to 52 percent. Mammals make up 62 percent of the total remains, most strongly represented again by gray squirrel and white-tailed deer. Bird remains decrease to 16 percent, fish to 12 percent, reptiles to 8 percent, and amphibians represent the remaining 1 percent.

Preliminary analysis of freshwater mussels from Dust Cave showed that exploited species came from shoals as well as larger tributary streams of the Tennessee River. At least 40 percent of the species inhabited small streams or creeks, indicating that these types of environments were used along with larger shoal areas (Parmalee 1994:135). Mussels from species that inhabited small creeks and streams comprise one-quarter of the assemblage from Dust Cave, suggesting that these types of environments were exploited by the sites' inhabitants, as compared to the 5

percent at Smith Bottom Cave. Gastropods as well as freshwater mussels provided a valuable food source for the inhabitants of Dust Cave. Thirty-three different species of valves were identified from Dust Cave. These resources would have provided a food source to people living along the Tennessee River during prehistoric times.

Botanical Analysis

Initial analysis of botanical remains was conducted on 25 samples recovered from Test Unit A, in the entrance chamber of the Dust Cave (Gardner 1994). Hickory (n=2000) and acorn (n=500) nutshells dominated the initial samples, while only three fragments of black walnut were recovered. One grape and three chenopod seeds were recovered from the Early Side-Notched component¹ (Gardner 1994:193). Gardner (1994:193) suggests that the presence of chenopod seeds in the Early Holocene, while not domesticated at this early date, demonstrates a relationship between the early domesticate and Native American occupants of the region.

Despite the small sample size initially analyzed, temporal trends were apparent (Gardner 1994:193). The first trend Gardner discussed was the increase in wood charcoal density through time. While poorly represented in the earliest levels, wood charcoal increases from the Early Side-Notched into the Eva/Morrow Mountain component, possibly reflecting differences in occupation intensity and length (Gardner 1994:193). The second trend discussed by Gardner is a sharp increase in acorn shell density towards the end of the Early Side-Notched period with one-third of the acorn shell recovered coming from this level (Gardner 1994:193). While there appears to be another great fluctuation in acorn shell density during the Eva/Morrow Mountain

¹Because the complex stratigraphy of Test Unit A was poorly understood at the time of Gardners (1994) analysis, samples that he assigned to the Early Side-Notched component may have actually been Late Paleoindian.

occupation there are no real significant changes across time (Gardner 1994:193). Gardner's analysis also shows an increase in hickory use especially during the Benton occupation, and he suggests that this increase reflects the increasing importance of hickory over time (Gardner 1994:206). He also suggests that an increase in nutshell to debitage ratios through time indicates that these plant resources became more important through time, and that the decrease in debitage indicates that less time was spent in the production and maintenance of hunting equipment by the occupants of Dust Cave (Gardner 1994:206).

In 2005, more extensive analysis of carbonized plant remains from Paleoindian and Early Archaic components from Dust Cave was completed by Hollenbach. Sixty-five samples were analyzed from three columns (N62W64, N62W62, and N60W65). Thirty-five of the samples came from Paleoindian contexts (Zone U and T), 12 came from Early Side-Notched components (Zone R), 10 samples came from a mixed Early Side-Notched/Kirk Stemmed component (Zone Q), and 13 from the Kirk Stemmed components² (Zone P) (Hollenbach 2005:165). Forty-one additional samples were analyzed from features. Fourteen came from Paleoindian contexts, 11 came from Early Side-Notched component, six from the mixed Early Side-Notched/Kirk Stemmed component, and the remaining ten samples from the Kirk Stemmed component (Hollenbach 2005:165). Column samples were selected based on their proximity to heavy activity areas (Hollenbach 2005:165). Feature samples analyzed in this study were selected based on their location, their function, and their inclusion in previous geochemical and micromorphological analyses conducted by Homsey (2004). The combination of column and

² In Hollenbach (2005) Kirk Stemmed is treated as a late Early Archaic component.

feature samples provides both an averaged analysis of plant use over time(column samples) and a view that is captured in time and space (feature samples) (Hollenbach 2005:328).

The importance of hickory nuts to the occupants of Dust Cave cannot be understated, as hickory is recovered from all column and feature samples. The significant numbers of acorn shell recovered from features, in many instances in greater quantities than hickory, also address the importance that acorn played to the occupants (Hollenbach 2005:328). The smaller amount of both black walnut and hazelnuts suggests that these species were not targeted as hickory and acorn nuts were (Hollenbach 2005:328). The presence of these taxa suggests a fall occupation at Dust Cave.

A variety of fruits was also consumed by the occupants of Dust Cave. Included in this group are hackberry, persimmon, grape, and sumac. Possible nightshade and black gum seeds were also recovered. These fruits could have been collected prior to and or after the harvesting of nuts in the fall, and could have been either eaten fresh or stored for later use (Hollenbach 2005:258).

Edible seeds were recovered from over half of the samples examined from the Late Paleoindian and Early Side-Notched components (Hollenbach 2005:258). Chenopod seeds appear to have been the most widely exploited edible seeds at Dust Cave, occurring in 42 of the 106 samples analyzed from the site (Hollenbach 2005:258). Wild legumes were recovered from ten samples, cheno-am seeds from six features, and smartweed recovered from one Paleoindian sample.

Poke, bedstraw, and purslane seeds were also identified in the samples from Dust Cave. The leaves and shoots from these species, as well as chenopod, smartweed, nightshade, and sumac, could have been used for the greens (Hollenbach 2005:228-229). The seeds though were available in the fall. Hollenbach (2005) suggests that these seeds could have been introduced to the cave by wind, or carried in by animals or people. The presence of these species indicates that the areas surrounding the cave were disturbed, either by fluvial processes or repetitive human occupation of the site, or a combination of the two (Hollenbach 2005:30).

Column Samples

Analysis of remains from the Dust Cave column samples indicates that the use of plants increases through time, with exception to the mixed Early Side-Notched/Kirk Stemmed component (Hollenbach 2005:15). Hickory is well represented in both Late Paleoindian and Early Archaic components and usually in greater numbers than all other taxa, indicating the importance of this resource through time. Acorn, black walnut, and hazelnut are also represented in Paleoindian components. Fruit remains represented in the Late Paleoindian component include hackberry, grape, and possible nightshade. Edible seeds found in Late Paleoindian contexts included chenopod, cheno-am, wild legumes, and smartweed. Poke, star grass, purslane, and bedstraw represent weedy seeds recovered from these contexts. The lower quantities of both wood and acorn during the Late Paleoindian deposits are attributed to possible fluvial activity that could have washed these remains from the cave (Hollenbach 2005:215).

During the Early Archaic period, hickory and acorn use increases, while wood, hazel, and black walnut uses decreases. Black walnut is found in feature samples from the Early Side-

Notched and Kirk Stemmed components, but it is absent from the column samples (Hollenbach 2005). The use of fruit increases over time indicated by the 100 percent ubiquity of hackberry in all Early Archaic samples and the addition of sumac and persimmon during this period (Hollenbach 2005:158). Wild legumes, chenopod, and hackberry use increases during the Early Side-Notched component. By the end of the Early Archaic the use of hazel, chenopod and hackberry, and weedy seeds significantly drop off. This drop off is viewed as the result of a significant increase in the use of hickory during the Kirk Stemmed phase (Hollenbach 2005:190). The increase in the use of hickory is also accompanied by an apparent decrease in the amount of wood charcoal recovered also. Hollenbach (2005:259) suggests that the decrease in wood recovered could indicate that hickory nutshell replaced wood as a major source of fuel during this period.

Feature Samples

Changes in plant use over time are also apparent from feature samples. The density of plant remains increases through time in features, as it did in the column samples. While hickory remains the dominant source of plant food used through time, acorn shell is much better represented upon examination of features (Hollenbach 2005). During the Late Paleoindian occupation, hickory, acorn, and black walnut remains are present in features. Fruit remains include grape, persimmon, and black gum. Poke, star grass, and bedstraw represent weedy seeds during this time, while chenopod and cheno-ams represent groups of edible seeds recovered (Hollenbach 2005).

Acorn shells increase from the Late Paleoindian throughout the Early Archaic component. Black walnut remains are found in features representing all components. Hazel though is found only in features from the Kirk Stemmed components. Of the fruit remains recovered, hackberry is the best represented in all components, but decreases towards the end of the Early Archaic. Persimmon, grape, and sumac are found in low quantities but show little change in use over time. The use of chenopod decreases through time, and the use of wild legumes increases (Hollenbach 2005).

Both column and features samples indicate that the density of plant materials increases from the Late Paleoindian through the Early Archaic components at Dust Cave. An increase in plant remains over time suggests that the site was used more intensively over time. The increase is attributed to wood and hickory nutshell (Hollenbach 2005:258). As noted previously the scarcity of hickory and wood from earlier levels and features may be the result of fluvial activity, washing out ash and charcoal, as well as indicative of less human occupation of the cave (Hollenbach 2005). While the column samples show an increase in the use of nut foods over time, highlighted by a sharp increase in the use of hickory during the Kirk Stemmed occupation, this trend is not well represented in the feature analysis, which suggests that both hickory and acorn were possibly targeted (Hollenbach 2005). The increase in the use of nuts and the decrease in the use of chenopod over time may be the result of the availability of each due to changes in the local ecology (Hollenbach 2005). With the exception of hackberry, which decreases during the Kirk Stemmed component, the use of fruit changes little over time (Hollenbach 2005:31).

Features Analysis

Micromorphological and geochemical analyses were conducted on features from Dust Cave in order to gain a better understanding of the functions associated with each. Three hundred thirty-nine features from the cave were analyzed. The features were divided into the following categories: human burials, canine burials, rock pits/clusters, charcoal or ash stains, charcoal pits, ash pits, charcoal or ash pits, charcoal concentrations, ash concentrations, undifferentiated pits, hearths and unknown (Table 2.2) (Homsey 2004:209).

Table 2.2: Feature Types by Component.(Reconstructed from Homsey (2004:209)).

Feature Type	B	E/MM	KS	ESN	LP
Human Burial	3	13	3	0	0
Canine Burial	1	3	0	0	0
Surface Hearth	3	13	3	0	1
Pit Hearth	1	15	5	1	0
Expedient Hearth	6	11	7	0	0
Charcoal Pit	9	71	12	14	9
Ash Pit	0	10	6	1	2
Charcoal Conc.	0	26	4	8	4
Ash Conc.	0	3	0	1	1
Charcoal/Ash Stringer	0	0	4	2	11
Unknown	3	24	8	3	3
Rock Pit	1	6	1	2	2
Total	27	193	53	32	33

LP-Late Paleoindian, ESN-Early Side-Notched, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton..

Based on an analysis of features at Dust Cave, Homsey (2004) concludes that during the Paleoindian and Early Side-Notched occupations the cave probably served as a seasonal residential camp used during the fall, and possibly the spring. She finds this to be consistent with the large number of scrapers recovered from Paleoindian components.

Based on the number and diversity of features, lithic artifacts, separation of living and refuse areas, and the presence of storage pits, Homsey (2004:246) concludes that domestic and maintenance activities at the site are suggestive of a residential base camp during the Kirk Stemmed period (Homsey 2004:246). The number of features jumps from the previous period from 33 to 53. The emergence of storage pits and processing pits indicates a shift towards more domestic activities indicative of a base camp. Middens of disposed refuse associated with Zones P3 and P5 include combusted organic materials, containing high levels of strontium and potassium that are associated with nut burning. Homsey (2004:230) suggests that these midden-like zones indicate conscious removal of refuse, which in turn suggests stays of longer duration. The presence of storage pits and the decrease in scrapers possibly point towards a seasonal base camp (Homsey 2004:247).

The increase in the number of features during the Eva/Morrow Mountain period exceeds the expectation given an assumption that occupations remained constant over time. Though the time span of the period almost doubles that of the Paleoindian period, the number of features is almost four times greater (Homsey 2004:247). A decrease in the diversity of features and the disappearance of storage pits, but not a decrease in intensity of site use, indicate a change in site function. The decrease in diversity has been attributed to a focus on limited or specialized activities at sites (Homsey 2004:247). The increase in the amount of processing pits and nutting

stones and the significant increase in the amount of hickory nutshell suggests that Dust Cave became an extraction/processing site during the Eva/Morrow Mountain period (Homsey 2004:248).

The Benton occupation appears to have been limited based on the amount of available headroom available during this period. Twenty-seven features make up the Benton levels, which span approximately 1,000 years. Diversity of feature type decreases but remains greater than that of the Late Paleoindian and Early Side-Notched components.

Charcoal pits were the dominant feature through time followed by hearths. Charcoal stringers are the major feature type during the Late Paleoindian occupation and disappear after the Kirk Stemmed occupation. Hearths and burials both increase through time. Homsey (2004:208) attributes these changes to cave geology and climate. Homsey (2004:245) suggests that the dynamic microenvironment of Dust Cave affected both the activity and the preservation of these activities at the site, the Late Paleoindian and Early Archaic activities being more greatly affected by flooding and wet conditions and the later Middle Archaic populations constrained more by ceiling height and the location of the dripline.

Homsey (2004:248) concludes that with the exception to nut processing and storage that occurs during the Kirk Stemmed and other Middle Archaic components, a comparison of features through time indicates that there is little change in the types of activities occurring at the site but not in the intensity of use. She determined that Dust Cave operated as a short term residential camp during late summer and fall during the Late Paleoindian and Early Archaic occupations, but during the late Early Archaic it was used as a longer-term residential base camp.

The site function changed during the Middle Archaic to a logistical camp used primarily for the extraction of hickory nuts, which were then transported to base camps (Homsey 2004). The warmer and drier conditions brought about by an ameliorating Holocene climate beginning ca. 10,000 B.P. made conditions favorable for hickory trees, which began moving into the Middle Tennessee Valley between 10,000 and 8,000 B.P. At Dust Cave these changes correspond with the emergence of nutting stones, processing pits, increase in the variety of feature, and intensity in activity at Dust Cave (Homsey 2004:249).

Skeletal Analysis

Due to the excellent preservation of bone at Dust Cave, skeletal analyses completed on the human remains have provided valuable information regarding stature, demography, paleopathology, violence and stresses that affected Middle Archaic populations that inhabited the cave (Davis 2004; Hogue 1994; Turner 2006). Nineteen complete burials and 24 incomplete burials have been recovered from the cave, and it is believed that at least four more remain in the cave (Davis 2004:34).

Forty-three individuals were aged and sexed. Nineteen were identified as adults and 24 as sub-adults. Of the 19 adults only 16 could be sexed 11 as females and 5 as males. The average age for the entire sample was 15.37 years (Davis 2004:35; Hogue 1994; Turner 2006:43). The average age of 13 adults was 38.31 years (males 24.75, 44.3 years for females), and 2.95 for sub-adults (Davis 2004:35). Stature analysis was conducted on 12 adults including nine females and three males. The average stature for females was 155.5 cm, and for males was 169.84 cm (Davis 2004:68).

Of the adult male and females, seven are considered victims of violence, two males and five females (Table 2.3). All of the evidence of violence displayed in the burials at Dust Cave involved cranial depressions. Only four individuals, one male and three females, displayed trauma considered to be definitively related to violence (Hogue 1995; Turner 2006:53). This is determined by the presence of multiple cranial fractures, the presence of projectile points, and/or the post cranial fractures in conjunction with cranial fractures (Turner 2006:53). Three other individuals, one male and two females, exhibit signs of possible violent trauma defined as a single traumatic injury absent of other traumas. While only a small portion of the population displayed signs of violence or possible violence several other individuals showed signs of degenerative diseases, or osteoarthritis. All of these observations are considered to be normal for pre-agricultural populations (Hogue 1994).

Table 2.3: Burials Exhibiting Evidence of Violence at Dust Cave.(Reconstructed from Davis 2004 and Turner 2006).

Burial Number	Age / Sex	Trauma
5**	26 +/- 2 / Female	Single cranial depression fracture right frontal bone
7*	33 +/-7 / Female	Cranial depression fracture on left frontal bone, two broken ribs, fractured metacarpal
16*	55+/-3 / Female	Two cranial depression fractures, one on frontal one on parietal bone, four broken ribs
18*	58+/- / Female	Three cranial fractures, two on right parietal and one on occipital bone
19**	22 +/- 2 / Male	Cranial depression on right frontal bone
27**	45+ Female	One cranial depression fracture on left parietal bone
30a*	30-40 Male	Two cranial depression fractures on right parietal bone, dislocated right scapula

***Table shows burials in which remains show evidence of violence related trauma.**
****Indicates victims of possible violent trauma.**

Chapter 3: Methods

Rockshelters preserve carbonized plant remains beautifully and provide an invaluable source of information due to the environment created within (Ford 1985; Miksicek 1987:218; Watson and Cowan 1992:4). Because they provide a protected environment from the natural elements, which work against the preservation of organic remains at open-air sites, archaeological remains that are preserved from the accumulation of debris resulting from intense habitations and frequent reuse provide valuable research opportunities (Walthall 1998:225). In order to address the specific research questions of this paper, carbonized plant remains from Dust Cave were analyzed to explore the changing diet of the inhabitants of the site through time. Column samples and features from the Eva/Morrow Mountain and Benton components of the Middle Archaic were analyzed, and then compared with samples previously analyzed to construct a chronological sequence covering the entire occupation of Dust Cave.

In order for plant remains to be preserved in the archaeological record they must be charred or carbonized (Miksicek 1987:219). The likelihood that this happens depends on the exposure to fire during use, processing, or storage. Carbonization occurs when plants are introduced to temperatures between 250 and 500 degrees Celsius. During the carbonization process the organic material in plants are rearranged or replaced by inorganic material, making them more durable and indestructible (Lopinot 1984:97). However, if remains are exposed to extremely high temperatures in oxygen rich environments, an adverse effect can occur, reducing the plant remains to ash. The carbonization process reduces the remains to 50-60 percent elemental carbon, protecting the remains from elemental decay (Miksicek 1987:219). Carbonized plant remains preserve better in the archaeological record because elemental carbon

is resistant to microbial activity (Popper 1988:57). While the carbonization process makes the remains more stable they are still susceptible to mechanical damage postdepositionally and during recovery and processing, which can destroy the carbonized remains (Miksicek 1987:219).

Plant remains can be introduced to the archaeological record either through intentional or accidental processes (Helbaek 1952:232). Nutshell, corncob, and olive pits are dense and inedible and have been used throughout history as a source of fuel. Intentional introduction to fire ensures these remains will be preserved and will appear in large numbers in the archaeological record (Miksicek 1987:220). Plant remains can be exposed to flame accidentally as well. Seeds that were parched, toasted, or boiled could have spilled into a hearth during these processes. Non-dense plant foods, such as leafy greens or fruits, are likely to be underrepresented in the archaeological record because they are not frequently exposed to fire (Miksicek 1987:220). Insects, rodents and other scavengers can cause the underrepresentation of remains from sites (Popper 1988:57).

Dense nutshells and seeds preserve better than fleshy fruits (Popper 1988:56). Environmental conditions also play a large role in preservation of plant remains. Temperature, moisture, and soil acidity can all inhibit microbial activity. Activity such as erosion can destroy carbonized remains. Deep deposits and caves provide excellent preservation (Popper 1988:57).

Once plant remains are carbonized and enter the archaeological record, they must be recovered in a manner which will allow for their identification. Plant remains are recovered from soils at archaeological sites through the process of flotation. Developed in the 1960's by Stuart Streuver, the process is considered to be "50 times as effective as quarter-inch field

screening” for recovering plant remains (Munson, Parmalee, Yarnell 1971:421; Wagner 1988:23). Dirt collected from features and column samples is added to water. Objects that have a specific gravity less than that of the water can then be poured or scooped off of the surface. These items are referred to as the “light fraction.” The remains that are too heavy to float, but too large to pass through the screen used, are collected and referred to as the “heavy fraction” (Pearsall 1989, 2000; Wagner 1988:19). Once the light and heavy fractions are dried they are set aside for sorting and analysis.

Although biases exist in the analysis of botanical remains (sample sizes in relation to the original assemblage, factors regarding deposition, and preservation and recovery), the insight that can be gained from the analysis can be very powerful. Analysis of botanical remains from archaeological sites provides direct evidence of the economic systems of prehistoric populations, the changing relationships between human-plant behavior through time, and can provide valuable information regarding the economic bases that are involved in culture changes (Johannessen 1988:145).

The Dust Cave Samples

The samples used in this research were collected from Dust Cave during the 1990-1994, 1996-2000, and 2002 field seasons. All feature fill from the site was floated. Samples were also collected from 50-x-50-cm columns in 5-cm arbitrary levels by zone from the 1-x-1-m units. Samples were processed both in the field, and at the University of Alabama’s Office of Archaeological Research using a modified SMAP machine, described by Watson (1976). One

mm mesh or window screen (1/16-inch) was used to capture the heavy fraction, and 0.03 mm mesh was used to capture the light fraction (Hollenbach 2005).

My analysis includes the examination of both column samples and features collected from Eva/Morrow Mountain and Benton components of Dust Cave. Column samples from N60W65 (Figure 3.1) were selected for analysis in order to continue a sequence that had been previously analyzed by Hollenbach (2005). When levels were missing from N60W65, I examined those equivalent levels from adjacent columns to ensure that there was a representation from every level. In total, 23 column samples were analyzed; 15 from the Eva/Morrow Mountain component and eight from the Benton component. Eleven previously unpublished samples analyzed by Dr. Kandace Hollenbach were added to the Eva/Morrow Mountain samples in order to create a complete sample for comparison, providing a chronological sequence spanning the entire occupation of the cave (Table 3.1)..

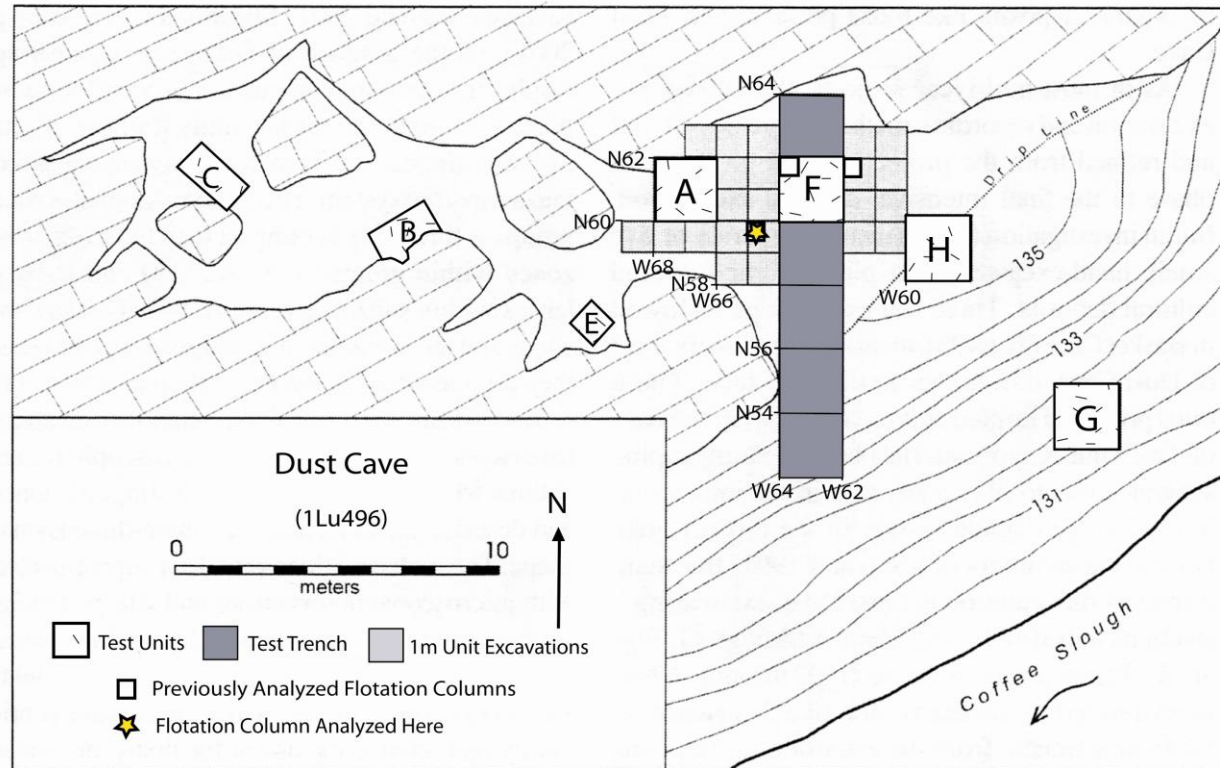


Figure 3.1: Plan view of Dust Cave. Adapted from Sherwood et al.2004.

Fifteen features were analyzed in addition to the column samples. Nine samples from the Eva/Morrow Mountain component that had been previously analyzed were re-analyzed for accuracy, and six samples from the Benton component were analyzed (Table 3.2). Features were selected based on their inclusion in previous geochemical and micromorphological studies (Homsey 2004), and then based on their assigned function.

Each sample was analyzed according to standard ethnobotanical methods described by Pearsall (2000) and Hastorf and Popper (1988). First, each sample analyzed was re-floated for cleaning purposes using the tub method (Pearsall 2000) prior to examination. After the samples had dried, each was weighed and separated by size (1/4 inch, 2 mm, 1.4 mm, .07 mm, and pan) using geologic sieves. All materials greater than 2.00 mm in size were separated into categories, for example, bone, lithics, shell, plant materials, and contaminant. Plant materials were further separated into types, counted and weighed. The items in the remaining categories were then weighed. Shell was always removed only from the largest sieve in which it was found, so when it was recovered from the 1/4-inch sieve it would be counted and weighed, and then not separated out again from the smaller sized sieves. Lithic materials and bone were separated and weighed from both the 1/4-inch and 2-mm sieve. Plant taxa that were not recovered from the 2 mm sieve were removed from the 1.4-mm sieve, along with small seeds. Acorn shell is more fragile and fragments more easily than other denser nutshell, like hickory, and is thought to be underrepresented in most archaeobotanical assemblages (Lopinot 1984:112; Miksicek 1987:221). For this reason both acorn shell and meat were included from the 2 mm and 1.4 mm sieves, in order to account for these sampling biases.

Types of Analysis

Ubiquity, or presence analysis, is one method of quantifying archaeobotanical data. This method provides a measure of the number of samples in which a specific taxon is present or absent. This method disregards the absolute count, which can be biased by preservation, collection, and recovery. The ubiquity value is represented by a percentage that reflects the number of samples in which a particular taxon was present divided by the total number of samples analyzed. An important aspect of ubiquity is that the scores provided remain independent from one taxon to the next.

Ratios also provide a useful way of constructing intrasite comparisons of samples of disproportionate sizes and to compare quantities and relationships between different categories of materials. Density measures use as the denominator the total volume of sediment comprising the sample being evaluated which allows for comparison of samples of varying sizes. The numerator is the count of a particular taxon. By using counts as opposed to weights these measures allow for the comparison of categories of disproportionate weights, like hickory and acorn nutshell. Relative density measures are also used and are important because they measure particular plants relative to other plant material. Relative density is calculated by dividing the count of a specific taxon by the total combined weight of all of the plant remains from the same sample (Scarry 1986:206). This is useful because the results do not rely on the volume of the entire sample, as do measures of density. The advantage of relative density is that it adjusts the denominator, so as not to bias the presence of smaller quantities of plant remains that may be found in only a few samples.

The use of exploratory data analysis was also employed in this study. Exploratory data analysis is useful because it advocates the use of robust descriptions of data, such as medians and quartiles, which are less influenced by outliers common in data that cannot be assumed to follow a normal distribution, such as archaeobotanical data. Also, exploratory data analysis employs the use of graphs to aid in the discovery of patterns that can be found within the data. The graphs concisely sum up the datasets visually, while aiding in the identification of outliers (Hollenbach 2005).

In particular, boxplots are employed in this research to show changes in the use of botanical materials through time. The boxplots present the data and allow for easy comparison between samples from different time periods. The range of the data is displayed in the form of a notched box, where the “waist” represents the median, and the top and bottom ends of the box mark the 25th and 75th percentiles of the data. The notch itself represents the 95 percent confidence interval around the median. If the notches of two boxes overlap, then the differences between the two are not statistically significant at the 95 percent confidence level. “Whiskers” extend from the top and bottom of the boxes to the lowest values within 1.5 times the hinge spread, which represents the distance between the 25th and 75th percentiles. Outliers in the data are displayed as asterisks, and are considered to be any value beyond 1.5 times the hinge spread. Extreme outliers are 3,0 times the hinge spread and are displayed as open circles (ex. Figure 4.20) (Hollenbach 2005).

Table 3.1: Column Samples Analyzed from Middle Archaic Components

Bag #	Unit	Component	Level	Top Depth	Zone	Volume
2182	N61W65	Benton	5	140	D3	7
2077	N61W65	Benton	6	145	D3	10
2092	N61W65	Benton	7	150	D3	10
2127	N61W65	Benton	8	155	D3	8
2138	N61W65	Benton	9	160	D4	8
2153	N61W65	Benton	10	165	D4b	10
2167	N61W65	Benton	11	170	D4b	8.5
2196	N61W65	Benton	12	175	D4c	2
2425	N62W65	Eva/Morrow Mountain	13	180	E2	9
2701	N61W65	Eva/Morrow Mountain	14	185	E5	2
2614	N60W65	Eva/Morrow Mountain	15	190	E5	10
2725	N60W65	Eva/Morrow Mountain	16	195	E8	10
2792	N60W65	Eva/Morrow Mountain	17	200	E8	8
2810*	N60W65	Eva/Morrow Mountain	18	205	E8a	10
2826	N60W65	Eva/Morrow Mountain	19	210	E8	4
2864*	N60W65	Eva/Morrow Mountain	20	215	J1	11
2885	N60W65	Eva/Morrow Mountain	21	220	J1	1.5
2892*	N60W65	Eva/Morrow Mountain	22	225	J3	2.5
2928*	N60W65	Eva/Morrow Mountain	23	230	J3a	10
2950	N59W65	Eva/Morrow Mountain	24	235	J3a	12.5
2957	N59W65	Eva/Morrow Mountain	25	240	K1	10
3010*	N60W65	Eva/Morrow Mountain	26	245	K2	8
3034	N60W65	Eva/Morrow Mountain	27	250	K2	7.5
3013*	N60W65	Eva/Morrow Mountain	28	255	K3	7
3060	N60W65	Eva/Morrow Mountain	29	260	K2	10
3081*	N60W65	Eva/Morrow Mountain	30	265	K7	10
4819	N60W65	Eva/Morrow Mountain	31	270	K7	12
4833*	N60W65	Eva/Morrow Mountain	32	275	K9	1
4910	N60W65	Eva/Morrow Mountain	33	280	N8	1.3
4967*	N60W65	Eva/Morrow Mountain	34	285	N8	8
4997	N60W65	Eva/Morrow Mountain	35	290	N7a	3
5009*	N60W65	Eva/Morrow Mountain	36	295	N7a	5
5047	N60W65	Eva/Morrow Mountain	37	300	N7a	3

Indicates samples previously analyzed by Dr. Hollenbach/ unpublished.

Table 3.2: Features Analyzed From Middle Archaic Components

Bag #	Unit	Component	Level	Top Depth	Feature Number	Feature Type
507	N60W64	Benton	4	140	41	CC/Ash Pit -
2302	N59W65	Benton	8	172	47	Hearth
2099	N59W65	Benton	8	155	121	Hearth
2440	N60W65	Benton	11	170	136	Hearth
2462	N59W65	Benton	11	170	137	CC Pit / Hearth
2407	N62W65	Benton	12	175	123	CC/Ash Pit -
2894	N61W62	Eva/Morrow Mountain	16	195	178	
3981	N61W62	Eva/Morrow Mountain	22	225	282	CC Pit
3913	N62W62	Eva/Morrow Mountain	23	230	274	CC Pit / Hearth
3687	N59W66	Eva/Morrow Mountain	24	235	190	CC Pit / Hearth
3586	N61W66	Eva/Morrow Mountain	24	250	231	
3623	N61W66	Eva/Morrow Mountain	25	255	236	
2986	N60W65	Eva/Morrow Mountain	25	240	194	CC Pit
3943	N60W62	Eva/Morrow Mountain	32	230	275	
4379	N62W61	Eva/Morrow Mountain	35	245	328	Pit

***CC= Charcoal**

Chapter 4: Results

Plant materials recovered from the Middle Archaic component of Dust Cave can be placed into one of the following categories: wood, nuts, fruits, or edible seeds. Nut taxa recovered from Eva/Morrow Mountain and Benton components include hickory nutshells, both acorn nutshells and meats, black walnut shell, and hazelnut shell. Fruit remains include persimmon, hackberry seeds, grape, and sumac. Purslane, bedstraw and poke belong to the seed category. The seeds in this category have no real nutritional value and are normally considered to be inadvertently brought into campsites and introduced to the archaeological record. This being stated, each of the plants can be used as greens, and they each also have known medicinal uses in the ethnographic literature. Not included in one of the five categories mentioned above, but recovered in Benton samples is squash rind and is discussed further in later sections. See Appendix Tables A.1 and A.2 for detailed lists of taxa recovered from the column and feature samples.

Results from Column Samples

Thirty-eight column samples were analyzed from the Middle Archaic period at Dust Cave. Twenty-five are from the Eva/Morrow Mountain component (Table 4.1) and eight are from the Benton component (Table 4.2). While feature samples provide a snapshot of an activity caught in time, column samples provide a general picture or overview of plant use at sites.

Table 4.1: Plant Remains Recovered from Eva/Morrow Mountain column samples.

Bag #l	Unit	Depth	Level	Pl. Wt	Wood Wt.	Lithics Wt	Bone Wt	Shell Wt	Hickory Ct	Acorn Ct	Hack Ct	Other
2425	N62W65	180	13	17.82	5.27	44.43	3.1	22.15	1422	9	4	
2701	N61W65	185	14	1.61	1.73	0	0.86	17.39	136	8	1	
2614	N60W65	190	15	7.58	0.14	0.78	1.27	9.12	566	6	1	
2725	N60W65	195	16	32.24	2.59	41.62	7.97	95.56	1882	38	16	3 Persimmon
2792	N60W65	200	17	3.03	0.01	1.39	1.03	8.17	271	56	2	
2810	N60W65	205	18	2.34	0.4	138.95	17.7	135.34	139	8	125	1 Sumac, 2 Persimmon
2826	N60W65	210	19	2.15	0.78	24.6	19.35	8.52	323	2	13	
2532	N60W65	185	20	7.61	1.9	33.89	6.4	35.11	1050	12	1	
2864	N60W65	215	20	9.78	1.22	55.9	19.21	86.05	541	34	171	1 Purslane
2885	N60W65	220	21	3.27	0.09	4.46	6.64	31.41	448	12	42	

Table 4.1: Plant remains from Eva/Morrow Mountain column samples (continued).

Bag #	Unit	Depth	Level	Pl. Wt	Wood Wt.	Lithics Wt	Bone Wt	Shell Wt	Hickory Ct	Acorn Ct	Hack Ct
2892	N60W65	225	22	7.43	0	56.81	5.5	51.97	412	11	0
2928	N60W65	230	23	2.23	0.07	17.89	11.59	38.02	159	4	132
2950	N59W65	235	24	0.36	0.06	33.25	3.92	9.56	12	2	0
2957	N59W65	240	25	0.25	0.02	3.14	9.94	1.53	28	1	1
3010	N60W65	245	26	0.17	0.01	8.48	13.08	21.47	11	0	5
3034	N60W65	250	27	0.08	0.01	3.98	5.2	3.43	3	2	3
3013	N60W65	255	28	1.43	2.19	19.35	9.04	33.4	111	116	20
3060	N60W65	260	29	0.32	0.29	18.64	3.23	1.33	39	3	1
3081	N60W65	265	30	34.43	3.07	5.73	17.42	60.71	2139	53	53

Table 4.1: Plant remains from Eva/Morrow Mountain column samples (continued).

Bag	Unit	Depth	Level	Pl. Wt	Wood Wt.	Lithics Wt	Bone Wt	Shell Wt	Hickory Ct	Acorn Ct	Hack Ct
4819	N60W65	270	31	1.56	1.35	0.75	1.37	7.87	222	1	4
4910	N60W65	280	33	0.1	0.03	1.6	2.4	0.43	11	0	2
4967	N60W65	285	34	1.59	1.37	10.35	3.27	11.2	124	3	5
4997	N60W65	290	35	1.62	1.62	1.27	1.79	0.71	178	10	0
5009	N60W65	295	36	3.39	0.91	0.29	1.98	11.62	255	3	4
5047	N60W65	300	37	5.33	1	16.23	5.38	36.94	989	6	1

Table 4.2: Plant Materials Recovered from Benton column samples. Weight in grams.

Bag #	Level	Unit	Depth	Vol(L)	Pl. Wt	Wood Wt.	Lithics Wt	Bone Wt	Shell Wt	Hickory Ct	Acorn Ct	Hack Ct	Other
2182	5	N61W65	140	7	3.94	1.87	4.09	7.12	22.39	474	21	0	11 acorn meat
2077	6	N61W65	145	10	18.02	4.91	26.52	21.39	53.94	1950	10	5	1 Cucurbita rind cf
2092	7	N61W65	150	10	10.45	2.49	16.96	19.63	43.31	419	10	6	
2127	8	N61W65	155	8	2.63	3.25	1.4	4.32	32.15	227	12	2	
2138	9	N61W65	160	8	5.23	2.73	5.92	8.59	26.66	482	32	2	
2153	10	N61W65	165	10	1.21	2.05	16.95	5.01	57.45	129	11	1	
2167	11	N61W65	170	8.5	8.42	1.84	8.42	6.26	59.36	851	16	1	
2196	12	N61W65	175	2	0.91	0.27	5.31	1.36	13.04	61	2	0	

Table 4.3: Ubiquity Results from Middle Archaic Column Samples.

Eva/Morrow Mountain (N-25)		Benton (N-8)	
Hickory	100 %	Hickory	100 %
Acorn	92 %	Acorn	100 %
Hackberry	96 %	Hackberry	75 %
Persimmon	20 %	Bl. Walnut	12 %
Sumac	12 %	Cucurbita Rd cf	12 %
Hazel	4 %		
Purslane	4 %		
Grape	4 %		
Poke	4 %		

Comparisons of ubiquity values (Table 4.3) provide insight into the use of plant resources through the recovery of remains at Dust Cave. Most notable from Middle Archaic column samples is the 100 percent ubiquity of hickory in all samples. The presence of hickory in each sample reveals the importance of hickory to prehistoric populations that used Dust Cave through the Middle Archaic period. Acorn remained an important food resource over time, actually increasing from 92 percent during the Eva/Morrow Mountain occupation to 100 percent during the Benton phase. Its absence from only two columns during the Eva/Morrow Mountain more likely reflects issues concerning preservation than its importance during the Eva/Morrow Mountain occupation. Hazelnut shell is 4 percent ubiquitous in Eva/Morrow Mountain sample and is absent in the later Benton samples. Black walnut is absent from Eva/Morrow Mountain samples but appears in one Benton sample.

The use of hackberry decreases throughout the Middle Archaic period dropping from 96 percent ubiquity during the Eva/Morrow Mountain occupation to 75 percent during the later

Benton occupation. With the exception of hackberry, all other fruits that appear in Eva/Morrow Mountain contexts are absent in Benton samples. Persimmon, sumac, and grape are present in Eva/Morrow Mountain component with ubiquity values of 20, 12, and 4 respectively.

Purslane and poke each appear in one Eva/Morrow Mountain sample yielding a ubiquity measure of 4 percent. They are both absent from Benton samples. Squash rind appears in one Benton sample, giving it a ubiquity of 12 percent in Benton column samples, while it is absent from the preceding Eva/Morrow Mountain column samples.

Comparisons of plant density between the two Middle Archaic components indicate that there are no significant differences in the density of plant materials in the Middle Archaic at Dust Cave (Figure 4.3). Differences in the density of plant material show changes in plant material recovered through time by comparing plant materials recovered by liters. This method, however, excludes differences in sedimentation rates. Accounting for differences in sedimentation rates can be achieved by comparing plant material densities based on a *per year* measure. Column samples are 50 x 50 x 5 cm, or 12.5 liters, which translates into 2.5 liters/cm. A measure of *years per liter* can be calculated then by dividing *years per cm* by 2.5 liters/cm (Table 4.4) The plant density can then be divided by the years per liter, which determines a *plants per year* (Hollenbach 2005:159). The boxplot for *plants per year* trends very closely to that of plant density (Figure 4.2).

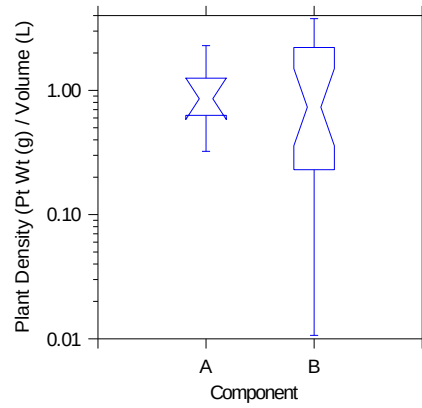


Figure 4.1: Ratios of plant density in Middle Archaic column samples. A-Benton period, B-Eva/morrow Mountain period

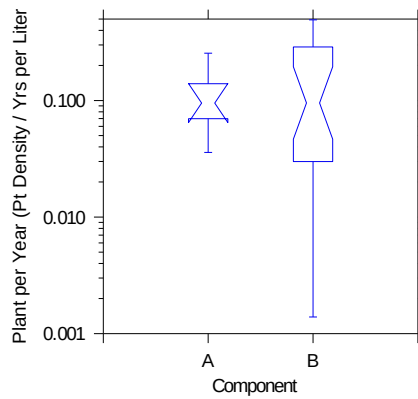


Figure 4.2: Ratio of plant density per year for Dust Cave Middle Archaic column samples. A-Benton period, B-Eva/Morrow Mountain period.

Table 4.4: Calculations for Plants per Year

Component	Average Thickness (cm)	Date Range (cal B.P.)	Years	Years/cm	Years / L
Benton	40	6,500-5,600	900	22.5	9
Eva/Morrow Mountain	125	8,400-6,000	2400	19.2	7.68
Kirk Stemmed	54	9,570-7,800	1770	32.7	13.1
Mixed KS/E SN	16	10,200-9,570	630	40	16
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

Additional information about plant use at Dust Cave during the Middle Archaic can be seen by comparing the relative densities of the various plant taxa recovered from the column samples. Boxplots comparing the relative densities of wood, hickory, acorn, and fruit between the two Middle Archaic components patterns similarly to what was seen in the ubiquity tables (Figure 4.3, 4.4, 4.5, 4.6). Use of wood, hickory and acorn appear to remain the same through time, while there is a significant decrease in exploitation of fruit. As seen previously all taxa of fruit with the exception of hackberry are absent in the later Benton phase column samples at Dust Cave.

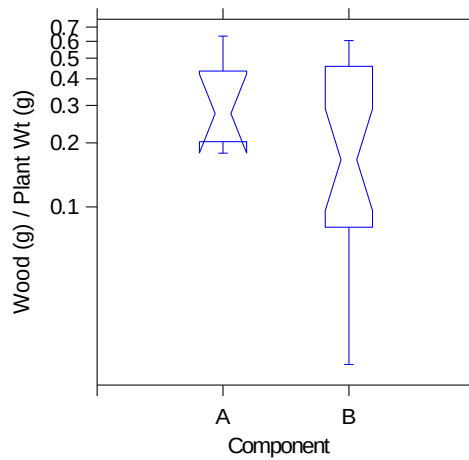


Figure 4.3: Relative density of wood in Middle Archaic column samples. A-Benton, B-Eva/Morrow Mountain.

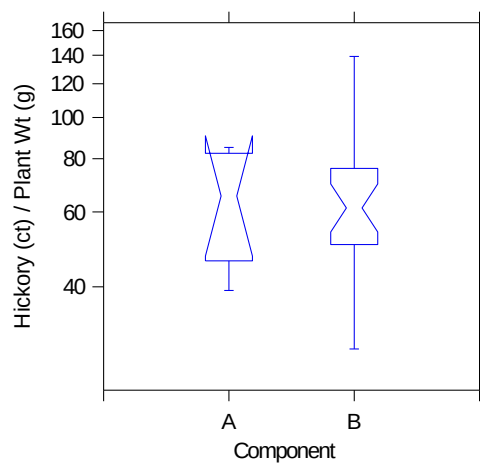


Figure 4.4: Relative Density of hickory in Middle Archaic column samples. A-Benton / B-Eva/Morrow Mountain.

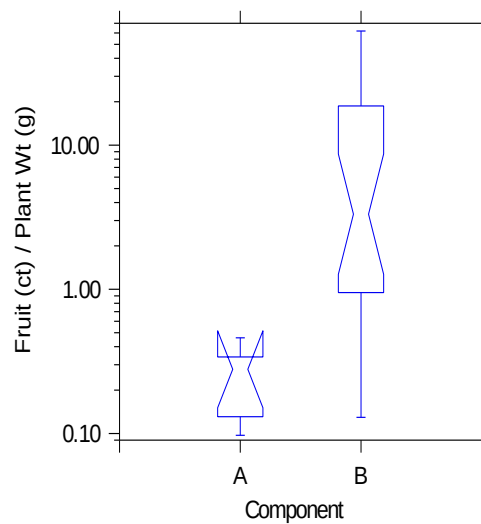


Figure 4.5: Relative density of fruit in Middle Archaic column samples. A - Benton, B - Eva/Morrow Mountain.

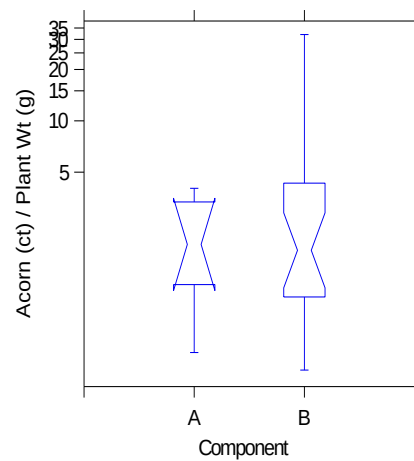


Figure 4.6: Relative density of acorn in Middle Archaic column samples. A – Benton period/B-Eva/Morrow Mountain period.

Table 4.5: Plant Remains Recovered from Eva/Morrow Mountain Feature Samples.

Bag #	Level	Unit	Depth	Fea.	Vol.	Pl. Wt	Wood Wt.	Lithic Wt.	Bone Wt.	Shell Wt.	Hickory Ct.	Acorn Ct.	Hack. Ct.	Other
2894	16	N61W62	195	178	7	28.91	8.36	184.04	22.52	160.83	658	18	144	9 acorn meat
3981	22	N61W62	225	282	1	0.72	1.41	0.35	0.66	5.1	42	3	1	
3913	23	N62W62	230	274	5	2.17	1.22	7.13	7.35	17.5	174	5	1	
3687	24	N59W66	235	190	1.5	1.15	0.6	1.79	3.02	3.63	183	29	2	
3586	24	N61W66	250	231	Nr	1.75	1.7	0.72	10.42	3.47	130	38	0	
2986	25	N60W65	240	194	5	12.88	6.92	16.44	8.3	57.81	1257	4	38	
3623	25	N61W66	255	236	4.25	1.02	0.93	2.82	7.2	6.46	69	39	6	1 Bedstraw
3943	32	N60W62	230	275	5	2.77	0.67	16.43	4.89	11.03	196	15	9	
4379	35	N62W61	245	328	6	1.7	1.55	2.47	6.16	50.57	169	7	4	

Table 4.6: Plant Remains Recovered from Benton Feature Samples.

Bag #	Unit	Level	Depth	Feature	Vol.	Pl. Wt	Wood Wt.	Lithic Wt.	Bone Wt.	Shell Wt.	Hickory	Acorn Ct	Hack Ct.	Other
507	N60W64	4	140	41	12	0.23	1.89	0.57	0.46	1.17	26	0	0	Cucurbita rind cf.
2302	N59W65	8	172	47-B	3	0.87	2.58	0.25	3.06	7.09	199	9	2	
2099	N59W65	8	155	121	19	2.61	6.96	51.54	35.07	52.81	326	10	2	
2462	N59W65	11	170	137	1.5	0.69	0.44	6.62	0.98	2.77	94	1	0	
2440	N60W65	11	170	136-A	5.5	13.45	18.49	7.35	3.45	16.51	1375	3	0	Persimmon
2407	N62W65	12	175	123	5	3.06	3.76	8.92	13.27	32.76	367	29	4	

Results from Feature Samples

Feature samples, unlike column samples, reflect specific activities over a shorter duration of time. Fifteen features were analyzed from the Middle Archaic period, nine from the Eva/Morrow Mountain component (Table 4.5) and six from the Benton component (Table 4.6).

Table 4.7 shows ubiquity results from the Middle Archaic feature samples. Both hickory and acorn are 100 percent ubiquitous in Middle Archaic features at Dust Cave. The presence of both hickory and acorn in every feature sample analyzed from the Middle Archaic component addresses the importance that mast resources played in Middle Archaic subsistence. There is a decrease in the ubiquity of hackberry from 88 in the Eva/Morrow Mountain component to 50 during the later Benton component. Persimmon appears in a Benton feature sample and is absent from the previous Eva/Morrow Mountain phase features. Cucurbita has a ubiquity value of 16 percent in Benton features, while it is absent in Eva/Morrow Mountain features. One bedstraw seed was recovered from an Eva/Morrow Mountain feature, but was absent from the later Benton features.

Table 4.7: Ubiquity results for Middle Archaic Feature Samples

Ubiquity Results For Middle Archaic Feature Samples		
	Eva/Morrow Mountain(9)	Benton (6)
Hickory	100 %	100 %
Acorn	100 %	100 %
Hackberry	88 %	50 %
Persimmon	0	16 %
Cucurbita rind	0	16 %
Bedstraw	11 %	

The boxplot in Figure 4.7 below shows the density of plant remains (grams/volume) recovered from Middle Archaic feature samples. While there appears to be a slight decrease from the Eva/Morrow Mountain period to the Benton period, that change is not significantly different. When the densities of specific taxa are examined, Figures (4.8, 4.9, 4.10, and 4.11), there appears to be no significant differences between taxa in the two Middle Archaic components; however, there appears to be a slight decrease in the use of both fruit and acorn from the Eva/Morrow Mountain period to the Benton period, but these differences are not considered to be statistically significant. The density of hickory (Figure 4.10) and wood (Figure 4.8) appears to remain constant throughout.

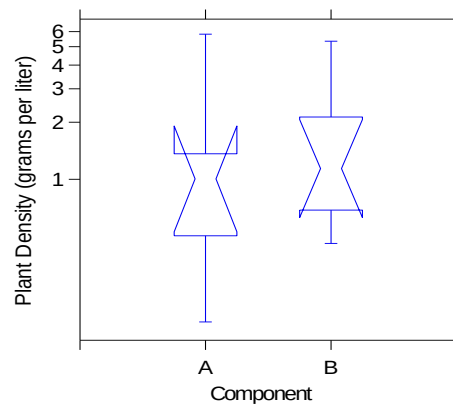


Figure 4.7: Plant materials in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

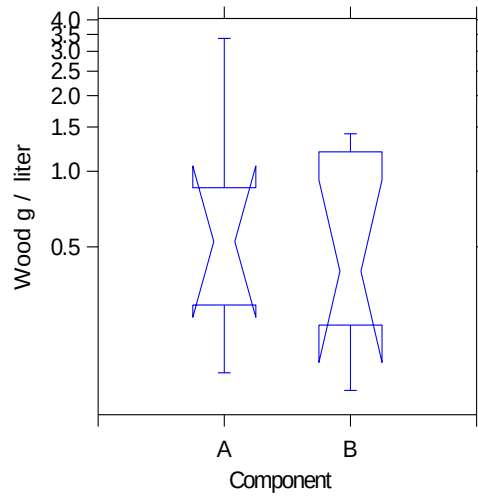


Figure 4.8: Density of wood in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

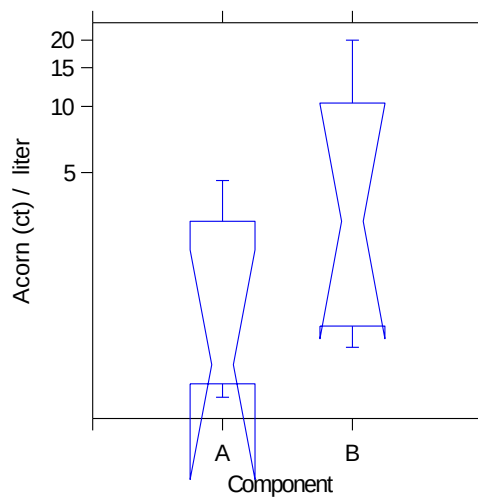


Figure 4.9: Density of acorn in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

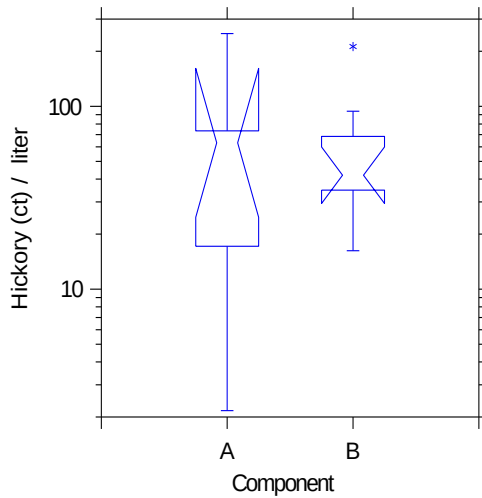


Figure 4.10: Density of hickory in Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

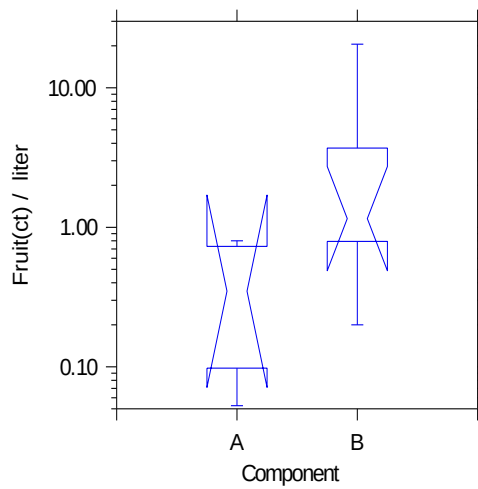


Figure 4.11: Boxplot shows a comparison of the density of fruits between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

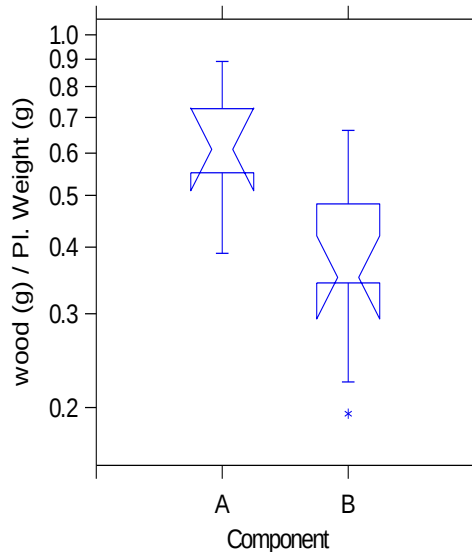


Figure 4.12: Comparison of relative density of wood between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

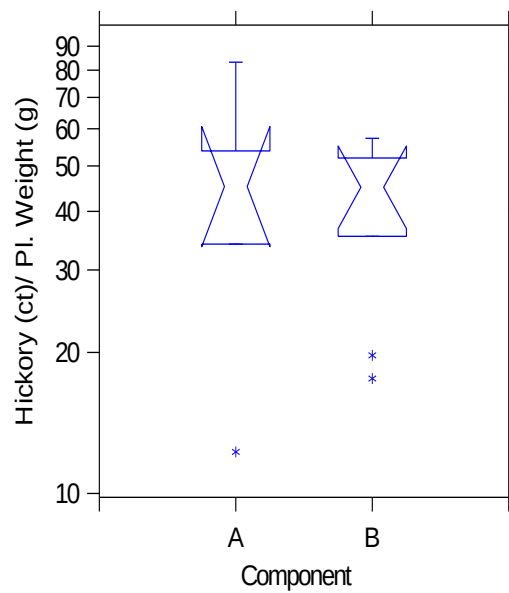


Figure 4.13: Comparison of the relative density of hickory between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

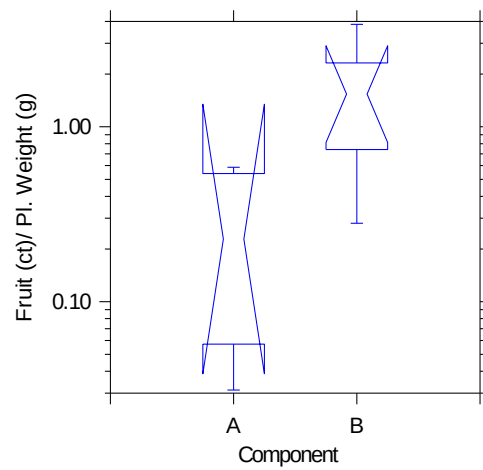


Figure 4.14: Comparison of the relative density of fruit between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period.

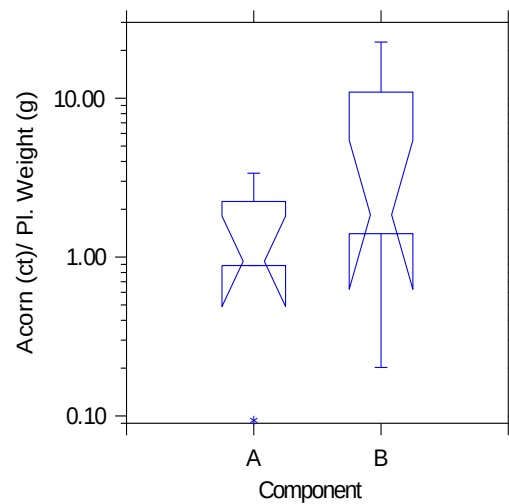


Figure 4.15: Comparison of the relative density of acorn between Middle Archaic feature samples. A - Benton period, B - Eva/Morrow Mountain period

A comparison of boxplots displaying relative densities, (Figures 4.12, 4.13, 4.14, and 4.15) shows differences that are not apparent when comparing density. While the use of hickory (Figure 4.13) remains consistent there is a statistically significant increase in wood (Figure 4.12) during the Benton phase of the Middle Archaic period. There is a decrease again in the presence of fruit (Figure 4.14) and acorn (Figure 4.15); however, these decreases are not statistically significant.

Conclusions from Middle Archaic Column and Feature Sample

The relative lack of variation in diets through the Middle Archaic occupations, evident in both column and feature samples, indicates that the occupants of Dust Cave exploited plant resources from the surrounding areas in a similar fashion throughout the Middle Archaic. The use of nuts remains consistent during both the Eva/Morrow Mountain and Benton occupations with hickory being 100 percent ubiquitous and acorn present in all but one. Similar trends are found between the use of fruits and small seeds through time also. Though fruit does not occur in great numbers during the Eva/Morrow Mountain occupation it decreases in both numbers and diversity in the later Benton component. The same holds true for small seeds. Their presence is not great in the earlier Eva/Morrow Mountain component and they decrease through time. The only plant remains which increase through time is Cucurbita, which is absent in all Eva/Morrow Mountain samples but is present in both column and feature samples from the later Benton component

Trends in Plant Use from the Late Paleoindian through the Benton Period at Dust Cave

In order to examine the changing foraging patterns used by the inhabitants of Dust Cave over time, the same techniques used to examine changes in plant use during the Middle Archaic period can be employed. Ubiquity tables show the changing presence of plant materials found between cultural components while boxplots allow for comparisons in density and relative density of plant remains in column samples and feature samples. The changes that pattern over time allow us a better understanding of changes in the diet and foraging patterns employed through time by the occupants of Dust Cave.

Column Samples through Time

Hickory nuts are 100 percent ubiquitous in column samples at Dust Cave (Table 4.8). The presence of hickory in each column sample analyzed shows the importance of hickory to those who occupied Dust Cave throughout its 7,000 year occupation. While acorn is only 39 percent ubiquitous in Late Paleoindian samples it increases to 92 percent during the Early Side-Notched component and remains between 92 percent and 100 percent throughout the cave's occupation. The use of hazel is also sporadic with a ubiquity value of 19 percent during the Late Paleoindian component, increasing to 25 percent during the mixed Early Side-Notched/Kirk Stemmed component, and dropping to 4 percent during the Eva/Morrow Mountain component and absent in later periods.

Table 4.8: Table of Ubiquity Results for column samples from Dust Cave.

Ubiquity Results for Dust Cave Column Samples						
	LP (N=36)	ESN (N=12)	ESN/KS (N=10)	KS (N=8)	E/MM (N=25)	B (N=8)
	%	%	%	%	%	%
Hickory	100	100	100	100	100	100
Acorn	39	92	100	100	92	100
Black Walnut	36	0	20	0	0	12
Hazel	19	0	0	25	4	0
Hackberry	75	100	100	100	96	75
Grape	3	8	20	25	4	0
Persimmon	0	0	10	38	20	0
Sumac	0	8	0	38	12	0
Chenopod	56	75	20	13	0	0
Wild Legume	3	0	10	38	0	0
Purslane	0	0	0	0	4	0
Cucurbita rind cf	0	0	0	0	0	12

Data from Late Paleoindian through Kirk Stemmed period borrowed from Hollenbach 2005.LP-Late Paleoindian, ESN-Early Side-Notched, ESN/KS-Early Side-Notched / Kirk Stemmed, KS-Kirk Stemmed, E/MM-Eva/Morrow Mountain, B-Benton period.

Hackberry is the only fruit that is present in all occupation periods at Dust Cave. Although the ubiquity values fluctuate between components, hackberry has a ubiquity value of 100 percent from the Early Side-Notched component through the Kirk Stemmed component and decreases throughout the Middle Archaic component. Behind hackberry, grapes are the most commonly recovered plant remains. While present in much smaller numbers than hackberry, grape is most commonly found during the Early Side-Notched and Kirk Stemmed occupations and like hackberry decreases to only 4 percent during the Eva/Morrow Mountain components and is absent from Benton component column samples. Sumac and persimmon remains are each found in three cultural components, both having their highest ubiquity values during the Kirk Stemmed component, at 38 percent. Following the Kirk Stemmed component, their ubiquity values drop during the Eva/Morrow Mountain component, like grape, and then are absent from Benton component samples.

Chenopod was recovered from each component leading up to the Middle Archaic components. With a 75 percent ubiquity value during the Early Side-Notched occupation, the use of chenopod drops off rapidly, falling to 20 percent during the Early Side-Notched/Kirk Stemmed samples, 13 percent during the Kirk Stemmed samples, and is absent in the later samples. Wild legume is present in the Late Paleoindian, Early Side-Notched/Kirk Stemmed, and Kirk Stemmed periods but like many of the other taxa is absent from Middle Archaic samples. Purslane is only present in the Eva/Morrow Mountain component, with a ubiquity value of 4 percent. Cucurbita, like purslane, is also present only in the Middle Archaic components but is limited to the Benton period with a 12 percent ubiquity value.

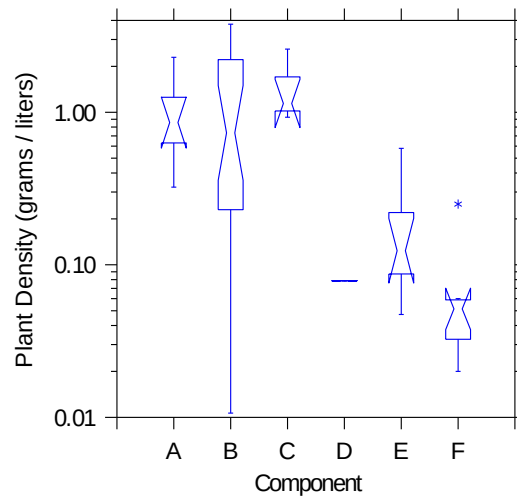


Figure 4.16: Changes in Plant Material Density through Time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period.

Figure 4.16 shows the change in density of plant materials across components. What stand out are the similarities that occur in the Kirk Stemmed, Eva/Morrow Mountain, and Benton components, and the significant increase in plant material density during these occupations as compared to the earlier Late Paleoindian and Early Side-Notched components.

Figure 4.17 shows plant density per year. While appearing similar to that of plant density, it further demonstrates a significant difference between the Late Paleoindian and the Early Side-Notched components, and then again a significant change between the Early Side-Notched and Kirk Stemmed components. There are no significant changes between the Kirk Stemmed, Eva/Morrow Mountain, and Benton components.

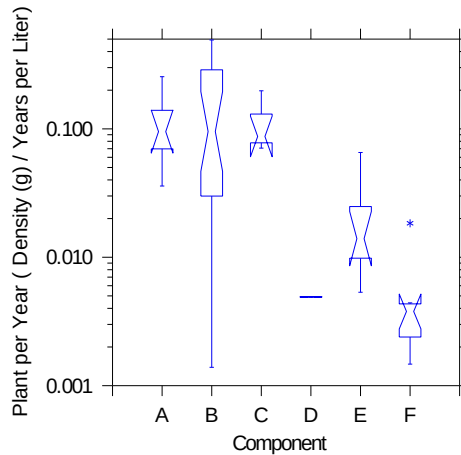


Figure 4.17: Plant Density per year in Dust Cave components. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

The use of hickory nut decreases in the Early Side-Notched component but is not significantly different from the remains from the Late Paleoindian component (Figure 4.18). The increase in hickory in the Kirk Stemmed period is statistically significant from the previous Early Side-Notched component and remains fairly consistent through the rest of the cave's occupation. Also, hickory may have been used as a source of fuel as it became more abundant across the landscape. While the use of hickory increases over time, the use of acorn decreases (Figure 4.20). The Late Paleoindian and Early Side-Notched components have overlapping values, but by the Kirk Stemmed component acorn decreases significantly compared to the Late Paleoindian. By the Eva/Morrow Mountain component, the drop is also statistically significant compared to the Early Side-Notched. Black walnut is present in the Late Paleoindian period but remains mostly absent from the later column samples, appearing later only in the Benton period (Figure 4.21).

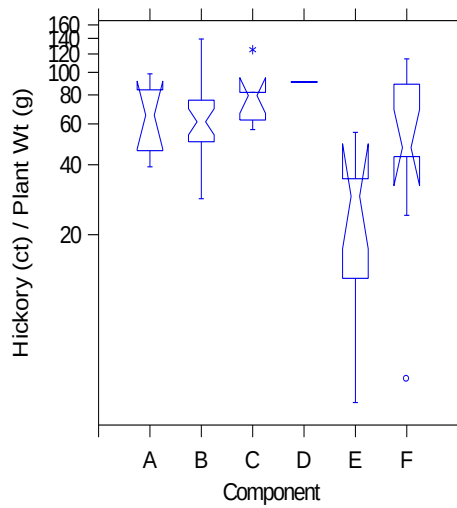


Figure 4.18: Relative density of hickory through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

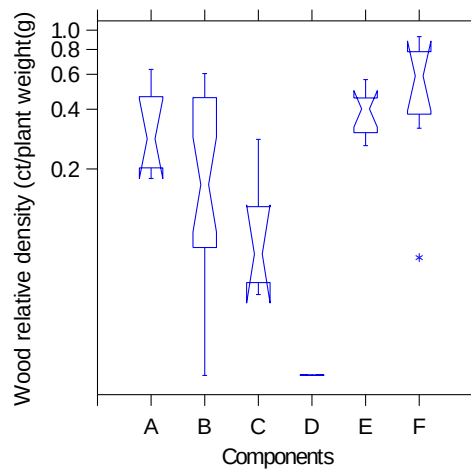
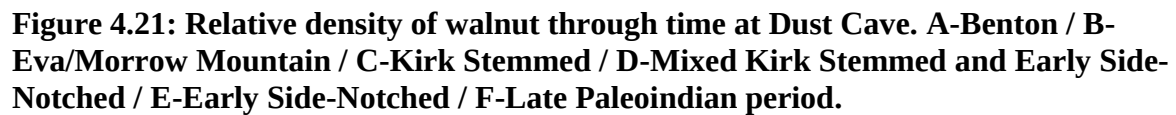


Figure 4.19: Relative density of wood through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period



The greatest variability through time occurs in the use of fruits and edible seeds. The use of fruit significantly increases from the Late Paleoindian to the Early Side-Notched component and then decreases significantly during the Kirk Stemmed component (Figure 4.22). The use of fruit between the Kirk Stemmed and Eva/Morrow Mountain component is not significant but the drop-off during the Benton occupation is significant from the preceding Eva/Morrow Mountain component. The use of edible seeds by the occupants of Dust Cave decreases greatly through time. Use during the Late Paleoindian and Early Side-Notched component remains consistent, but drops of significantly during the Kirk Stemmed and Eva/Morrow Mountain components. Evidence of the use of edible seeds in Benton period column samples is absent (Figure 4.23).

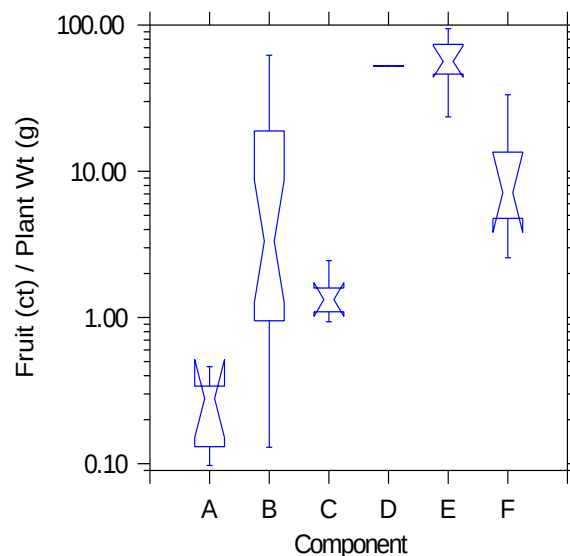


Figure 4.22: Relative density of fruit through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

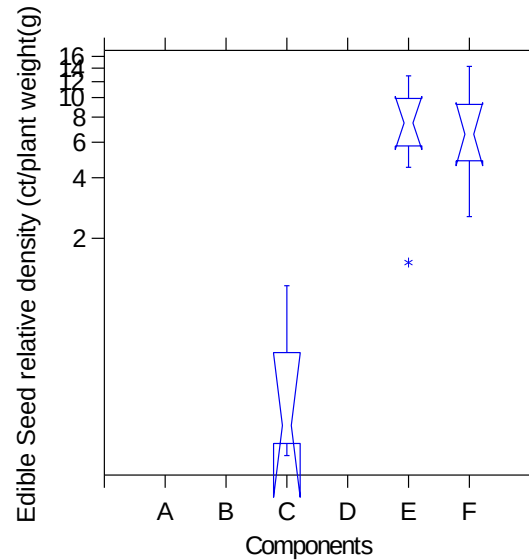


Figure 4.23: Relative density of edible seeds through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

Feature Samples through Time

The ubiquity table, Table 4.9 shows the changes that occur in Dust Cave features through time. Hickory nutshell is 100 percent ubiquitous in all features from all components at Dust Cave. The use of acorn increases through time becoming 100 percent ubiquitous during the later occupations at the cave. The use of black walnut jumps from the Late Paleoindian components to the Early Side-Notched components, but drops off significantly in the later periods of occupation: by the Middle Archaic occupations black walnut is absent from the feature samples. Hazel nutshell appears only in Kirk Stemmed features, and is absent from the previous and later components.

Table 4.9: Ubiquity Values for Dust Cave Feature Samples.

	LP (N=14) %	ESN (N=11) %	ESN/KS (N=6) %	KS (N=10) %	E/MM (N=9) %	B (N=6) %
Hickory	100	100	100	100	100	100
Acorn	71	82	100	100	100	100
Black Walnut	7	55	33	20	0	0
Hazel	0	0	0	20	0	0
Hackberry	86	100	100	90	88	50
Grape	0	0	33	0	0	0
Persimmon	7	27	33	50	0	16
Sumac	0	9	17	10	0	0
Chenopod	50	9	17	10	0	0
Wild Legume	0	0	17	30	0	0
Cucurbita rind cf	0	0	0	0	0	16
Bedstraw	0	0	0	0	11	0

Data for Late Paleoindian through Kirk Stemmed period borrowed from Hollenbach 2005.

Hackberry appears in all Early Side-Notched and mixed Early Side-Notched/Kirk Stemmed component features but drops afterwards, having a high ubiquity value of 90 percent during the Kirk Stemmed component, 88 percent during the Eva/Morrow Mountain component, and 50 percent in the Benton component. Grape appears in the mixed Early Side-Notched/Kirk Stemmed component, and is absent in all features from all other time periods. The use of persimmon increases slightly through the earliest occupations of Dust Cave before its absence in the Eva/Morrow Mountain component, but returns in the Benton component. Sumac appears in the Early Side-Notched component with a ubiquity value of 9 percent. It increases to 17 percent during the mixed Early Side-Notched/Kirk Stemmed component, decreases to 10 percent during the Kirk Stemmed component and is absent in Middle Archaic features.

Chenopod is found in Late Paleoindian component samples through the Kirk Stemmed component but is absent from the Middle Archaic feature samples. Wild legume appears in the mixed Early Side-Notched/Kirk Stemmed components but is absent in the earlier and later feature samples. Cucurbita appears only in the Benton feature samples with a ubiquity value of 16 percent. Bedstraw also appears in only one component, the Eva/Morrow Mountain, with a ubiquity value of 11 percent.

Figure 4.24 shows the changes in the density of plant remains through time in the features from Dust Cave. Plant densities increase consistently throughout the occupation of the cave, beginning in the Late Paleoindian period and only decreasing slightly in the Benton period. However, the only changes that are statistically significant are the differences in the densities in the Kirk Stemmed, Eva/Morrow Mountain, and Benton components and the density of features in the Late Paleoindian component. The density of wood, shown in the Figure 4.25 below, tracks

very similarly to that of plant densities. The use of wood increases slightly over time, displaying statistically significant changes between the Late Paleoindian and Kirk Stemmed through the Benton component.

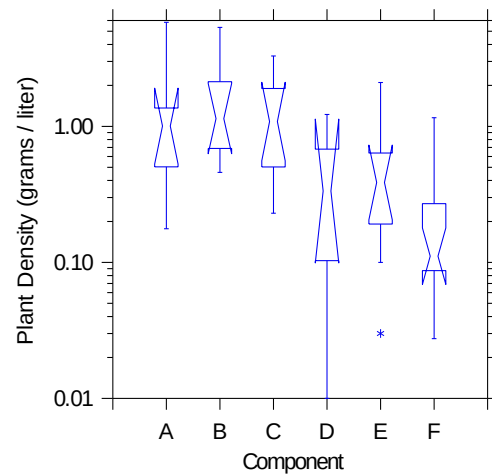


Figure 4.24: Changes in plant density through time in Dust Cave feature samples. A- Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

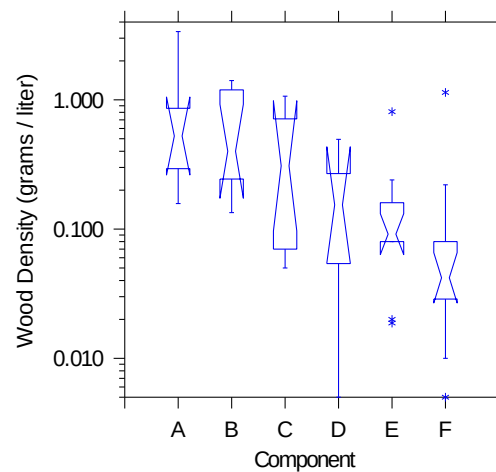


Figure 4.25: Changes in wood density through time in Dust Cave feature samples. A- Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side-Notched / F-Late Paleoindian period

The density of hickory (Figure 4.26) increases through time similar to the density changes in wood (Figure 4.25). The differences in density between the Late Paleoindian component and all but the mixed Early Side-Notched/Kirk Stemmed components are statistically significant. The density of acorn is highest during the mixed Early Side-Notched/Kirk Stemmed component; however the changes throughout the entire occupation of the cave are not statistically significantly (Figure 4.27). In the periods in which black walnut is present the changes in the density are not significant, however, it is absent from Middle Archaic features (Figure 4.28). Hazel is present in Kirk Stemmed features and one mixed Early Side-Notched/Kirk Stemmed feature, but absent from all others (Figure 4.29).

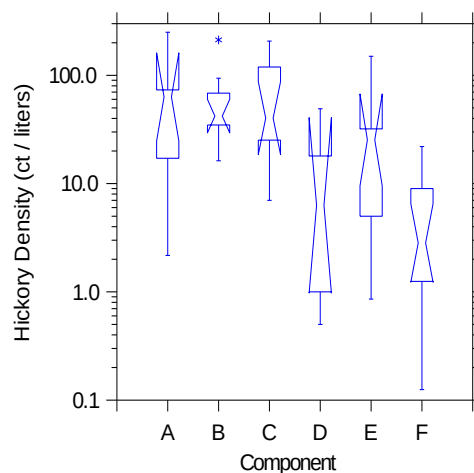


Figure 4.26: Changes in density of hickory through time at Dust Cave from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.

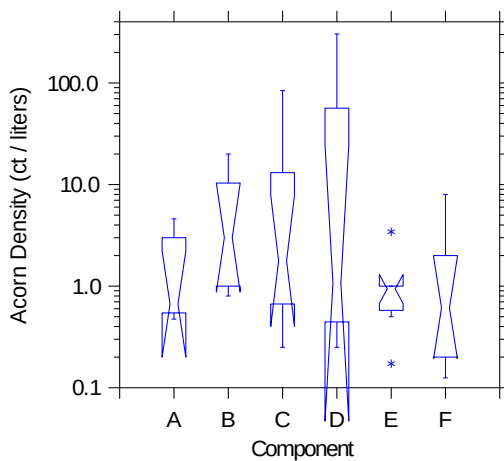


Figure 4.27: Changes in density of acorn through time at Dust Cave from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.

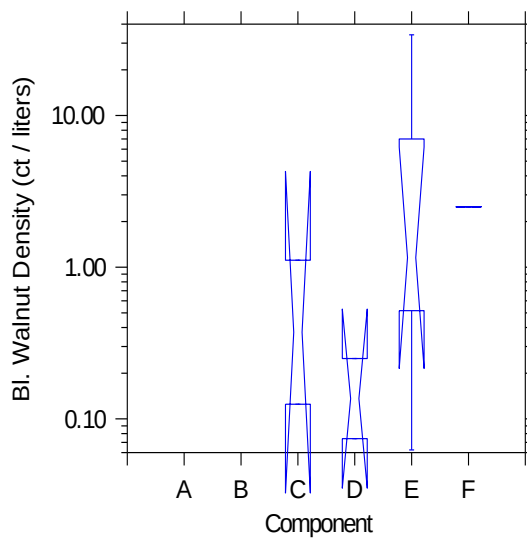


Figure 4.28: Changes in density of black walnut through time at Dust Cave from feature samples. A-Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - ESN/KS / E - Early Side-Notched / F - Late Paleoindian.

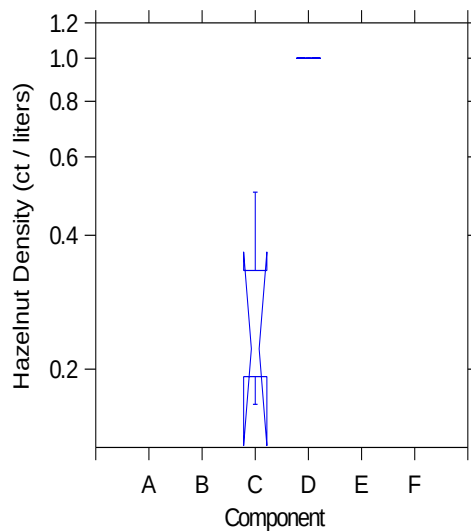


Figure 4.29: Changes in density of Hazelnut through time at Dust Cave from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

The density of fruit changes over time also, reaching its height in the Early Side-Notched and decreasing significantly throughout the later periods of occupation (Figure 4.30).

Evidence for the use of edible seeds is absent from the later Middle Archaic component features from Dust Cave (Figure 4.31). The presence of edible seeds is greatest in the Kirk Stemmed and Late Paleoindian occupations although the differences are not statistically significant.

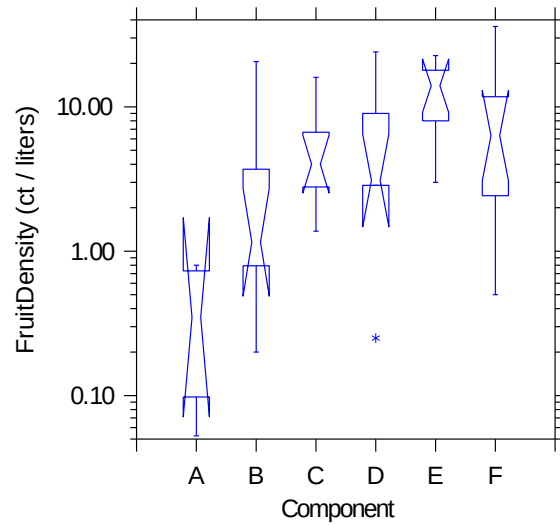


Figure 4.30: Changes in fruit density through time from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

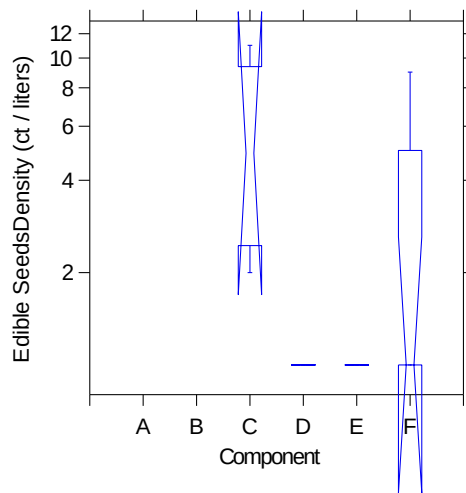


Figure 4.31: Changes in edible seed density through time from feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

Comparisons of plant remains by relative densities are similar to the comparisons based on density with the exception of hickory nuts. Figure 4.32 shows that through the entire occupation sequence at Dust Cave there are no statistically significant changes in the relative density of hickory. The relative density of acorn looks similar to comparisons of density with the only significant difference being between the Benton component and the earlier Early Side-Notched and the Late Paleoindian component (Figure 4.33). Black walnut and hazel pattern similarly to the density comparison; although the decrease seen in black walnut in the Kirk Stemmed component is statistically significant here. Most notable is the absence in the later Middle Archaic occupations (Figures 4.34 and Figure 4.35).

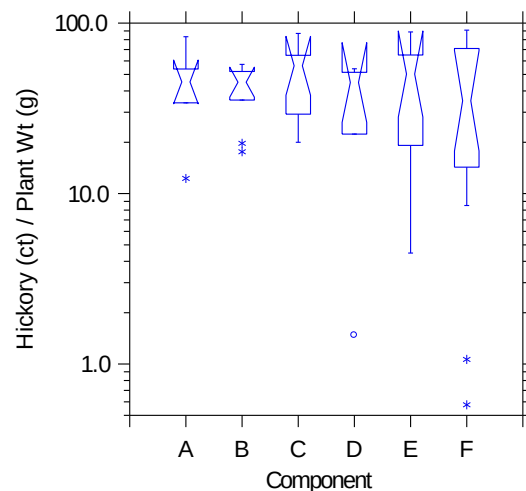


Figure 4.32: Relative density of hickory through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

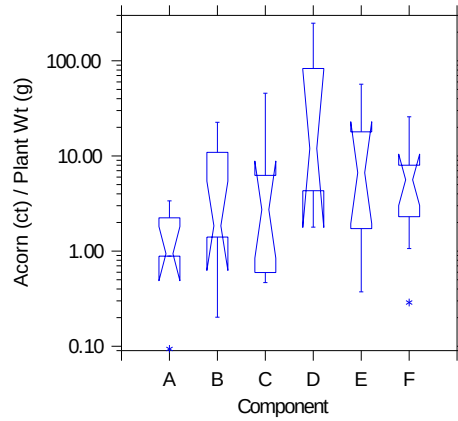


Figure 4.33: Relative density of acorn through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

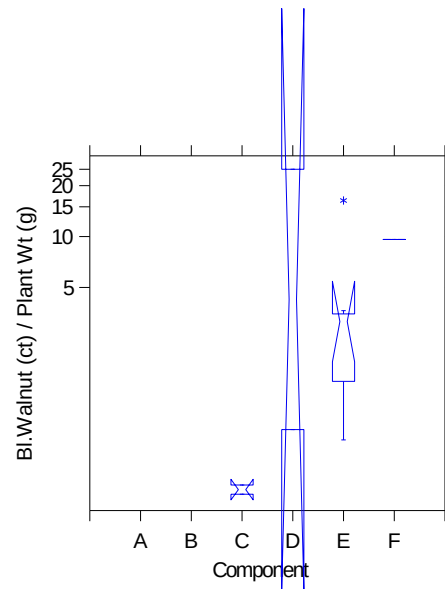


Figure 4.34: Relative density of black walnut through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched/Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

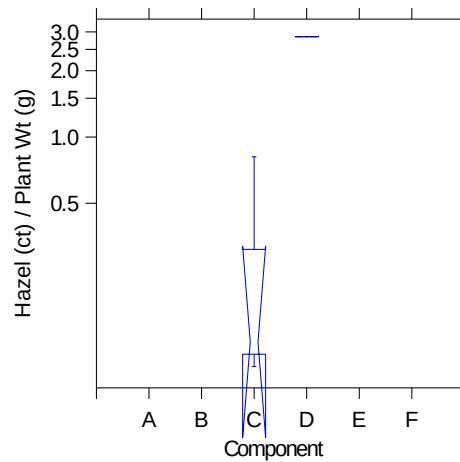


Figure 4.35: Relative density of hazelnut through time in feature samples. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

While fruit patterns similarly using density and relative density, edible seeds pattern differently. Edible seeds, based on relative density, show a statistically significant decrease between the Kirk Stemmed and the Late Paleoindian components (Figure 4.36). Also notable is their absence in the Middle Archaic samples. Fruit decreases through time with the first significant change coming in the Kirk Stemmed component. From there the decrease continues throughout the cave's occupation (Figure 4.37).

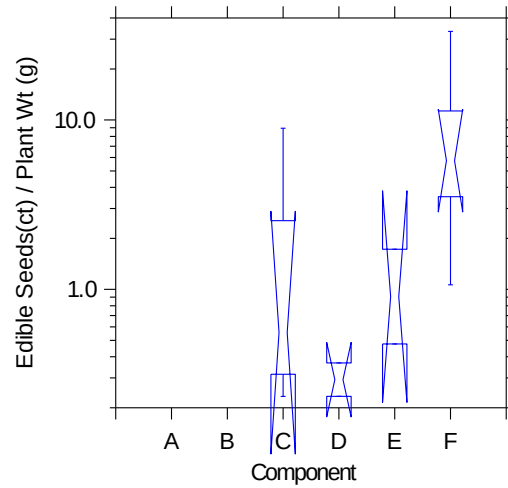


Figure 4.36: Changes in use of edible seeds through time at Dust Cave. . A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

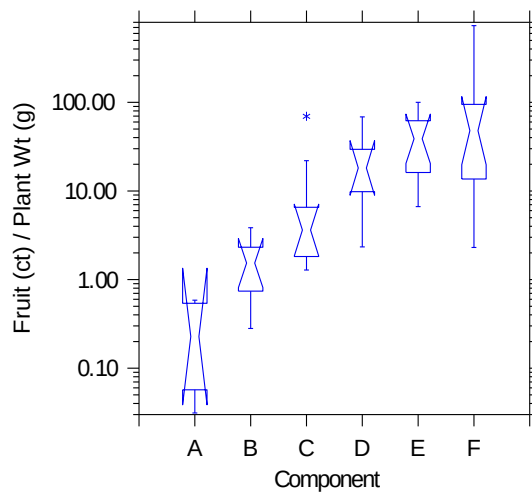


Figure 4.37: Changes in the relative density of fruits through time at Dust Cave. A- Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D – Early Side-Notched / Kirk Stemmed / E - Early Side-Notched / F - Late Paleoindian.

Trends through Time in Plant Exploitation at Dust Cave

Comparisons of plant remains recovered at Dust Cave show trends through time that provide insight into the use of the cave and the exploitation of plant resources by its occupants throughout its 7,000 year history. Plant density increases through time with a minor decrease during the Benton period, which might be associated with the limited amount of space available in the cave during this time periods. Similarly, the relatively limited quantities of remains found in the Late Paleoindian component may be more indicative of erosional events than foraging behaviors.

Hickory is 100 percent ubiquitous in all samples from all components analyzed from Dust Cave. Its presence in both column samples and features increases through time. The use of acorn increases after the Late Paleoindian period, reaching its peak during the Early Side-Notched and Kirk Stemmed periods before dropping off in the later Middle Archaic period. The sporadic use of black walnut and hazel by the occupants at Dust Cave is most likely a result of their handling cost. In addition, black walnut grows as stationary trees and hazel as shrubs, both requiring different collection strategies from hickories, which grow in stands or groves

The use of fruits and small seeds trend similarly through time at Dust Cave. The use of fruit spikes in the Early Side-Notched, mixed Early Side-Notched/Kirk Stemmed and Kirk Stemmed occupations and decreases in later Middle Archaic components, with hackberry being the most abundant through time. Small seeds also are more abundant in earlier time periods and drop off significantly during the later Middle Archaic occupations.

Changes in Artifact Densities in Middle Archaic Column Samples

By comparing the changes in artifact densities in both the Middle Archaic period and through time, useful information can be contributed to aid in our understanding of how the cave and surrounding resources were being utilized in relationship to plant resources. Figures 4.38, 4.39, 4.40, and 4.41, below show the densities of shell, lithics, bone, and plant remains from Dust Cave column sample. Though there appear to be slight differences, either increases or decreases, the changes in the presence of shell, lithics, and bone generally reflect those of plant remains between the Eva/Morrow Mountain and Benton periods, which are not statistically significant.

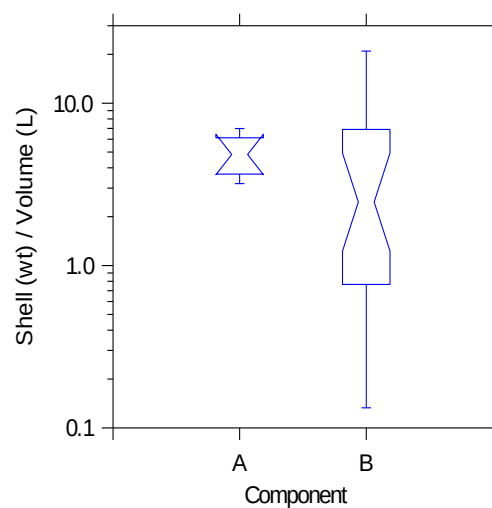


Figure 4.38: Density of shell recovered from Middle Archaic column samples. A - Benton / B-Eva/Morrow Mountain.

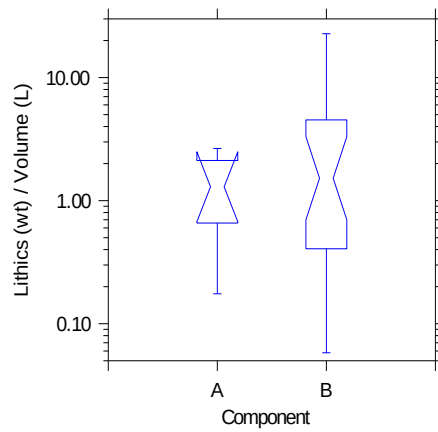


Figure 4.39: Lithic materials recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain.

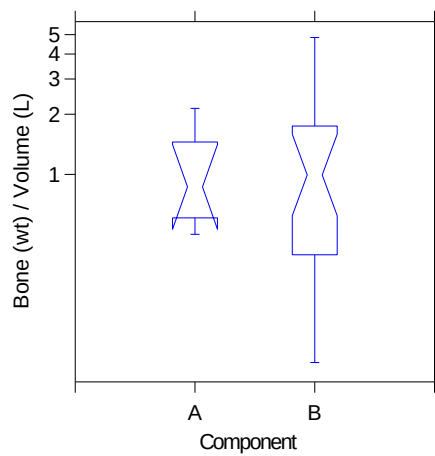


Figure 4.40: Density of bone recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain.

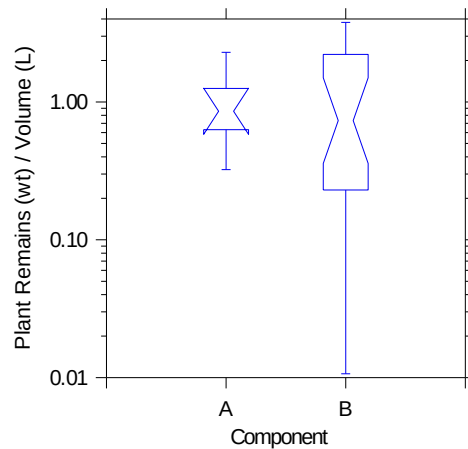


Figure 4.41: Density of plant remains recovered from Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain period.

When these densities are compared across time the changes are much more significant. While the presence of shell across the Middle Archaic components shows no significant change, the presence of shell over time shows significant changes, patterning very similarly to plant materials. The increase in shell through the first two components, Late Paleoindian and the Early Side-Notched component, is statistically significant between each period (Figure 4.42). While the change throughout the last three occupational components increases slightly, the changes between these periods are not statistically significant.

Although some of the shell in the sample is attributable to terrestrial gastropods, the increase in shell mirrors a significant increase in recovery of shellfish at the site during the Middle Archaic (Parmalee 1994). Through 1994, only seven identifiable mussel specimens were recovered from the Late Paleoindian component, five from the Early Side-Notched, and 24 from the Kirk Stemmed component. The remaining 322 specimens identified by Parmalee

(1994:Table 2) derive from the Eva/Morrow Mountain and Benton components. The changes in the use of shellfish over time reflected in the archaeological record from Dust Cave should not be surprising, and reflect trends that occur across the Southeast during these times. The increase in the exploitation of marine resources during these periods is attributed to more favorable environmental conditions for shellfish brought about by the Hypsithermal warming episode, which marks the transition between the Early and Middle Archaic periods. The proximity of Dust Cave to these riverine resources makes shellfish an obvious food choice for occupants of the cave.

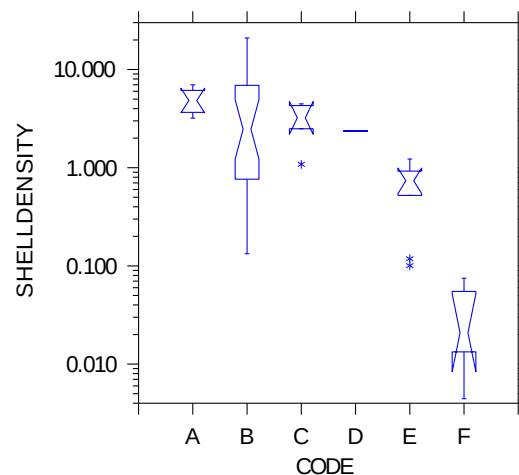


Figure 4.42: Density of shell recovered from Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched/Kirk Stemmed mixed / E - Early Side-Notched / F – Paleoindian

The increase in the use of shellfish as a food resource in the later periods of occupation at Dust Cave may account for the decrease in the amount of animal bone recovered from contemporary occupation periods, as it provided an alternative food resource. As shell density increases in the Kirk Stemmed, Eva/Morrow Mountain, and Benton components, the density of bone decreases (Figure 4.43). The density of bone recovered from the Early Side-Notched is significantly higher than in all other occupations, and while the densities in the later occupations decrease slightly through time, most of these changes are not statistically significant.

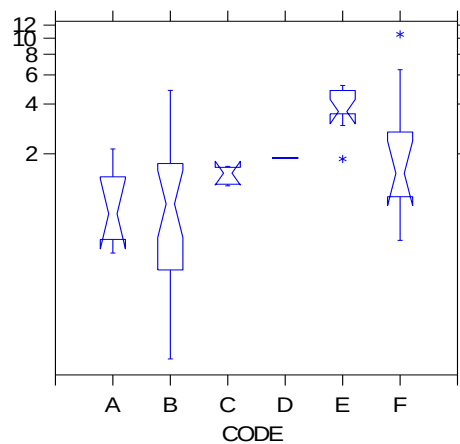


Figure 4.43: Density of bone in Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched/Kirk Stemmed mixed / E - Early Side-Notched / F – Paleoindian

Figure 4.44 shows the changes in lithic density over time. These changes are very similar to the changes in bone density over time, but because lithics, especially debitage recovered in flotation samples, is attributed to tool maintenance and manufacture, likely related to hunting, butchering, and hide preparation, then the bone and lithics should be expected to pattern similarly. Lithics, like bone density, jumps significantly during the Early Side-Notched component and then drops significantly following. Lithics density fluctuates slightly but is not statistically significantly between the Kirk Stemmed, Eva/Morrow Mountain, and Benton components. Figure 4.45 shows the changes in density of plant materials through time and interestingly patterns opposite of lithics, greatly increasing after the mixed Early Side-Notched component whereas lithics decrease significantly after the Early Side-Notched. These changes reflect a shift in subsistence strategies employed by the occupants of the cave through time.

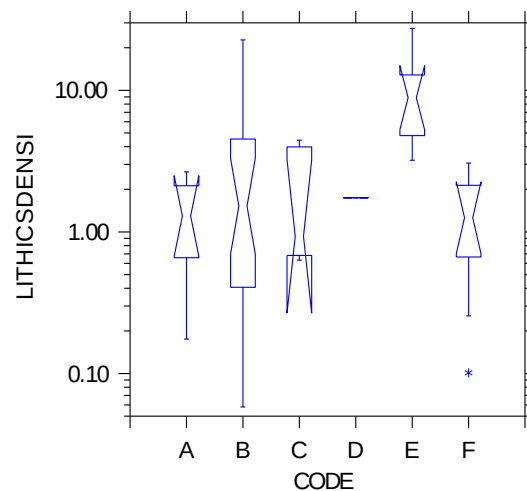


Figure 4.44: Density of lithic materials recovered from Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched / Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian

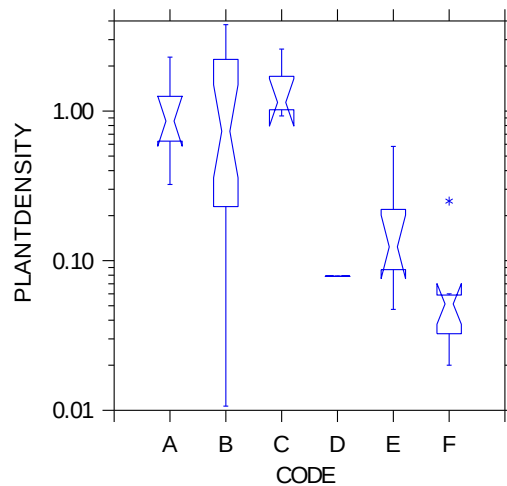


Figure 4.45: Density of plant remains in Dust Cave column samples through time. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched / Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian

Another way that lithics can be incorporated into ratios that can be used to help understand changes over time by the occupants of Dust Cave is by comparing nutshell counts to lithic weight (g). Figures 4.46 and 4.47 show these ratios. Gardner (1994) used this comparison to suggest an increased importance of nut gathering as opposed to hunting, supposing that most debitage recovered from sites is produced through the maintenance of hunting tools. While the figure below indicates that there seems to be an increase between the components of the Middle Archaic period, when viewed over the cave's entire occupation larger changes become obvious.

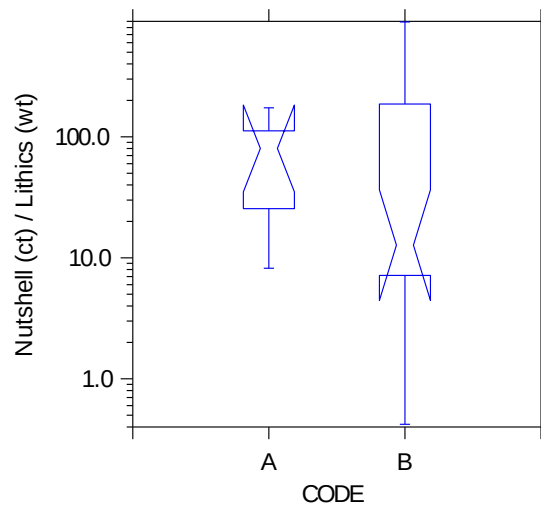


Figure 4.46: Comparison of nutshell to debitage in Middle Archaic column samples. A - Benton / B - Eva/Morrow Mountain Phase

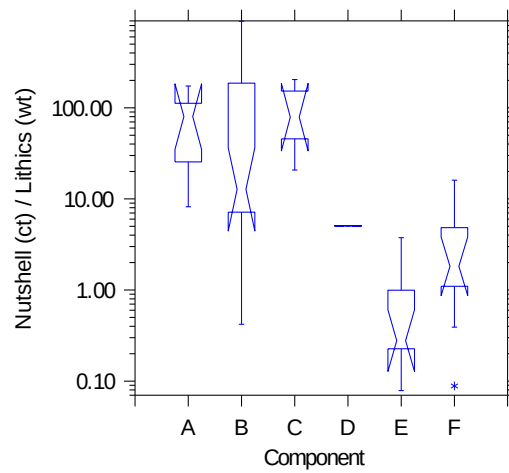


Figure 4.47: Comparison of nutshell to debitage in Dust Cave column samples. A - Benton / B - Eva/Morrow Mountain / C - Kirk Stemmed / D - Early Side-Notched Kirk Stemmed mixed / E - Early Side-Notched / F - Paleoindian

The decrease in the ratio during the Early Side-Notched component is expected based on the significant increase in lithics during this component, which suggests that hunting, or at least tool manufacturing or repair, was a major focus of the occupants during that occupation. Based on the changes over time in lithic density and plant densities, which is composed mainly of nutshells during the later occupation periods, the increased but not significantly different ratios during the Kirk Stemmed, Eva/Morrow Mountain, and Benton periods is not surprising. These ratios indicate that during these later occupations of Dust Cave the individuals occupying the cave were focused more on the procurement of plant resources, mainly hickory and acorn nuts, than hunting.

Results of the artifact comparisons indicate that while changes between Middle Archaic components are minimal, the changes that occur throughout the occupation are significant. The increase in shellfish along with the decreases in lithic and faunal remains indicate that patterns of mobility and subsistence dramatically changed at Dust Cave from the Paleoindian to the end of the Middle Archaic occupations. When compared to the changing plant material densities, there appears to be a greater focus on plant resources and more specifically mast resources, while the emphasis on hunting appears to decrease. The results indicate that the function of Dust Cave changed over time from a more generally used residential base camp (Binford 1980), to a location used specifically to exploit hickory resources, which are of high nutritional value and were abundant during the Middle Archaic periods due to changing climatic conditions brought about by the Hypsithermal warming episode.

Chapter 5: Botanical Materials Discussion

Plant Remains Recovered from the Middle Archaic at Dust Cave

Forager subsistence is based on non-domesticated resources acquired through some combination of gathering, collecting, hunting, fishing, and trapping these resources from their surrounding communities (Winterhalder 1992:12). These resources are categorized by abundance, quality, and timing of access, which results in a highly flexible use of the landscape that varies from year to year (Smith 2007:31). By closely examining the availability, seasonality, and nutritional values of individual plant species that were recovered from feature and column samples from Dust Cave, a clearer understanding of subsistence strategies and resource procurement practiced by the prehistoric hunter-gathers using the site during the Middle Archaic can be formed.

The availability, seasonality, nutritional values, and uses of the various plant taxa recovered from the Middle Archaic samples at Dust Cave are discussed below. As seen in Table 5.1, the majority are available in late summer and fall.

Table 5.1: Seasonality of Plant Remains Recovered from Dust Cave Eva/Morrow Mountain and Benton Samples (adapted from Hollenbach 2005 and Scarry 2003).

Species	Common Name	Category	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April
<i>Carya</i> spp.	Hickory	Nuts					X	X	X					
<i>Juglans nigra</i>	Walnut	Nuts						X	X	X				
<i>Quercus</i> spp.	Red acorn	Nuts					X	X	X	X	X			
<i>Quercus</i> spp.	White acorn	Nuts					X	X	X					
<i>Corylus</i> SPP.	Hazelnut	Nuts					X	X	X	X	X			
<i>Celtis</i> spp.	Hackberry	Fruit			X	X	X	X	X	X	X	X	X	
<i>Rhus</i> spp.	Sumac	Fruit		X	X	X	X	X						
<i>Vitis</i> spp.	Grapes	Fruit			X	X	X	X						
* <i>Galium</i> spp.	Bedstraw	Weedy seed/ greens	X										X	X
<i>Phytolacca americana</i>	Poke	Weedy seed/ greens	X	X	X								X	X
* <i>Portulaca oleracea</i>	Purslane	Edible seed/ greens	X	X	X								X	X
* <i>Cucurbita pepo</i>	Squash	Misc.				X	X							

Nuts

Mast resources are considered to be one of the most important wild food plants exploited by Native Americans from Paleoindian through prehistoric times (Caldwell 1958; Scarry 2003:56; Yarnell and Black 1985). The different taxa present in the Southeast each produce edible nuts that ripen in the fall so they are sometimes treated as a single category; however, they each provide different nutritional qualities and require different types of processing, storage, and collecting techniques (Scarry 2003:57). Mast resources (hickory, acorn, chestnut, walnut) provided larger portions of carbohydrates and vegetable fats than any other resource during the Middle Archaic period, with hickory being the most abundantly recovered nutshell during the period, as well as throughout southeastern U.S. prehistory (Gremillion 1996:104, 2003; Scarry 2003).

Hickory

Hickory nutshells are the most abundant type of plant remains recovered from archaeological contexts, especially during the Archaic period in the Eastern Woodlands. Hickories are found in groves in mixed hardwood forests and are usually the dominant tree where they occur. They produce heavier or bumper, crops (see discussion below) every two to three years that would have provided large quantities of nuts at low search and travel costs. They are also advantageous because they can be collected and stored in bulk, and if properly stored and kept free from moisture and rodents, can be kept for extended periods of time, somewhere between three and five years (Gardner 1997:172; Scarry 2003:60; Schopmeyer 1974:271). While hickory trees produce high yields, their period of availability is very small because they

are favorites of squirrels and other animals. They disappear quickly from trees and also from the forest floor. Nuts can be collected from late September through late November, though mid-October through mid-November is the optimal period for collection (Munson 1984:462; Scarry 2003:60).

The exceptional amounts of hickory nutshell recovered from the archeological record speak to the importance that hickory nuts played in the subsistence strategies of populations dating back to the Late Paleoindian period (Asch, Ford, and Asch 1972; Gremillion 2003; Munson 1984:462; Yarnell and Black 1985). Referred to as a “first line food” by Asch, Ford, and Asch (1972), the nutritional value in terms of both calories and protein reinforces the importance that hickory played throughout prehistory. Hickories provided a high source of energy to prehistoric diets (Scarry 2003:60). While the value of hickory nuts in term of calories, fat, and amino acids cannot be underestimated, they provide inadequate levels of carbohydrates. Only 349 g of dry hickory nutmeats are required to meet the daily caloric intake needs (2,220 kcal) as opposed to that of acorn (427 g) and maize (604 g) (Gardner 1997:162). Hickory nutmeats are also higher than acorn and maize in eight out of the ten amino acids. Even more important than calories and amino acids is the amount of fats provided by hickory nuts, especially in the winter and early spring when fats provided by animals may be scarce (Gardner 1997:172; Speth 1990; Speth and Spielman 1983; Thomas 2009:166). The fat content in hickory nuts is twice that of acorns, and 16 times greater than that provided by maize (Fritz et al. 2001:5; Gardner 1997:162-164).

It is believed that the nuts were mainly processed for oils and milk to avoid the labor-intensive task of removing the meats from the shells (Thomas 2009:172). Ethnohistoric accounts

indicate that unshelled nuts would be crushed and placed in boiling water, strained and then used as milk, or the oil would be skimmed off the top as the nutshells sank (Fritz et al. 2001; Scarry 2003:61). The practice of processing nuts to make the traditional Cherokee soup-like *Ku-nu-che* dish provides one alternative example of ways in which hickory nuts could have been processed in the past. *Ku-nu-che*, a traditional hickory nut soup, is produced by cracking and pounding the nuts and shells into a mixture of the two that is then formed into balls, which can then be boiled with water, strained and served as soup (Fritz et al. 2001:1). This traditional form of hickory nut preparation that is still commonly practiced by Cherokee people today provides insight into harvesting and processing techniques possibly used by past populations (Fritz et al. 2001:3). *Ku-nu-che* is still made today because of its significance as a traditional food that has been passed down through many generations and was responsible for group survival during times of famine (Fritz et al. 2001:19).

No early ethnohistorical records indicate the forming of balls from shell and hickory nutmeats; instead the emphasis has been more focused on the use of hickory in liquid form, as an oil or milk, reduced through a boiling process (Fritz et al. 2001:23; Gardner 1998; Reidhead 1981:193). Fritz et al. (2001) suggest that the weight and bulk of hickory nuts could have been reduced by processing the nutmeats and shells and forming them into balls. This process would have made transportation easier for groups moving hickory nuts from camps to bases, once they had been made and the weather had cooled to prevent them from spoiling. Return rates calculated for crushing and boiling the nuts are much greater because the handling costs decrease dramatically. Experimentation with processing techniques has shown that the process of cracking shells and picking the meats provides an extremely low or even negative return rate

when measuring returns of calories versus the costs of cracking and picking the meats (Munson 1986:4; Thomas 2009:172). Munson (1986) attributes the increase in hickory nutshell recovered from Middle Archaic contexts along with an increase in the number of shallow pits and fire-cracked rocks to the development of hickory oil extraction techniques. He believes that the pits were lined with hides and then filled with heated stones and crushed hickory nuts, resulting in a hickory milk or oil (Munson 1986; Scarry 2003:61).

Acorn

Acorn shells and meats are the second most common food remains recovered from the Middle Archaic component at Dust Cave. Acorns were relied upon heavily across the Eastern Woodlands by both human and animal populations for survival during winter months and served as an important food resource during prehistoric times (Reidhead 1981:183; Scarry 2003:65). While acorn remains are recovered in lower frequencies than hickory, it has been argued that their importance to prehistoric populations has been masked by problems involving preservation and recovery techniques (Lopinot 1984; Miksicek 1987:221). Acorn was also an important resource to wildlife, possibly contributing as much as 25 percent of the diet of turkeys, black bears, raccoons, white-tailed deer, and other upland birds and mammals (Lopinot 1982:715).

Twenty-seven different species of white and red oak trees are found in the Eastern Woodlands. The greatest differences between the two types of trees are the availability and sweetness of the nuts they produce (Scarry 2003:65). Acorns from white oaks are sweet, easily processed, and mature in one year whereas acorns from red oak trees mature in two years and produce a more bitter nut that must be leached to remove high levels of tannic acid before they

can be consumed (Scarry 2003:65-66). Good crops are produced every two to three years meaning that one type of acorn would usually be available in large quantity. However, due to the thin shell of both acorns types they are susceptible to insects, molds, and tend to sprout quickly after they fall. The sweeter white oak acorns are also favorites of bird and mammals, and must be collected quickly (Petruso and Wickens 1984:366; Scarry 2003:66). One-hundred eighty-six different animal species, including squirrels, mice, deer, and turkeys, are known to feed on acorns, demonstrating the level of competition that prehistoric populations would have encountered for acorns (Petruso and Wickens 1984:373; Reidhead 1981:183).

Acorn was most commonly prepared by pulverizing the meats into a meal, and then baking the meal like a cake or pancake, or cooking it as a gruel or porridge made from the meal. It was also used in soups, as well as to make a coffee-like beverage from the grounds (Petruso and Wickens 1984:362-363). Acorns contain high levels of carbohydrates, but relatively low percentages of protein, fats and fiber. Red oak acorns contain three to four times more fat than acorns from white oaks, and more calories, but do not reach the level of fat provided by other mast resources (Scarry 2003:67). Due to their higher levels of tannin, which require longer leeching and boiling times, the nutritional levels of proteins and fats of red acorns are reduced, along with water-soluble vitamins, which appear to diminish as a result of leeching and boiling processes (Petruso and Wickens 1984:367). Acorns contain two to three times less the amount of proteins and calories provided by other nuts, but provide higher levels of carbohydrates.

Problems associated with the recovery of acorn shell and meats are well documented in the archaeological literature, and raise questions as to the real importance of acorn to prehistoric populations. The problem has been referred to as “selective preservation” (Asch et al. 1972:10;

Munson et al. 1971:426). Acorn meats are rarely preserved, and where they are, they are often difficult to identify. Acorn shells are less dense than hickory nutshells and are believed to turn to ash when exposed to prolonged and intense heat, and when they are only partially carbonized they will decompose. This means that only a small percentage will be preserved and recovered (Petruso and Wickens 1984:360). Removing the tannic acid from acorns also presents an additional step in processing acorns, one that is absent in the processing of hickory and black walnut. Higher processing costs associated with acorn nuts possibly contributed to its decrease in use through time, especially when compared to hickory, which was as abundant and less costly to process. Several different methods have been employed by Native American tribes in order to remove the tannins, including: parching; boiling and/or roasting; immersion or burial of the meats; soaking the nuts in fresh water; boiling in fresh water; and soaking or boiling in ash-treated waters (Petruso and Wickens 1984:362).

Parching acorns directly after collection has been shown to greatly reduce the occurrences of sprouting and infestation by worms. Acorns from white oak trees are most commonly found in open and mid-slope environments (Petruso and Wickens 19984:363). They require less processing than those from the red oak group. Because they are consumed by mammals, birds, and insects, as well as being susceptible to mold and sprouting, their optimal collection period is from October 1 to November 1. Unlike red oak acorns, they germinate and sprout quickly after falling and would need to be collected quickly (Petruso and Wickens 1984:374). The more bitter acorns from the red oak group are commonly found in mid-slope and gravelly upland environments with poor soils and have a mast cycle of two to five years (Petruso and Wickens 1984:363). They are available from mid October until mid December, and in some

years are available from late September until late February (Munson 1984:468; Schopmeyer 1974:695). Unlike the white oak acorns, which sprout quickly after falling, red acorns can remain on the ground for much longer periods of time without sprouting, allowing for collection throughout the winter months and possibly making them more favorable for storage (Reidhead 1981:183). Red oak acorn groups are usually only affected by animal populations after sweeter acorn populations are depleted (Petruso and Wickens 1984:366; Scarry 2003:67).

Black Walnut

Black walnuts were commonly used by prehistoric populations in eastern North America. Although they provide a better source of plant protein than all other nut resources found in the Eastern Woodlands, other factors made them less desirable to collect and process (Scarry 2003:64). Because they grow as solitary trees, rather than in stands like hickories and oaks, collection of large numbers of walnuts is more difficult. Also, higher processing costs relative to hickory nuts may have discouraged greater use of both black walnuts and hazelnuts (Gardner 1997; Scarry 2003:64; Talalay et al. 1984). Because they are not as desirable to squirrels and other animals, black walnuts have a longer period of availability than other nuts. They are available from late September until late December, but most optimally from mid October to early December (Munson 1984:465; Schopmeyer 1974).

Hazelnuts

Hazelnuts, unlike the previously discussed mast resources, grow on shrubs instead of trees. The shrubs grow in open areas, forest margins, on hillsides, and near streams where soils are dry to moist. The shrubs are most commonly found in marginal environments as a colonizer

species. Hazel is not typically found evenly distributed across the landscape but more commonly in clumps or thickets (Radford et al. 1964; Schopmeyer 1974). Hazelnuts are ripe enough to be consumed by humans by late August, but collection is considered to be most optimum during mid to late October. Though some shrubs may retain their nuts until January, usually by the end of November there are not enough left on the shrubs to make collection beneficial. Hunter-gatherers would have collected hazelnuts from the shrubs, like berry picking, because once fallen the nuts are immediately targeted by chipmunks, mice, and other small animals. Nutmeats are most effectively removed by individual cracking and picking, because shells and oils do not separate out using techniques that are employed for hickories (Talalay et al. 1984). Hazelnuts provide a good source of fats and protein, but low levels of carbohydrates (Scarry 2003:65).

Fruits

Hackberry

Hackberry trees and shrubs are widely distributed throughout the eastern United States. While commonly found on slopes and bluffs and on limestone outcrops in bottomlands and under oak stands at upland sites, its widespread distribution provides evidence of the variety of climatic and soil conditions that the tree can withstand (Harper 1965:141). The fruits that are produced, or drupes, have a sweet, edible flesh that surrounds a large seed, or stone (Harper 1965:139). The fruits ripen in September/early October but collection is much easier in mid October once the leaves have fallen from the trees. The fruits can remain on the trees until mid March and it has been estimated that one acre of trees can produce approximately 18 pounds of fruit. The trees produce good crops most years and lighter crops the intervening years (Harper

1965:141; Young and Young 1992:91). The fruit can be harvested by picking, or by shaking the trees or branches. Because it is inefficient to remove the small amount of fruit from the seed, the fruits were often smashed and the resulting paste added to corn, meat, or consumed. As a result, it has been suggested that few identifiable remains would be found in the archaeological record from open sites, and that the larger amounts that occur in both cultural and non-cultural contexts of caves and rockshelters can be attributed to rodent activity (Munson 1984:462-463).

Persimmon

Persimmon, when ripe, is considered to be a delicacy where and when it is available. The fruit ripens between mid September and mid November, and can remain on trees until late January, with great variation between trees. The fruit can be eaten fresh, or preserved. Often recovered in small amounts from the archaeological record, persimmons make seasonality of occupation more difficult to determine due to the length of time the fruits can remain on the tree (Munson 1984:464). Persimmon trees grow in dry, deciduous forests and pinelands. Persimmons were kept for winter use by fashioning the pulp into cakes (Swanton 1946), and also were used to make pudding (Moerman 1998:201). These fleshy fruits are not palatable until after the first frost of autumn. Persimmon trees thrive in disturbed and/or edge habitats (Radford et al. 1964).

Sumac

Sumac shrubs grow in open and edge environments. The seeds are covered with red hairs that contain malic acids, which are high in vitamins. By September the fruits are ripened and by early to mid October the seeds have become less sour to taste. Ethnobotanical literature suggests

that the seeds were usually chewed for medicinal purposes, or boiled or soaked to make a tea or a lemonade-type beverage, and also that these seeds were stored for use during winter (Lopinot 1982:764; Munson 1984:469; Tomikel 1976:51).

Wild Grapes

Wild grapes tend to occur near riverbeds and streams, and along field edges as a result of being shade intolerant (Lopinot 1982:766). Grapes can be harvested from late August until mid November, and are usually gone by December. Ethnobotanical literature suggests that grapes were eaten fresh or stored for later use (Munson 1984:470). A medicinal drink was also made from the sap and twigs (Lopinot 1982:766).

Greens

Bedstraw, purslane, and poke, along with other herbaceous plants, were collected for the use of their leaves and young shoots, which could have either been eaten raw or cooked as potherbs. Available in early spring, greens were likely an important seasonal addition to the diets of hunter-gatherers. They are rich in minerals and vitamins, and would have been a welcome inclusion after a winter diet that would have lacked greens and been high in lean meat and stored nuts (Hollenbach 2005:233; Moerman 1998; Scarry 2003:73). As well as their use as greens, poke, bedstraw and purslane each had several medicinal uses, particularly among native North American peoples (Stepp and Moerman 2001). However, it is just as likely that the seeds are incidental inclusions, and simply indicate the presence of disturbed grounds, in which these weedy species thrive (Hollenbach 2005; Radford et al. 1964).

Purslane

Though the seeds are edible, purslane was most commonly used for greens (Duke 1992:157; Tomikel 1976:90). Purslane also has several medicinal uses among Native Americans (Scarry 2003:73). The juice from the berries was used to cure earaches and stomach aches, and the plant used as a poultice to heal bruises and burns (Moerman 1986:366).

Poke

Though poisonous raw, when cooked properly poke had many uses as both food and medicines. The young shoots can be used as greens or potherbs harvested in the spring (Duke 1992:148; Tomikel 1976:90). Usually found growing in woodland margins and edge environments, the berries of this weedy plant were used for arthritis and rheumatism, as well as used in traditional beverages (Moerman 1998:398). A poultice was used on sores or swellings and infusions of roots were used on skin irritations. Powdered poke roots were used to treat skin cancers as well as kidney ailments (Kavasch 2005:162; Moerman 1986).

Bedstraw

In the Southeast, bedstraw can be found in hardwood and river bottom forests and can tolerate a wide range of climatic conditions. Bedstraw favors moist but well-drained soils and tolerates a range of acidities and textures. The shoots of leaves can be cooked as greens, dried seeds can be used as a coffee substitute, and the plant can be dried and used to make tea (Duke 1992:100; Tomikel 1976:59). As well as their use as greens, bedstraw had several medicinal uses, particularly among native North American peoples (Stepp and Moerman 2001). The stems and leaves of bedstraw were used as a cure for rheumatism and to heal skin irritations and rashes,

while infusions of the whole plant were used as a diuretic and to combat vitamin C deficiencies, kidney disorders, and gallstones (Moerman 1986:192, 1998:242).

Squash

The recovery of small seeds and thin rinds from wild species of *Cucurbita pepo* across archaeological sites in eastern North America indicates that gourds were being used as early as 8,000 B.P., although evidence for their domestication in the form of larger seeds, a variety of colors, and thicker rinds, does not appear until ca. 4,440 +/- 75 B.P. (Cowan and Smith 1993; Smith 1989, 1997, 2006). It is also believed that prior to domestication the seeds and flesh of *Cucurbita pepo* were extremely bitter due to chemicals known as cucurbitacins, which would have made them inedible without costly processing techniques such as soaking, boiling, or crushing and boiling (Hart 2004:1632). Believed to have been introduced to sites either by flood or from human collection of floodplain stands, *Cucurbita* could have taken advantage of disturbed soils at habitation areas and thrived with little human intervention as “weedy invaders”, initially being tolerated and eventually encouraged to grow, leading to its domestication (Smith 1993:102). Though it is possible that the rinds and seeds of the wild variety provided an important food resource for prehistoric Native Americans, others have suggested that wild cucurbits possibly played a more significant role in fishing technology, used as floats for fishing nets, and possibly as containers, spoons, and cups (Cutler and Whitaker 1962:474; Fritz 1999:424; Gremillion 2003:32). However, Cowan (1997) suggests that the thin walled gourds were too fragile to have served as containers, believing that they were more important for their nutritional content.

Summary

Upon closer examination of the plant food resources recovered from Middle Archaic components at Dust Cave, better insight into the strategies employed by hunter-gatherers who occupied the cave during this time is provided. Initially, all resources were available and ripe in the fall, with the exception of species that were more likely used as greens and would be more indicative of a spring occupation. The food resources selected were all available in close proximity to the cave, and in most instances, especially hickory, readily available and abundant. The most resources would have been available for two to three weeks in the fall. While they could have been collected, stored, and processed later, their availability is limited. All of the fruits recovered grow in disturbed, edge, and/or riverine environments. This suggests that the fruits were available with little to no search cost. Squash is also present in riverine environments, similar to many of the fruits recovered.

While the importance of Dust Cave to prehistoric hunter-gatherers is obvious by the repeated use of the cave for over 7,000 years, the abundance of food resources that were available during late summer/fall demonstrates the importance of the site during these seasons. The environment surrounding Dust Cave would have provided prehistoric populations with numerous calorically valuable plant food resources, with low search costs, prior to the lean winter months of resource shortages. Familiarity with the plants and the environment, along with experience and knowledge of the area, would have guaranteed local populations a reliable location where resources were rich and readily available.

Chapter 6: Discussion

The previous chapters provided a detailed overview of the food resources exploited by inhabitants of Dust Cave throughout its 7,000 year occupation. Ubiquity measures and ratios are useful for comparisons and for establishing trends through time but by ranking food resources from highest to lowest, based on kcal return rates, it is possible to investigate whether selection of food resources over time led to greater foraging efficiency.

Evolutionary Ecology and the Diet Breadth Model

Evolutionary ecology involves the study of adaptive design in behavior, life history, and morphology in an ecological context through the application of natural selection theory (Bird and O'Connell 2006:143; Broughton and O'Connell 1999:153; Smith and Winterhalder 1992:5). Modeled in part after evolutionary biology, behavior is considered to be adaptive when it is conditioned by environmental variability in such a way that it increases the fitness, or the tendency to reproduce and survive, of individuals within a population (Bird and O'Connell 2006; Kaplan and Hill 1992:167). When offspring are produced and enculturated into the behaviors of their parents, their parents' behaviors as well as their genes will flourish. While these behaviors are not necessarily genetically linked, they can be measured in terms of Darwinian models of genetic fitness (Bettinger 1991:154).

Rooted in the 1960's work of population biologists and ecologists, evolutionary ecology combines optimization concepts with quantifiable cost-benefit measures (Bettinger 1991:83; Smith and Winterhalder 1981:7). Believing that behavior is often contingent upon changing environmental conditions, the models that are created pay great attention to the environment

(Winterhalder and Smith 1992:9). Under these models the environment is defined as everything that impinges upon an individual's probability to survive and reproduce, and is the focus of study in evolutionary ecology because it is considered to be the arena in which individuals "live, reproduce and die" (Winterhalder and Smith 1992:8).

Optimal foraging theories developed in evolutionary ecology provide a "generalized and realistic approach" to the study of hunter-gatherer activities (Winterhalder 1981:13). The theory suggests in areas such as diet choice, settlement locations, foraging locations, foraging time, and group size, decisions are made in order to maximize the net rate of energy return (Bettinger 1991:84). These theories produce simple models derived from Neo-Darwinian ideas that generate hypotheses about the different ways hunter-gatherers forage in varying environmental settings (Winterhalder 1981:13). Because evolution is considered to be competitive, natural selection is believed to favor those individuals who are able to maximize the net fitness results of the potential behavioral choices that they face, or the benefits minus the costs including the returns on resources selected, considering time and energy spent foraging (Kaplan and Hill 1981:168). These models are significant because they allow rigorous investigation and testing. The predictions about subsistence strategies that are generated attempt to show the best cost-benefit outcome under different sets of circumstances and then allow for comparisons against remains found in the archaeological record (Shennan 2002:1).

The optimization concept employed in evolutionary ecology focuses on efficiency, suggesting that an increase in efficiency leads to an increase in fitness. When individuals compete for resources, those individuals who can most effectively collect nutrients and energy will have an evolutionary advantage over others who do not because they can use their collected

energy on other activities such as reproduction, care to offspring, or building shelter (Hawkes et al. 1982:381; Kaplan and Hill 1992:167; Winterhalder 1981:15). This logic does not suggest that natural selection favors the best foraging strategy possible, but rather will favor the most optimal strategy that exists. As long as there is some risk involved in the search for food, an efficient foraging method will be favored whether resources are abundant or scarce (Kaplan and Hill 1992:168).

Application of Optimal Foraging Models

Foraging and all other optimality models involve currencies, decisions, and constraints (Kaplan and Hill 1992:168; Pyke et al. 1977:138; Stephens and Krebs 1986:5). The decision aspect of the foraging model deals with the behavior that the model is attempting to explain and refers to the type of choices an individual is assumed to make (Stephens and Krebs 1986:6). For example, a prey choice or diet breadth model attempts to determine which resources a forager will pursue or consume upon encounter. It involves the decision to procure a resource upon encounter, or pass for a more favorable item. Search time, or non-encounter time, includes all time that is spent looking for food resources, either moving through the environment or waiting on mobile resources to pass. Time spent foraging cannot be spent on other activities and the risk of predation increases with extended foraging (Winterhalder 1981:20). Handling, or encounter, involves all of the time a forager will dedicate towards pursuing, processing, cooking, and eating a resource once it is encountered (Kaplan and Hill 1992:169; Stephens and Krebs 1986:13).

Currency is used to measure the results of the different decisions that a forager can make while searching for food. Energy is a commonly used currency because it is directly affected by

a forager's decision and is necessary for individuals to reproduce (Stephens and Krebs 1986; Winterhalder 1981). So while reproductive fitness is considered to be the most fundamental evolutionary property of an individual, it is hard to measure, making energy a more practical currency. An increased rate of energy obtained by efficiently foraging allows individuals to engage in "non-feeding activities" such as fleeing from danger and producing offspring (Stephens and Krebs 1986:8; Pyke et al. 1977:139). While energy is not the only crucial aspect of food resources, the merit of energy as a currency is that it is possible to some degree to determine how energy efficiency can directly affect other foraging behaviors (Winterhalder 1981:21).

Constraints include all other factors involved in foraging like the density and distribution of available resources, associated dangers, technology, an individual's knowledge of the local environment, and mobility patterns (Kaplan and Hill 1992:169). Several constraints are present in foraging models like the diet breadth model. The first deals with the mutually exclusive nature of search and handling activities, meaning a forager can only be engaged in either search or handling activities at any given time. Increased search or handling times become a constraint upon a forager when resources are passed over with hopes of encountering a higher ranked resource. But, settling for a lower ranking resource that possibly requires a greater handling cost can also result in a diminished return rate. Similarly, if a resource is encountered and selected, the time spent handling cannot be spent searching for another item (Kaplan and Hill 1992:170; Stephens and Krebs 1986:9). The possibility of sequential encounter is another constraint that can be placed upon foragers. This assumes that prey are encountered one at a time and involves the probability that these encounters of prey will be constant over a short time period. The third

constraint assumed to affect foragers deals with a forager's knowledge of the local environment and the limitations of their abilities (Stephens and Krebs 1986:11).

Diet Breadth Model

The diet breadth or prey choice model focuses on a forager's selection of food in relationship to his/her environment. The model is designed to answer specific questions regarding a forager's preference in food choice, namely, what items will be included or excluded from a forager's diet upon encounter, the range of items included in a forager's diet breadth and how this is affected by the environment, and which items will be dropped or added from a diet as environmental conditions change (Kaplan and Hill 1992; Winterhalder 1981:23). The model was developed by MacArthur and Pianka (1966) to determine which resources would be selected upon encounter, and assumes that foragers will either select or pass over certain types of resources upon encounter (Winterhalder 1981:24). MacArthur and Pianka (1966:608) proposed that a more productive environment should lead to a more restricted diet in terms of the number of different species/resources eaten. They suggested that with an increase in the density of high ranking prey, foragers should specialize, and that when high ranking resources decrease, foragers should generalize (Shettleworth 1984:184). Measuring abundance of resources is not adequate: harvesting times and processing costs are crucial factors that must be considered when calculating a region's resource potential (Kelly 1992:54).

Diet breadth models attempt to predict which resources will be selected based on variations in abundance, amount of potential energy, amount of energy necessary to harvest the potential energy, and the time necessary to acquire the energy once that resource is chosen

(Bettinger 1991:84; Kelly 2007:83). In the diet breadth model the logical assumption involves selecting those items that return the highest amount of energy for the lowest costs (Bettinger 1987:132). By calculating these return rates, the food items available can be ranked, and assumptions can be made based on these rankings about which items should be selected and which ones should be passed over upon encounter. An important outcome of this model is that as resource abundance declines, diet breadth should always increase as a function of increasing search times. As resources become sparse, diet breadth should not contract. However, as resources become more abundant diet breadth should contract because foragers have more options from which to select (Bettinger 1987:132; Winterhalder 2001:159-160).

Based on energetic return values, calculated using search and handling times, some prey may not be worth pursuing and may be passed over for more favorable prey in regards to return rates (Bulmer 1994:106). Effort is measured as time spent searching for food resources and time spent in pursuit, harvesting and consuming the resources. All items are searched for concurrently but are pursued individually. Upon encounter a forager must make a choice to either pursue the item or continue searching for a more advantageous resource (Winterhalder 1981:24; Winterhalder and Goland 1993:128). Resources are ranked using the formula provided below:

$$r = \frac{e^{\text{obt}} - e^{\text{exp}}}{t}$$

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).

The algorithm above helps identify which resources should be pursued by ranking all resources in a descending order of profitability and efficiency. The prey with the highest return rate should always be pursued upon encounter, and those items with lower return rates, regardless of abundance, should never be pursued. Also, as highly ranked resources become scarcer, the diet breadth will need to be expanded to account for a decline in foraging efficiency. Figure 6.1 below shows a graphical form of the model where ΔS represents changes in search costs, and ΔP represents changes in pursuit costs, as resources are added to a forager's diet. The model shows that search time decreases and pursuit time increases as additional resources are added to the diet. Prey types should be added to the diet until the pursuit time that accompanies that prey's inclusion exceeds the savings it brings in regards to search time. The extra resource will only be added to the diet if its inclusion will provide a net increase. Optimal diet breadth occurs where the two curves intersect (Winterhalder 1981:24).

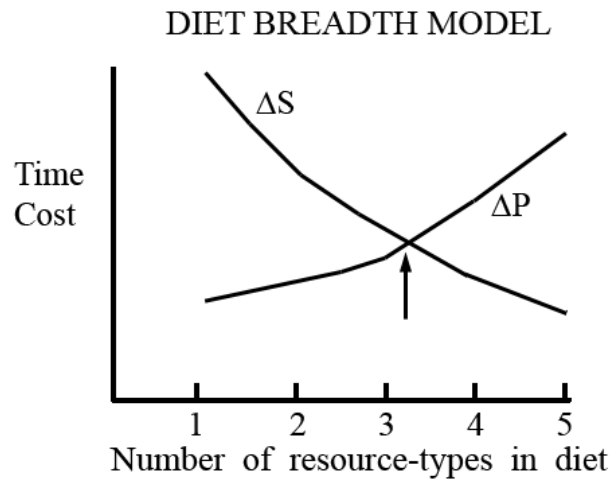


Figure 6.1: Diet breadth model (adapted from MacArthur and Pianka 1966).

Diet breadth models have three important implications. First, every resource encountered should either be exploited or ignored depending on its rank and inclusion in the optimal diet set. If a resource increases a forager's return rate it should always be exploited, and conversely if it decreases a forager's return rate, it should be ignored. Second, the energetic value of each resource does not determine its worth. Its value must be measured against its cost and ranked accordingly. Third, resources are not pursued based on their abundance but on the abundance of more highly ranked alternatives. As the abundance of highly ranked resources decreases, more time will be spent searching for alternatives, which inevitably decreases the return rates, resulting in lower ranked resources added to the diet (Kaplan and Hill 1992:172; Pyke 1984:531; Pyke et al. 1977:141).

Application of the Diet Breadth Model to the Dust Cave Botanical Record

By ranking plant resources across time periods at Dust Cave, changes in diet breadth can be explored in light of the factors explained above. The return rates in Table 6.1 were calculated by subtracting handling costs from return rates, and then dividing that number by the handling time in hours. The return rates are based on a load size of 15 kg except for cucurbits, whose load size was based on basket volume discussed in Bettinger and colleagues (1997). Handling costs and time for persimmon, sumac, and hackberry were taken from those used for mulberry by Hollenbach (2005), assuming that these tree fruits could be harvested in similar manners.

Table 6.1, which displays resource return rates, provides valuable information regarding the nutritional value of foods recovered through time at Dust Cave. Fruits provide the greatest amounts of kcal return rates per load, especially sumac, persimmons, grapes, and hackberries. Hickory nuts provide a great source of protein, fats, and amino acids and are one of the most highly ranked resources in terms of calories when processed using a smash and boil method. The return rate provided below varies, but is similar to results produced by Thomas (2009) and Gremillion (2002) using a crushing and boiling method. Picking and cracking the meats by hand, as opposed to boiling, would barely keep people from starvation (Munson 1986:4). Acorns fall beneath hickory in regards to return rates, while other nuts such as black walnuts and hazelnuts rank towards the bottom of the list of food resources. Edible seeds and greens also rank low in terms of return rates.

Table 6.1: Ranked Resources from Dust Cave Samples.

Food Resource	Load Size (kg)	Edible Portion	Caloric Content (kcal/kg)	Calories per Load (kcal)	Handling Cost (kcal)	Handling Time (hr)	Return Rate (kcal/hr)
Persimmon	15 kg	10.5	1270 ^b	13,335	270 ^g	0.75 ^g	17780
Hackberry	15 kg	3.75	1620 ^d	6,075	270 ^g	0.75 ^g	7740
Sumac	15 kg	3.75	1470 ^c	5,513	270 ^g	0.75 ^g	6990
Hickory, smash/boil ^a	15 kg	5.57	6570	36,595	4,086	11.3	2876.9
Grapes ^a	15 kg	12.8	670	8543	1188	3.3	2228.6
Amaranth, cut ^a	15 kg	2.1	3470	7854	1764	4.9	1242.8
Acorn ^a	15 kg	4.7	5050	23,735	6696	18.6	916
Chenopod / cut ^a	15 kg	2.1	4140	8694	2484	6.9	900
Cucurbita pepo	1.93 kg ^e	0.48	4460	2,815	893 ^f	2.48 ^f	775
Wild legume, raw	15 kg	2.1	3470	7,287	2,484	6.9	696
Chenopod, greens ^a	15 kg	6	430	2580	900	2.5	672
Chenopod, strip ^a	15 kg	15	4140	62,100	23,184	64.4	604.3
Amaranth, strip ^a	15 kg	15	3740	56,100	22,392	62.2	541.9
Black walnut ^a	15 kg	2.91	6180	17,984	11,016	30.6	227.7
Greens ^a	15 kg	6	230	1380	900	2.5	192
Hazelnut ^a	15 kg	5.04	6280	31,651	20,844	57.9	186.7
Wild legume, boiled	15 kg	2.1	1430	3,003	2,484	6.9	75
Hickory, crack/pick ^a	15 kg	5.57	6570	36,595	87,228	242.3	(-)208

^a Information taken from Hollenbach 2005^b Caloric information taken from Scarry 2003^c Ozcan and Haciseferogullari 2004^d Demur 2002, Waino 1964^e Based on 52 liter basket size (Bettinger and Malhi 1997) and calculating a volume for the gourds using formula for prolate spheroid^f Acorn handling time and cost used for Cucurbita pepo^g Mulberry handling time and cost used for persimmon,sumac,hackberry

Table 6.2: Food Resources Exploited through Time at Dust Cave

Food Resource	Category	Late Paleo	ESN	Mixed ESN/KS	Kirk Stemmed	Eva/MM	Benton
Persimmon	Fruit	*	*	*	*	*	*
Hackberry	Fruit	*	*	*	*	*	*
Sumac	Fruit		*	*	*	*	
Grapes	Fruit	*	*	*	*	*	
Hickory	Nut	*	*	*	*	*	*
Acorn	Nut	*	*	*	*	*	*
Black walnut	Nut	*	*	*	*		*
Hazelnut	Nut	*			*	*	
Bedstraw	Greens	*	*			*	
Purslane	Greens					*	
Poke	Greens	*	*	*	*	*	
Chenopod	Edible seeds	*	*	*	*		
<i>Cucurbita pepo</i>	Edible seeds						*
Wild legume	Edible seeds	*			*		
Stargrass	Edible seeds	*	*	*			
Smartweed	Edible seeds	*					
Total Resources		13	11	10	11	10	6

Table 6.2 shows the different plant remains that were recovered and identified from the different cultural components at Dust Cave. There are several points of interest. Initially, it should be noted again that the decrease in the number of plant food resources recovered during the Benton occupation may be a result of the decreased use of the site due to lack of headroom. What is more noticeable is the consistency in the range of resources recovered from all other components, suggesting that there are not many differences in foraging strategies between components. However, upon closer examination of the data there is a noticeable decrease in the use of edible seeds during the Middle Archaic components, with the exception of *Cucurbita pepo* recovered during the Benton occupation. These lower ranked resources were eliminated from the diet.

Another point that emerges is that there are more resources used for greens recovered during the Eva/Morrow Mountain component (n=3) than recovered from any other period. While these resources are lower ranking resources they also are more suggestive of a spring/summer occupation, and should not be considered to be part of a fall diet. In addition, the seeds themselves, which are present in autumn on plants, should probably be considered commensal. If greens are removed from all time periods, due to their lack of inclusion into a fall diet, there is a greater contrast between the number of food resources exploited between the different occupations: eleven from the Late Paleoindian component, nine from the Early Side-Notched and the mixed Early Side-Notched/Kirk Stemmed occupations, ten from the Kirk Stemmed component, seven from the Eva/Morrow Mountain component, and six from the Benton occupation.

In terms of diet breadth, then, the most notable change through time is the decrease in the use of edible seeds, which carry high processing costs. With the exception of *Cucurbita pepo* remains recovered from the Benton component, the Eva/Morrow Mountain and Benton components lack edible seeds, which are recovered in all previous times periods. Based on the discussion in Chapter Five it is possible that the *Cucurbita pepo* remains were not even used for their nutritional properties. A decrease in food resources that carry high processing costs and low return rates suggests that hunter-gatherers during the Middle Archaic were increasing their foraging efficiency.

An increase in efficiency and intensification should reflect an emphasis on certain and specific resources (Ames 1985:171). At Dust Cave, as well as other sites with Middle Archaic components, that specific resource appears to be hickory (Asch et al. 1972:10; Caddell 1983:338; Chapman and Shea 1981:66; Lopinot 1982:713; Munson 1986). The importance of hickory to Native American inhabitants of the Eastern Woodlands is evidenced by the abundance of nutshell in the archaeological record. The importance of hickory nuts over time probably results from changes in mobility patterns, storage, and processing; in other words, the specific behaviors involved in their procurement (Gremillion 1996:100).

Middle Archaic botanical assemblages from other sites across the Southeast and the Midwest look similar to the remains from Dust Cave. In Alabama, Caddell (1983:338) analyzed six Benton (5600-5000 B.P.) features from three sites (1FR310, 1FR538, and 1FR593) excavated in the Cedar Creek and Upper Bear Creek Reservoir of northwest Alabama. Hickory represented 99 percent of the nutshell recovered from these features. Acorn, black walnut, beech, and thin-

shelled hickory were also identified. In addition three grape seeds, one persimmon seed, one pokeweed seed, one plum seed fragment, and one stargrass seed were also recovered.

Middle Archaic components were uncovered at three sites located within the Little Tennessee River Valley of Monroe and Loudon County, Tennessee: Icehouse Bottom, Bacon Farm, and the Howard site (Chapman and Shea 1981:66). Four samples from the Morrow Mountain component of the Icehouse Bottom site (40MR23) were analyzed, as were 44 from the Howard site (40MR66). Seventy-six percent of the total sample weight from the Icehouse Bottom site was hickory, 20 percent was acorn, and the remaining 4 percent was made up of nutshell from the walnut family. Forty samples from the Howard site contained 81.4 percent hickory nutshell. The remaining portion included 15 percent walnut remains, 3 percent acorn, and less than 1 percent chestnut. Remains of poke, bedstraw, grapes, and persimmon were also recovered from this sequence.

The Koster site, located at the edge of Illinois River Valley in Illinois, was an open air site that was occupied intermittently from the Early Archaic through the Mississippian period (Asch et al. 1972:1). Horizons 6 and 8 date to the Middle Archaic period (7,000-4,800 B.P.) Hickory was found in every sample analyzed from the two horizons and comprised 91.7 percent of the total weight of nutshell from Horizon 8, and 96.8 percent from Horizon 6. Black walnut produced the second highest total weight in Horizon 8 at 3.7 percent, followed by acorn at 2.9 percent, and pecan at 1.7 percent. From Horizon 6 acorn made up the second highest weight at 1.4 percent, followed by black walnut at 1 percent, and pecan made up less than 1 percent of the

total nutshell weight from the horizon (Asch et al. 1972:9). The uniformity of hickory nutshell at the Koster site is explained as short term stability in the use of mast resources as well as long term stability during periods of occupation, with hickory always being the dominant nut (Asch et al. 1972:10).

Excavations in the Carrier Mills Archaeological District in southwestern Saline County, Illinois, were conducted from 1978 through 1979 by the Center for Archaeological Investigation, Southern Illinois University Carbondale. The excavation uncovered three major archaeological sites, SA-86, SA-87, and SA-89, and associated smaller sites and scatters located nearby. Each of the three sites contained Middle Archaic components (Jefferies and Morrow 1982:3). At the three sites combined, nutshell accounted for 76.18 percent or 2029.9 g of 2663.63 g, and 73.91 percent of the total plant weight from Middle Archaic features (Lopinot 1982:698). Hickory combined to account for 690.54 g of 944.88 g of total plant remains, with acorn at 3.28 g, walnut at 3.94 g, and hazelnut at 0.63 g (Lopinot 1982:698). Though acorn representation appears to be minimal in weight, it was recovered from all 46 late Middle Archaic features (Lopinot 1982:713).

While many of these results are recorded in weights, which is problematic for comparison between taxa due to differences in density of different plant remains, what these examples indicate is that during the Middle Archaic period hickory nutshell dominates the botanical records from archaeological sites in the Southeast and Midwest. It is also interesting that each of these examples is from a river valley, which suggests that these areas became more densely populated during the Middle Archaic period.

Increases in Foraging Efficiency

Winterhalder and Goland (1997) describe four possible factors that lead to an increased foraging efficiency. The first possible cause involves an increase in the density of a highly ranked resource, which leads to an increase in a forager's encounter rate. The increase in density can be the result of changing environmental conditions, animal migration cycles, decreased exploitation, etc. A second factor that can lead to increased foraging efficiency involves reduced search costs resulting from a decrease in energy costs related to movement. Changes in resource distributions are another factor that can lead to an increase in foraging efficiency. The fourth possible cause for increased foraging efficiency described by Winterhalder and Goland (1997:148) involves a decrease in pursuit and handling costs of food resources in hunter-gatherers diet due to technological advances. The causes of increased efficiency laid out above contribute to increasing efficiency as a result of environmental factors or technological advancements.

Environmental Changes

The first three causes of foraging efficiency described by Winterhalder and Goland (1997) can be associated with changes in the environment. Increases in density and changes in resource distributions can both be the result of a changing environment. Reduction in search costs can also be a function of changing resource densities and distributions. If a particular high ranking resource, like hickory, becomes more abundant and more widely distributed, search costs will be reduced as encounter rates increase. In the Southeast, an increase in pollen from both oak and hickory trees demonstrate that hickory mast resources become more dominant

during the Middle Archaic period as a result of the Hypsithermal warming episode (Delcourt 1979:255; Delcourt and Delcourt 1985:20; Delcourt et al. 1983:885; Prentice et al. 1991:2047). An increase in hickory trees during the Middle Archaic would have met each of the three conditions mentioned above leading to an increase in foraging efficiency.

Warmer climates brought about by the Hypsithermal warming episode made conditions more favorable for open oak-hickory forests, which expanded during the Middle Archaic period (Figure 6.2). However, the warmer conditions might have played a larger role in resource density, distribution, and decreased search costs, conditions leading to increased efficiency, through increased masting brought about by warmer climatic conditions. *Masting* is a phenomenon in which populations of trees synchronize their reproductive activities, producing variability in reproductive output from year to year (Kelly 1994:465; Koenig and Knops 2000, 2005; Satake and Iwasa 2002:830), and is common among many temperate tree species (Sork 1983:81). The result of this process is synchrony and variability from year to year. Years with greater production are referred to as “bumper crops.” Evolutionarily it is believed that this occurs to ensure that some fruits go uneaten and are able to reproduce. Small crops during intervening years keeps populations of predators low so that in good years there are fewer predators, allowing a higher proportion of seeds to survive (Koenig and Knops 2005; Satake and Iwasa 2002:830).

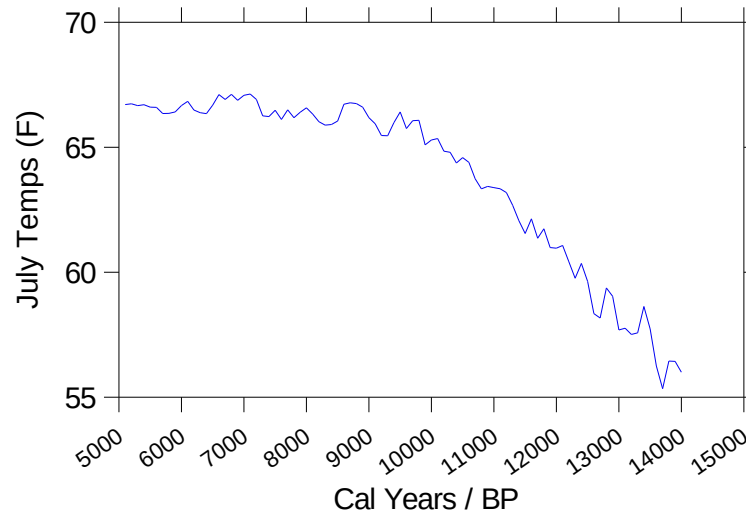


Figure 6.2 : Increase in July temperatures from 15,000 to 5,000 years cal B.P. (adapted from Viau et al. 2006).

Variability is also considered to be the result of variation in resources available to the tree populations (Koenig and Knops 2000 2005; Satake and Iwasa 2002). Warmer weather will produce more resources for the trees, which will increase the amount of seeds produced. Alternatively, in colder years smaller crops will be produced as a result of lower resource availability and decreased opportunity for photosynthesis. Evidence supports the hypothesis that higher temperatures induce flowering, thereby increasing seed production and decreasing the periodicity between bumper crops (McKone et al. 1998:591; Schaubert et al. 2002:1215). Availability of resources could also explain why synchronicity occurs in large geographic areas, as rainfall and temperatures usually fluctuate over these areas from year to year (Koenig and Knops 2005:342). Masting in forest trees is especially important because of the contributions that these food resources produce to forest ecosystems, both human and animals (Koenig and Knops 2000:59; Schaubert et al. 2002:1223).

While the warming effects of the Hypsithermal may have been beneficial in regards to the masting phenomenon and the effects that warmer climates had on tree productivity, what may have been more beneficial for hunter-gatherers living in the forests of the Southeast was the changing forest canopy dynamics. It is estimated that hickory trees in closed canopy forest produce between 1 and 1.2 kg of hickory nuts per tree, while in open habitats trees can produce between 4.3 and 8.2 kg of nuts, the higher proportion based on the edge effect (Munson 1986:6). Closed canopy forests are described as forests in which the canopy is continuous. Edge habitats are those in which the crown of a tree touches another on one side but is open on the other, and open habitats are those where tree crowns are separated by at least 10 meters (Munson 1986:6). Munson's results determined that while nut production was greater in open habitats than closed that yield, defined as nuts on the ground at the optimum collection period, was actually 287 times that of closed habitats, which had very low yields. Trees in edge habitats produce more and have better yields than closed habitat situations, but it is still lower than that in open habitats (Munson 1986:7). Munson (1986:7) claims that knowledge and understanding of this situation encouraged the intentional creation of stands of widely spaced hickory trees in the Midwest during the Middle Archaic period.

During the mid Holocene, forests became species poor and more xeric as a result of warmer and drier climates brought about by the Hypsithermal (Delcourt 1979; Delcourt and Delcourt 1985:20). This would have created a more open forest which, according to Munson (1986), would have created more productive hickory trees. In addition, the location of Dust Cave places it in an ecotone habitat, located in a bluff that connects karstic uplands to the Tennessee River floodplain (Hollenbach 2005:35).

The calculations shown in Tables 6.3 and 6.4 are based on modern day estimates of hickory tree production calculated based on 17 seed producing hickories per acre on average in typical oak-hickory forests in northern Alabama. These densities were determined to be accurate for 16 counties in northern Alabama: Blount, Cherokee, Colbert, Cullman, DeKalb, Etowah, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marion, Marshall, Morgan, and Winston (Brian Hendricks, Alabama Forestry Commission, personnel communication 2009).

Table 6.3: Forest Productivity in Northern Alabama.

Bushel	Lbs/Bushel	Edible Portion		kcal / Bushel	kcal per acre	kcal per km	kcal per sq.mile
		Lbs	Ozs			247 acres / sq.km	640 acres / sq. mile
1	40	14	224	41,066	698,122	172,436,134	446,798,080
2	80	28	448	81,984	1,393,728	344,250,816	891,985,920
3	120	42	672	122,976	2,090,592	516,376,224	1,337,978,880

*Kcal/acre based on estimated 62.5 hickory trees /acre (Brian Hendricks, Alabama Forestry Commission, personal communication 2009).

Table 6.4: Forest Productivity per Person.

Number of 2,200 kcal portions available and Annual per Person Yield						
Tree Production	Acre		Kilometer		Sq. Mile	
	2,200 kcal portions	Annual per Person yield	2,200 kcal portions	Annual per Person yield	2,200 kcal portions	Annual per Person yield
1 Bushel	317	0.8	78,380	215	203,090	556
2 Bushel	634	1.7	156,478	429	405,448	1,111
3 bushel	950	2.6	234,716	634	608,172	1,666

Based on the numbers in Table 6.3, the carrying capacity of the area that today encompasses Lauderdale County, the county where Dust Cave is located, can be calculated. Lauderdale County has 669 square miles of land, or 1,734 km², meaning that if each tree only produced one bushel of hickory nuts annually the area would be able to provide 2,200 kcal per day for one year for 371,964 people. Two bushels per tree would provide a year's worth of kcal requirements for 743,928 people and three bushels of hickory nuts would provide these daily requirements for 1,115,892 people. While these numbers are based on modern day tree density estimations, they are still useful in helping us understand how productive prehistoric forests could have been and the amounts of nutrition they could have provided. It is also important to remember that humans competed with various different animals for hickory nuts, so the numbers represented in the tables do not reflect the absolute numbers that were available for human consumption.

Technological Changes

One explanation that has been used to explain an increase in foraging efficiency is an increased ranking of food items due to more efficient handling or pursuit costs, or changes in technology. More efficient pursuit and handling can be the result of improved transportation for either pursuit of food resources or transporting resources, or improved technologies used for harvesting, processing, or storage (Winterhalder and Goland 1997:148). Increases in the use of hickory nuts during the Middle Archaic period have been attributed to changes in technology, namely nutting stones and larger features that are believed to have been associated with more efficient processing technologies (Munson 1986; Stafford 1991, 1994). At Dust Cave, however, while there is an apparent increase in the use of hickory nuts through time, there is no indication

that there was a major change in the way hickory is processed. While only five nutting stones were recovered from the cave, all from the Kirk Stemmed component, it is possible that more were discarded during the excavation, accidentally mistaken for limestone detritus (Randall 2003:10). The recovery of these nutting stones from Kirk Stemmed components and their absence from earlier components may initially appear as a change in technology through time except for the presence of mortars or nutting stones built in to bedrock at Stanfield-Worley Bluff Shelter, a shelter site in close proximity to Dust Cave, where Dalton deposits directly overlie the bedrock mortars (Hollenbach 2005; Homsey 2004:274).

The argument has also been made that changes in processing technology explain the increased exploitation of hickory nuts during the Middle Archaic period, and that these changes are evident not only in groundstone technologies but also in increases in the size of features, especially hearths, during the Middle Archaic period. In order to explore this possibility at Dust Cave I have calculated the surface area of features at Dust Cave using length and width measurements provided by Homsey (2004). The figure below (Figure 6.3) shows a comparison of all features from all time periods at Dust Cave. The boxplot shows that although there is an increase in the range of values during the Middle Archaic occupations as compared to those from the Late Paleoindian and Early Side-Notched components, there are no clearly significant differences in feature size through time. Benton features may be significantly larger than Early Side-Notched features, but the notches of the remaining components demonstrate considerable overlap.

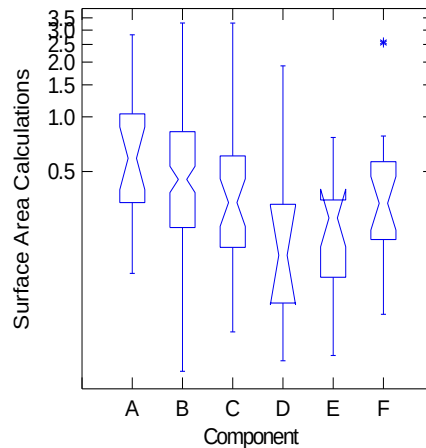


Figure 6.3: Changes through time in surface area of features. Calculations were made using major and minor axis dimensions provided by Homsey (2004). A-Benton / B - Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and ESN / E-Early Side Notched / F-Late Paleoindian periods.

Understanding that different features serve different functions and that size varies between features based on function, I have compared the surface area for the three different types of hearths – expedient (Figure 6.3), pit (Figure 6.4) and surface hearths (Figure 6.5) – described at Dust Cave (Homsey 2004). These features are most commonly associated with nut processing. The boxplots below show the comparison between each feature type through time. Differences between these feature types through time are negligible, and more heavily influenced by small sample sizes or absence of certain feature types from some components. The results do not suggest that there was a major shift in technology, one that is apparent in feature size. Though it was mentioned earlier in Chapter Four it is worth noting again that hickory remains recovered from features measured across time periods at Dust Cave indicated that there were no statistically significant changes in the relative density of hickory nutshell throughout the cave's different occupations. I believe that those results coupled with comparisons of feature surface

areas presented here strengthen arguments opposing the case for a technological explanation for the increased exploitation of hickory nuts during the Middle Archaic period at Dust Cave.

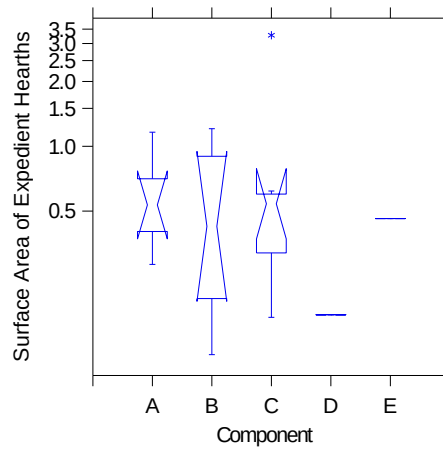


Figure 6.4: Changes in the surface area of expedient hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D- Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.

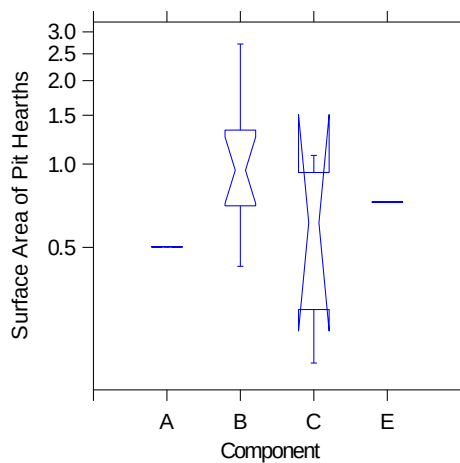


Figure 6.5: Changes in the surface area of pit hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D- Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.

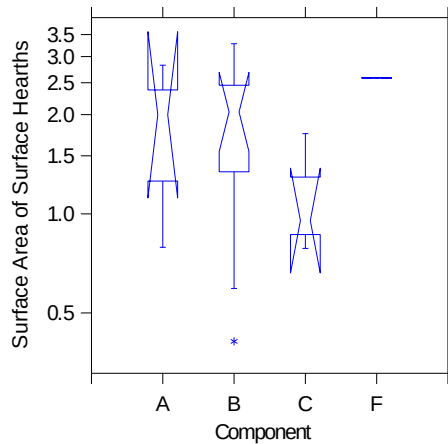


Figure 6.6: Changes in the surface area of surface hearths through time at Dust Cave. A-Benton / B-Eva/Morrow Mountain / C-Kirk Stemmed / D-Mixed Kirk Stemmed and Early Side-Notched / E-Early Side Notched / F-Paleoindian periods.

The prepared clay surfaces present in the cave also provide further evidence opposing a technological explanation for hickory intensification through time at Dust Cave. The prepared clay surfaces at Dust Cave were created with clay selected from local sources and were believed to have played an important role in the cooking or preparation of food, namely the roasting or parching of nuts, prior to the use of ceramics (Sherwood and Chapman 2005:70). The prepared clay surfaces appear during the Late Paleoindian period, but are most greatly concentrated during the Early and Middle Archaic components. Generally these surfaces are 50 to 100 cm in diameter and up to 3 cm thick, are located in areas identified as central activity areas, and in some instances these surfaces are stacked, one on top of another (Sherwood and Chapman 2005:72). The surfaces are believed to have been able to maintain their composition through time because they were fired at low temperatures, which also explain their reddish color. Although the prepared clay surfaces increase through time along with the frequencies of charred

nutshells, their presence in all components shows a continuity in technology used through time at Dust Cave (Sherwood and Chapman 2005:78).

Implications of Increased Foraging Efficiency: Time Minimization vs. Resource Maximization

There are two results of optimal time allocation: time minimization and resource maximization (Hames 1992:206). Resource maximization allows individuals to accumulate resources at a higher rate whereas time minimizers optimize so that they may complete tasks in the shortest time possible, freeing up time for other activities. Time minimization does not lead to increased foraging because greater fitness will come from activities that occur in the time gained than from increased consumption (Hames 1992:206). For resource maximizers, increased foraging efficiency leads to increases in foraging because fitness is enhanced more through foraging than through engaging in alternative activities (Hames 1992:206; Winterhalder 1983:75-76). Winterhalder (1983:81) suggests that in a richer environment, where an increased foraging efficiency results in a shrinking diet breadth, foragers would benefit more in terms of fitness from a time minimizer's strategy. The time afforded to foragers in a richer environment from more efficient foraging would allow for activities such as alliance formation, trade, and information sharing, all activities which would increase their fitness over foragers in poorer environments.

In order to better understand the implications of the trends seen in the botanical data I explore trends found in other classes of artifacts and ecofactual data including burials, lithics, faunal remains, and features.

Burials at Dust Cave

Important to the discussion involving the changing foraging patterns and function of Dust Cave are the burials that are found in the cave originating in Zone N and extending into Zone P. This marks a period of time between the Kirk Stemmed occupation and the Eva/Morrow Mountain component. The Eva/Morrow Mountain occupations following this period of burials represent the most intensive periods of human activity at Dust Cave (Sherwood et al. 2004:549). While there are burials associated with other periods of occupation, the number of burials associated with this one zone suggests that the function of the cave, as well as the use of the landscape, were changing during this period. The burials that are associated with other occupations probably reflect more greatly the significance of the cave to those who used it, and the great amount of history that is associated with the cave, a history that was appreciated and acknowledged and marked by these burials.

There are several different interpretations for burials or cemeteries in the archaeological record. While there seems to be varying opinions and suggestions about the true meaning of burials, some suggesting that they represent or mark the centers of territories and others believing that they are more indicative of edges or boundaries, the one thing that most people do agree on is that the emergence and appearance of burials and cemeteries in the archaeological record shows a changing relationship between populations and the territories in which they live

and create resource structures, or social geographies (Pearson 1999:141). Hunter-gatherers lived in a social environment or networks of neighboring bands, not in a vacuum. Hunter-gatherers' territories were maintained through habitual use and were delineated through distance from other groups, familiarity with local landscapes and environments, and by the natural landscape (Wobst 1974:153). Placing ancestors in a fixed location is believed to have been a social act carried out in order to establish certain groups' access and rights to natural resources, and express their relationships to the land (Pearson 1999:141). In the Midwest, Charles and Buikstra (1983) have suggested that burials were a way for Archaic populations to mark their territories, especially when they were located near valuable resources, establishing rights to sites among kin groups, and using cemeteries to ritually signify a relationship to lands and territories (Charles and Buikstra 1983:121). The remains of ancestors also signify a relationship of ownership to the land (Charles and Buikstra 1983:121).

Lithics

Studies have shown that the changing organization of lithic technology can be associated with changes in foraging patterns, mobility patterns and sedentism (Binford 1979; Kuhn 1992, 1994). These conclusions have been based on the differences between curated and expedient technologies, core technology, raw material use, etc. The lithic assemblage from Dust Cave also supports the conclusion that the function of Dust Cave changed over time, indicating a larger change across the broader landscape. Several trends were recognized and discussed in previous research conducted by Meeks (1994) and Randall (2001, 2003). A decrease in lithic density over time, an increase in bifacial technology through time, and a decrease in the diversity of raw

materials can all be examined and explained in relationship to changing use of the landscape and Dust Cave through time.

Decrease in Lithics from Flotation Samples

Initially the decrease in the recovery of lithics at the site through time could be interpreted as reflecting an overall decrease in tool production and maintenance. However, when examined more closely there are several different points to discuss regarding a decrease in lithic density. First, lithics recovered from flotation samples are usually small flakes associated with tool production and maintenance, so a decrease in small flakes does suggest that these activities did decrease through time. This idea is further supported by the decrease in faunal remains recovered from the flotation samples through time, suggesting that hunting activities did decrease through time. Also, a decrease in scrapers, a tool usually associated with hunting activities, provides further evidence suggesting that there was a decrease in hunting activities by the occupants of Dust Cave over time. Comparisons of nutshell to lithics (Figure 4.47) can also be used to suggest that through time the inhabitants of the cave spent less time involved in tool manufacture and repair, both activities that are associated with hunting, and more time gathering and processing mast resources while they occupied the cave (Gardner 1994; Hollenbach 2005).

While the decrease in lithics could be explained by a decrease in hunting activities, it is also possible that the decrease could be attributed to scheduled production and maintenance activities that occur during foraging down times by groups employing logistical mobility. As raw material procurement is embedded in other activities, so is tool maintenance and manufacture (Binford 1979:268; Kuhn 1992:189). This type of scheduling activity could also be

used to explain the high amounts of late stage bifaces found in all occupations at Dust Cave. These activities might be restricted or reduced at a plant processing site. The decrease in hunting activities suggested by a decrease in lithics does indicate that the activities that the cave's occupants participated in likely changed over time.

The Benton component, however, is an exception to the decreasing lithics patterns through time. The increase of debitage and tools, almost twice the number found in the previous Eva/Morrow Mountain component, which lasted almost 1,000 years longer, can be explained by participation in the Benton Interaction Sphere (Meeks 1994), an exchange network involved in the possible communal production of stone tools for exchange.

Bifacial Technology

A second trend that emerged in the Dust Cave lithics assemblage was a high frequency of late stage bifaces recovered from all components at Dust Cave, with an increase in bifaces in general during Benton and Eva/Morrow Mountain occupations, comprising up to 85 percent of the assemblage as compared to 75 percent in the Kirk Stemmed component (Randall 2003:8). Bifaces, or formal tools, are considered to be more flexible and can be rejuvenated or redesigned by retouching, and thus can be used for various functions (Andrefsky 1994:22). They are also advantageous for mobile groups because they can be used as cores. Studies have suggested that shifts towards logistical mobility can be correlated with an increase in curation and maintenance of tools as both are attempts to increase efficiency (Binford 1979:35; Kelly 1992:55). Because mobility places limitations associated with carrying costs, tools that are more multi-functional are more desirable (Schott 1986:19-20). Carrying costs would be minimized through the use of

tools that are more multi-functional (Schott 1986:29). This could explain the increase in the number of bifaces through time, and even the high number of late stage bifaces found throughout all occupations at Dust Cave.

Raw Materials

The Kirk Stemmed component shows the greatest raw material diversity at Dust Cave, with the Eva/Morrow Mountain component showing the lowest. As territories constricted and residential mobility gave way to logistical mobility as a means to procure resources, groups began to rely more heavily on, and perhaps forced to use, local lithic resources (Andrefsky 1994:22). Because of close proximity to a high quality raw material source, blue-gray Fort Payne chert, we would expect to see more expedient technologies at Dust Cave. Raw materials used in the manufacture of stone tools are normally obtained during scheduled subsistence procurement (Binford 1979:274; Brantingham 2006:437). If that is true, then as mobility became restricted and groups resorted to logistical strategies, access to resources or source areas could be limited, explaining the decrease in raw material diversity during the Eva/Morrow Mountain component.

Faunal Materials

Trends in faunal remains can provide as much insight into foraging patterns and mobility as botanical remains, burials, and lithics, but can also provide information about changing environmental conditions. During the Middle Archaic period decreases in the exploitation of fish and waterfowl and increases in the exploitation of mammals can be seen as a direct response to environmental changes. Decreases in waterfowl and fish are considered to be a reaction to the

drying of marsh areas around Dust Cave brought about by the Hypsithermal warming episode (Walker 1998:199). The Hypsithermal warming episode also led to an opening of forests which created more ecotone habitats. These habitats are preferred by species like white-tailed deer and rabbits (Walker 1998:144). White-tailed deer bones increase through time at Dust Cave, as well as Graham Cave, Smith Bottom Cave, and Stanfield-Worley Bluff Shelter (Walker 1998:202). An increase in white-tailed deer exploitation across the Midsouth during the Middle Archaic period has been attributed to an increase in acorn production as xeric oak-hickory forests replaced mesic forest communities (Bissett 2009). Walker (1998:204) states that the analysis of faunal remains from Dust Cave suggests that hunter-gatherers adapted to the local environmental changes that occurred through time.

Features

Changes in the number and diversity of features at Dust Cave also reflect shifts in mobility strategies by its occupants. Homsey (2004) notes a marked increase in the number of features associated with the Eva/Morrow Mountain component, but at the same time the features demonstrate a decrease in diversity. This decrease in diversity continues into the Benton component, although the number of features also decreases, likely associated with the more limited space available at the time. Homsey (2004) relates this decrease in diversity, along with an increase in features associated with nut processing, to a change in use of Dust Cave from a residential camp during the Late Paleoindian, Early Side-Notched, and Kirk Stemmed occupations to a logistical nut processing site during the Eva/Morrow Mountain and Benton components.

Logistical Organization

The emergence of logistical mobility strategies in northern Alabama during the Eva/Morrow Mountain period indicates a changing use of the landscape. Logistical mobility strategies are believed to emerge as the result of a reduction in normal residential mobility patterns (Binford 1980:17; Eder 1984:851; Kelly 1992:53). As noted above, evidence provided from previous research suggests that during the Eva/Morrow Mountain component Dust Cave may have served as a logistical style camp used primarily for the extraction of hickory nutmeats and oils (Homsey 2004). An increasing number of features with decreasing diversity, along with an increase in occupation intensity, suggest that the cave's function possibly shifted away from a residential base camp. The low diversity of features suggests a focus on limited activities and in the case of Dust Cave the evidence points towards hickory nut processing (Homsey 2004:247).

Kenneth Ames (1991) suggests that if a logistical style organization pattern emerges in a region, that over time these logistical systems should become more complex, bounded, and distinct. This type of behavior will in turn create an archaeological record that becomes more redundant at a site as the environment increasingly becomes divided between groups on the landscape (Ames 1981:165; Binford 1983; Graham and Roberts 1985). Through time the archaeological record at Dust Cave reflects this level of redundancy, witnessed in the analysis of feature functions, botanical remains, faunal remains, and lithics recovered from the site.

Chapter 7: Conclusion

The botanical remains recovered from Dust Cave have the potential to tell us much more than what the inhabitants of the cave ate during their seasonal occupations. They speak of larger patterns at play on the landscape involving mobility and organization. The way that hunter-gatherers use their terrain provides a distinct view of the way they conceptualize landscape as pockets of resources as opposed to homogenous territorial wholes (Johnson 1977:488). While the results from Dust Cave only represent one site, the results are no less significant. What is important is that they represent one site in what was clearly a much larger settlement system and each stop in a hunter-gatherers foraging rounds provides greater insight into their daily activities and routines.

Diet breadth models claim that in the presence of an abundance of a highly ranked resource a forager's diet breadth will constrict, as foragers increase their efficiency by dropping lower ranked resources from their diet. The application of the diet breadth model in this study indicates that the diet of Middle Archaic foragers at Dust Cave does constrict, with the removal of lower ranking edible seeds, which are present in earlier periods of occupation, as hickory nuts become more abundant and predictable, therefore increasing foraging efficiency. This increased efficiency is related to a reduction in mobility, as hunter-gatherers shifted from residential to logistical procurement strategies.

Reduced mobility, which occurs during the Middle Archaic period, usually results in changes involving trade, territoriality, and demography (Kelly 1992:43). In northern Alabama

changes in each of these arenas is witnessed during the Middle Archaic. Long distance trade networks, exemplified by the Benton Interaction Sphere, appear during the Benton phase (Brookes and Johnson 1989; Meeks 1998). Cashden (1992) has suggested that trade eventually replaces mobility as a way of averaging spatial variation of resources due to greater competition and population pressures. Territoriality is witnessed in the appearance of cemeteries and through evidence of interpersonal violence in the archaeological record during this period (Sherwood et al. 2004; Shields 2003). Evidence for demographic changes that occur in the Middle Archaic period can be witnessed by population shifts into resource-rich river valleys across the Southeast and Midwest (Brown and Vierra 1983; Hollenbach 2005; Meeks 1998).

A reduction in residential mobility as a result of population pressure and constricting territories created spatial variability on the landscape. As a result logistical mobility strategies would have been the most efficient ways to procure resources. Specialized tasks groups associated with this type of mobility are critical when there are time limits involved in harvesting resources, like hickory nuts. In resource rich areas logistical mobility would have allowed groups to procure large amounts of food at lower costs.

Logistical organization involves a different level of organizational complexity. The ability to organize tasks and task groups to perform specific activities indicates a level of organization similar to simultaneous and sequential hierarchies resulting from “scalar stress” described by Johnson (1982:369). The type of cooperation necessary in logistical mobility is important in the formation of social hierarchies (Boone 1992:311). So, where logistical group formation occurs, an increase in organization should be expected. Kelly (2007) suggests that reduction in residential mobility usually led to great socio-political changes across the landscape.

Evidence indicating that the appearances of mounds dates back at least 5,000 years, earlier than previously believed, has changed our perceptions about the types and complexity of organization that existed during the Middle Archaic period (Anderson 2004:270; Kidder and Sassaman 2009:674). Many of the components of complexity previously believed to have emerged after the Middle Archaic period are now being reconsidered as having origins in the Middle Archaic period (Anderson 2004; Sassaman 1995). What, if any, type of relationship exists between increases in organizational complexity and increased foraging efficiency, both of which appear to emerge in the Middle Archaic period? Did increases in foraging efficiency play into increases in complexity in resource-rich areas? Due to the timing of each in the region surrounding Dust Cave, should foraging efficiency and increases in complexity be considered interconnected?

I believe that in response to the environmental and cultural changes that occurred across the landscape during the Middle Archaic period that groups with access to resource-rich areas foraged more efficiently through logistical mobility strategies, strategies which were important in the formation of social hierarchies. Time minimization resulting from more efficient foraging would have allowed these hunter-gatherers the extra time necessary to participate in non-foraging activities like alliance formation, information sharing, craft specialization, and long distance trade networks, activities that would have advanced individual and group status, provided an evolutionary advantage to these groups over groups restricted to more marginal areas, and eventually contributed to greater social complexity.

References

Ames, Kenneth M.

1981 The Evolution of Social Ranking on the Northwest Coast of North America. *American Antiquity* 46(4):789-805.

1985 Hierarchies, Stress, and Logistical Strategies among Hunter-Gatherers in Northwestern North America. In *Prehistoric Hunter Gatherers: The Emergence of Cultural Complexity*, edited by T. Douglas Price and James A. Brown, pp. 155-176. Academic Press, New York.

Amick, Daniel S., and Phillip J. Carr

1996 Technological Innovations in Economic and Social Contexts. In *Archaeology of the Mid-Holocene Southeast*, edited by K. E. Sassaman. and D. G. Anderson, pp. 57-75. University of Florida Press, Gainesville.

Anderson, David G

2001 Climate and Culture Change in Prehistoric and Early Historic Eastern North America. *Archaeology of Eastern North America* 29:143-186.

2002 The Evolution of Tribal Social Organization in the Southeastern United States. In *The Archaeology of Tribal Societies*, edited by William A. Parkinson, pp. 246-277. International Monographs in Prehistory Archaeological Series 15, Ann Arbor.

2004 Archaic Mounds and the Archaeology of Southeastern Tribal Societies. In *Signs of Power: The Development of Complexity in the Southeast*, edited by John L. Gibson and Philip J. Carr, pp. 270-299. The University of Alabama Press, Tuscaloosa.

Anderson, David G., and Glen T. Hanson

1988 Early Archaic Settlement in the Southeastern United States: A Case Study from the Savannah River Valley. *American Antiquity* 53(2):262-286.

Anderson, David G., Lisa D O'Steen, and Kenneth E. Sassaman

1996 Environmental and Chronological Considerations. In *The Paleoindian and Early Archaic Southeast*, edited by David G. Anderson. and Kenneth E. Sassaman, pp. 3-15. The University of Alabama Press, Tuscaloosa.

Anderson, David G., Kirk A. Maasch, Daniel E. Sandweiss, and Paul A. Mayewski

2007 Climate and Culture Change: Exploring Holocene Transitions. In *Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transitions*, edited by Kirk A. Maasch, David G. Anderson, and Daniel E. Sandweiss, pp. 1-23. Academic Press, New York.

- Anderson, David G., Michael Russo, and Kenneth E. Sassaman
2007 Mid-Holocene Cultural Dynamics in Southeast North America. In *Climate Change and Cultural Dynamics: A Global Perspectives on Mid-Holocene Transitions*, edited by Kirk A. Maasch, David G. Anderson, and Daniel E. Sandweiss, pp. 457-489. Academic Press, New York.
- Anderson, David G., D. Shane Miller, Stephen J. Yerka, and Michael K. Faught
2005 Paleoindian Database of the Americas: 2005 Status Report. *Current Research in the Pleistocene* 22:91-92.
- Andrefsky, William, Jr.
1994 Raw Material Availability and the Organization of Technology. *American Antiquity* 59(1):21-34.
- Asch, Nancy B., Richard I. Ford, and David L. Asch
1972 *Paleoethnobotany of the Koster Site: The Archaic Horizons*. Report of Investigations No. 24. Illinois State Museum, Springfield.
- Bense, Judith A.
1994 *Archaeology of the Southeastern United States: Paleoindian to World War II*. Academic Press, Orlando.
- Bettinger, Robert L.
1987 Archaeological Approaches to Hunter-Gatherers. *Annual Review of Anthropology* 16:121-142.
1991 *Hunter-Gatherers: Archaeological and Evolutionary Theory*. Interdisciplinary Contributions to Archaeology. Plenum Press, New York.
- Bettinger, Robert L., and Ripan Malhi
1997 Central Place Models of Acorn and Mussel Processing. *Journal of Archaeological Science* 24:887-899.
- Binford, Lewis R.
1977 Forty-Seven Trips: A Case Study in the Character of Archaeological Formation Processes. In *Stone Tools as Cultural Markers*, edited by R.V.S. Wright, pp. 24-36. Australian Institute of Aboriginal Studies, Canberra.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255-273.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.
1983 The Archaeology of Place. *Journal of Anthropological Archaeology* 1:5-31.
- Bird, Douglas W. and James E. O'Connell,

- 2006 Behavioral Ecology and Archaeology. *Journal of Archaeological Research* 14:143-188.
- Bissett, Thaddeus
2009 Increased Exploitation of *Odocoileus virginianus* as a Causal Factor for Hunter-Gatherer Population Increases in the Southeastern United States during the Mid-Holocene. Unpublished manuscript on file, Department of Anthropology, University of Tennessee, Knoxville.
- Bonnichsen, Robson
2005 An Introduction to Paleoamerican Origins. In *Paleoamerican Origins: Beyond Clovis*, edited by Robson Bonnichsen, pp. 1-8. Center for the Studies of the First Americans, College Station Texas.
- Bonnichsen, Robson, Dennis Stanford, and James L Fastook
1987 Environmental Change and Developmental History of Human Adaptive Patterns; the Paleoindian Case. In *North America and Adjacent Oceans During the Last Deglaciation*, edited by W. F. Ruddiman. and H. E. Wright, pp. 403-424. Geologic Society of America, Boulder.
- Boone, James L.
1992 Competition, Conflict and the Development of Social Hierarchies. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder, pp. 269-301. Aldine De Gruyter, New York.
- Brantingham, P. Jeffrey
2006 Measuring Forager Mobility. *Current Anthropology* 47(3):435-459.
- Brown, James A., and Robert K. Vierra
1983 What Happened in the Middle Archaic? Introduction to an Ecological Approach to Koster Site Archaeology. In *Archaic Hunters and Gatherers in the American Midwest*, edited by James C. Phillips and James A. Brown, pp. 165-196. Academic Press. New York.
- Broughton, Jack M. and James F. O'Connell
1999 On Evolutionary Ecology, Selectionist Archaeology, and Behavioral Archaeology. *American Antiquity* 64(1):153-165.
- Bulmer, Michael
1994 *Theoretical Evolutionary Ecology*. Sinauer Associates Publishers, Sunderland, Massachusetts.

Caddell, Gloria M.

1983 Charred Plant Remains from the Cedar Creek and Upper Bear Creek Reservoirs. In *Archaeological Investigations in the Cedar Creek and Upper Bear Creek Reservoirs*, edited by Eugene M. Futato, pp. 335-350. University of Alabama Office of Archaeological Research Report of Investigations 29; Tennessee Valley Authority Publications in Anthropology 32.

Caldwell, Joseph R.

1958 *Trend and Tradition in the Prehistory of the Eastern United States*. Memoirs of the American Anthropological Association No. 88, Menasha, Wisconsin.

Cashdan, Elizabeth

1992 Spatial Organization and Habitat Use. In *Evolutionary Ecology and Human Behavior*, edited by Eric Alden Smith and Bruce Winterhalder, pp. 237-268. Aldine De Gruyter, New York.

Chapman, Jefferson, and Andrea Brewer Shea

1981 The Archaeobotanical Record: Early Archaic Period to Contact in the Lower Tennessee River Valley. *Tennessee Anthropologist* 6(1):61-85.

Charles, Douglas J., and Jane E. Buikstra

1983 Mortuary Sites in the Mississippi Drainage. In *Archaic Hunters and Gatherers of the American Midwest*, edited by James L. Phillips and James A. Brown, pp. 117-141. Academic Press, New York.

Collins, Michael B., Wulf A. Gose, and Scott Shaw

1994 Preliminary Geomorphological Findings at Dust and Nearby Caves. *Journal of Alabama Archaeology* 40(1 and 2):35-56.

Cowan, C. Wesley, and Bruce D. Smith

1993 New Perspectives on a Wild Gourd in Eastern North America. *Journal of Ethnobiology* 13(1):17-54.

Cowan, C. Wesley

1997 Evolutionary Changes Associated with the Domestication of *Cucurbita pepo*: Evidence from Eastern Kentucky. In *People, Plants and Landscapes*, edited by Kristen J. Gremillion, pp. 63-85. University of Alabama Press, Tuscaloosa.

Cowan, C. Wesley, and Patty Jo Watson (editors)

1992 *The Origins of Agriculture: An International Perspective*. Smithsonian Institution Press, Washington.

- Cutler, Hugh C., and Thomas W. Whitaker
1961 History and Distribution of the Cultivated Cucurbits in the Americas. *American Antiquity* 26(4):469-485.
- Davis, Valerie S.
2004 A Study of Stress Indicators as Evidence for Possible Differential Treatment of Males and Females at Dust Cave (1LU496), Alabama. Unpublished Master's thesis, Department of Sociology, Anthropology, and Social Work, Mississippi State University, Starkville.
- Deevey, Edward S. and Richard Foster Flint
1957 Postglacial Hypsithermal Interval. *Science* 125(3240):182-184.
- DeJarnette, David L., Edward B. Kurjack and James L. Cambron
1962 Stanfield-Worley Bluff Shelter Excavations. *Journal of Alabama Archaeology* 8(1&2).
- Delcourt, Hazel R.
1979 Late-Quaternary Vegetation History of the Eastern Highland Rim and Adjacent Cumberland Plateau of Tennessee. *Ecological Monographs* 49(3):255-280.
- Delcourt, Hazel R., and Paul A. Delcourt
1985 Quaternary Palynology and the Vegetational History of the Southeastern United States. In *Pollen Records of Late-Quaternary North American Sediments*, edited by V. M. B. J. a. R. G. Holloway, pp. 1-37. American Association of Stratigraphic Palynologists Foundation.
- Delcourt, Hazel R., Paul A Delcourt., and Elliot C.Spiker
1983 A 12,000 Year Record of Forest History from Cahaba Pond, St. Clair County, Alabama. *Ecology* 64(4):874-887.
- Delcourt, Paul A., and Hazel R. Delcourt
1980 Vegetation Maps for Eastern North America: 40,000 Yr B.P. to the Present. In *Geobotany*, edited by R. C. Romans. Plenum Press, New York. pp. 123-166
- Demur, Fikret Hakan Dogan, Musa Özcan and Haydar Haciseferogullari
2002 Nutritional and Physical Properties of Hackberry (*Celtis australis* L.). *Journal of Food Engineering* 54(3):241-247.
- Driskell, Boyce
1994 Stratigraphy and Chronology at Dust Cave. *Journal of Alabama Archaeology* 40(1 and 2):17-34.

- 2009 The Dust Cave Archaeological Project, Lauderdale County, Alabama. In *TVA Archaeology: 75 Years of Prehistoric Site Research*, edited by Erin K. Pritchard and Todd M. Ahlman, pp. 235-265. University of Tennessee Press, Knoxville.
- Duke, James A
1992 *Handbook of Edible Weeds*. CRC Press, Boca Raton.
- Dye, David H.
1996 Riverine Adaptation in the Midsouth. In *Of Caves and Shell Mounds*, edited by Kenneth C. Carstens and Patty Jo Watson, pp. 140-158. University of Alabama Press, Tuscaloosa.
- Eder, James F.
1984 The Impact of Subsistence Change on Mobility and Settlement Pattern in a Tropical Forest Foraging Economy: Some Implications for Archeology. *American Anthropologist* 86(4):837-853.
- Ford, James A., and Gordon R. Willey
1941 An Interpretation of the Prehistory of the Eastern United States. *American Anthropologist* 43(3):325-363.
- Ford, Richard I. (editor)
1985 *Prehistoric Food Production in North America*. Museum of Anthropology, University of Michigan No. 75, Ann Arbor, Michigan.
- Fritz, Gayle J.
1999 Gender and the Early Cultivation of Gourds in Eastern North America. *American Antiquity* 64(3):417-429.
- Fritz, Gayle J., Virginia Drywater Whitekiller, and James W. McIntosh
2001 Ethnobotany of Ku-Nu-Che: Cherokee Hickory Nut Soup. *Journal of Ethnobiology* 21(2):1-27.
- Futato, Eugene M.
1983 *Archaeological Investigations in the Cedar Creek and Upper Bear Creek Reservoirs*. University of Alabama Office of Archaeological Research Report of Investigations 29; Tennessee Valley Authority Publications in Anthropology 32.
- Gardner, Paul S.
1994 Carbonized Plant Remains from Dust Cave. *Journal of Alabama Archaeology* 40(1 and 2):192-212.
1997 The Ecological Structure and Behavioral Implications of Mast Exploitation Strategies. In *People, Plants, and Landscapes, Studies in Paleoethnobotany*, edited by Kristen J. Gremillion, pp. 161-178. University of Alabama Press, Tuscaloosa.

- Goldman-Finn, Nurit S., and Boyce N. Driskell
1994 Introduction to Archaeological Research at Dust Cave. *Journal of Alabama Archaeology* 40(1 and 2):1-16.
- Goldman-Finn, Nurit S., and Renee B. Walker
1994 The Dust Cave Bone Tool Assemblage. *Journal of Alabama Archaeology* 40(1-2):107-115.
- Graham, Martha, and Alexandra Roberts
1986 Residentially Constrained Mobility: A Preliminary Investigation of Variability in Settlement Organization. *Haliksa'I: UNM Contributions to Anthropology* 5:105-116.
- Graham, Russell W., and Jim I. Mead
1987 Environmental Fluctuations and Evolution of Mammalian Faunas during the Last Deglaciation in North America. In *North America and Adjacent Oceans during the Last Deglaciation*, Vol. K-3, edited by William F. Ruddiman and H.E. Wright, Jr., pp. 371-402. Geological Society of America, Boulder, Colorado.
- Gremillion, Kristen J.
1996 The Paleoethnobotanical Record for the Mid-Holocene Southeast. In *Archaeology of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp. 99-115. University of Florida, Gainesville.
2002 Foraging Theory and Hypothesis Testing in Archaeology: An Exploration of Methodology Problems and Solutions. *Journal of Anthropological Archaeology* 21:142-164.
2003 Eastern Woodlands Overview. In *People and Plants in Ancient Eastern North America*, edited by Paul E. Minnis, pp. 17-49. Smithsonian Books, Washington.
- Griffin, James B. (editor)
1952 *Culture Periods in Eastern United States Archaeology*. University of Chicago Press, Chicago.
1967 Eastern North American Archaeology: A Summary. *Science* 156(3772):175-191.
- Hames, Raymond
1992 Time Allocation. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder, pp. 203-237. Aldine De Gruyter, New York.
- Hart, John P.
2004 Can *Cucurbita pepo* Gourd Seeds Be Made Edible? *Journal of Archaeological Science* 31(11):1631-1633.
- Hart, John P., Robert A. Daniels, and Charles J. Sheviak
2004 Do *Cucurbita pepo* Gourds Float Fishnets? *American Antiquity* 69(1):141-148.

- Hawkes, Kristen, Kim Hill, and James F. O'Connell
1982 Why Hunters Gather: Optimal Foraging and the Ache of Eastern Paraguay. *American Ethnologist* 9(2):379-398.
- Helbaek, Hans
1952 Early Crops in Southern England. *Proceedings of the Prehistoric Society* 18(2):194-233.
- Hendricks, Brian
2009 Tree Density in Modern Oak Hickory Forests,
- Hogue, S. Homes
1994 Human Skeletal Remains from Dust Cave. *Journal of Alabama Archaeology* 40(1 and 2):173-192.
- Hollenbach, Kandace D.
2005 Gathering in the Late Paleoindian and Early Archaic Periods in the Middle Tennessee River Valley, Northern Alabama. Unpublished Ph.D. dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.
- Homsey, Lara Kristine
2004 The Form, Function, and Organization of Anthropogenic Deposits at Dust Cave, Alabama. Unpublished Ph.D. dissertation, Department of Anthropology, University of Pittsburgh.
- Jacobsen, George L., Jr., Webb Thompson III, and E.C. Grimm
1987 Patterns and Rates of Vegetation during the Deglaciation of Eastern North America. In *North America and Adjacent Oceans during the Last Deglaciation*, Vol. K-3, edited by William F. Ruddiman and H. E. Wright, Jr, pp. 277-289. Geological Society of America, Boulder, Colorado.
- Jefferies, Richard W.
1995 Late Middle Archaic Exchange and Interaction in the North American Midcontinent. In *Native American Interaction: Multiscalar Analysis and Interpretations in the Eastern Woodlands*, edited by Michael S. Nassaney and Kenneth E. Sassaman, pp. 73-100. The University of Tennessee Press, Knoxville.

1996 The Emergence of Long Distance Trade Network. In *Archaeology of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp. 222-235. University of Florida, Gainesville.

1997 Middle Archaic Bone Pins: Evidence of Mid-Holocene Regional-Scale Social Groups in the Southern Midwest. *American Antiquity* 62(3):464-487.

- Johannessen, Sissel
1988 Plant Remains and Culture Change: Are Paleoethnobotanical Data Better Than We Think? In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, edited by Christine A. Hastorf and Virginia S. Popper, pp. 145-166. Prehistoric Archaeology and Ecology Series. University of Chicago Press, Chicago.
- Johnson, Hunter B., and Scott C. Meeks
1994 Source Areas and Prehistoric Use of Fort Payne Chert. *Journal of Alabama Archaeology* 40(1 and 2):66-79.
- Johnson, Jay K., and Samuel O. Brookes
1989 Benton Points, Turkey Tails and Cache Blades: Middle Archaic Exchange in the Southeast. *Southeastern Archaeology* 8:134-145.
- Johnson, Gregory A.
1977 Aspects of Regional Analysis in Archaeology. *Annual Review of Anthropology* 6:479-508.
- Kaplan, Hillard, and Kim Hill
1992 The Evolutionary Ecology of Food Acquisition. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder, pp. 167-201. Aldine De Gruyter, New York.
- Kavasch, E. Barrie
2005 *Native Harvests: American Indian Wild Foods and Recipes*. Dover Publications, Mineola.
- Kelly, Dave
1994 The Evolutionary Ecology of Mast Seeding. *Trends in Ecology and Evolution* 9(12):465-470.
- Kelly, Robert L.
1992 Mobility/Sedentism: Concepts, Archaeological Measures, and Effects. *Annual Review of Anthropology* 21:43-66.
2007 *The Foraging Spectrum: Diversity in Hunter Gatherer Lifeways*. 2nd ed. Percheron Press, New York.
- Kidder, T.R, and Kenneth E. Sassaman
2009 The View from the Southeast. In *Archaic Societies: Diversity and Complexity across the Midcontinent*. Edited by Thomas E. Emersom, Dale L. McGrath, and Andrew C. Fortier. pp.667-697.

- King, Frances B.
 1985 Early Cultivated Cucurbits in Eastern North America. In *Prehistoric Food Production in North America*, edited by Richard I. Ford, pp. 73-97. Museum of Anthropology, University of Michigan, Ann Arbor, Michigan.
- Klippel, Walter E., and Paul M. Parmalee
 1974 Freshwater Mussels as a Prehistoric Food Source. *American Antiquity* 39(3):421-434.
 1982 Diachronic Variation in Insectivores from Cheek Bend Cave and Environmental Change in the Midsouth. *Paleobiology* 8(4):447-458.
- Klippel, Walter E., and Darcy F. Morey
 1986 Contextual and Nutritional Analysis of Freshwater Gastropods from Middle Archaic Deposits at the Hayes Site, Middle Tennessee. *American Antiquity* 51(4):799-813.
- Koenig, Walter D., and Johannes M. H. Knops
 2000 Patterns of Annual Seed Production by Northern Hemisphere Trees: A Global Perspective. *The American Naturalist* 155(1):59-69.
 2005 The Mystery of Masting in Trees. *American Scientist* 93(July-August):340-347.
- Kuhn, Steven L.
 1992 On Planning and Curated Technologies in the Middle Paleolithic. *Journal of Anthropological Research* 48(3):185-214.
 1994 A Formal Approach to the Design and Assembly of Mobile Toolkits. *American Antiquity* 59(3):426-442.
- Lewis, T. M. N., and Madeline Kneberg
 1959 The Archaic Culture in the Middle South. *American Antiquity* 25(2):161-183.
- Lopinot, Neal H.
 1982 The Carrier Archaeological Project: An Introduction. In *The Carrier Mills Archaeological Project: Human Adaptation in the Saline Valley*, Illinois, edited by Richard W. Jefferies and Brian M. Butler, Southern Illinois University Center for Archaeological Investigations, Research Paper 33.
 1984 Archaeobotanical Formation Processes and Late Archaic Human-Plant Interrelationships in the Midcontinental U.S.A., Ph.D. dissertation, Department of Anthropology, Southern Illinois University, Carbondale. University Microfilms, Ann Arbor.
- MacArthur Robert H., and Eric R. Pianka
 1996 On Optimal Use of a Patchy Environment. *The American Naturalist* 100(916):603-609.

- McKone, Mark, Dave Kelly and William G. Lee
1998 Effect of Climate Change on Mast-Seeding Species: Frequency of Mass Flowering and Escape from Specialist Insect Seed Predators. *Global Change Biology* 4:591-596.
- Meeks, Scott C.
1994 Lithic Artifacts from Dust Cave. *Journal of Alabama Archaeology* 40(1-2):79-106
1998 The Use and Function of Late Middle Archaic Projectile Points in the Midsouth, University of Alabama.
- Meyer, Catherine C.
1995 *Cultural Resources in the Pickwick Basin*. The University of Alabama Alabama Museum of Natural History Division of Archaeology. Report of Investigations 75.
- Miksicek, Charles H.
1987 Formation Processes of the Archaeobotanical Record. *Advances in Archaeological Method and Theory* 10:211-247.
- Minnis, Paul E.
2003 Prehistoric Ethnobotany. In *People and Plants of Ancient Eastern North America*, edited by Paul E. Minnis, pp. 1-17. Smithsonian Books, Washington.
- Moerman, Daniel E.
1986 *Medicinal Plants of Native America*. Research Reports in Ethnobotany, Contribution 2 1. University of Michigan Museum of Anthropology Technical Reports, Number 19, Ann Arbor.
1998 *Native American Ethnobotany*. Timber Press, Portland.
- Munson, Patrick J.
1984 Comments on Some Additional Species, and Summary of Seasonality. In *Experiments and Observations on Aboriginal Wild Plants Food Utilization in Eastern North America*, edited by Paul J. Munson, pp. 459-473. Prehistory Research Series Vol. 6, no. 2. Indiana Historical Society, Indianapolis.
1986 Hickory Silviculture: A Subsistence Revolution in the Prehistory of Eastern North America. Emergent Horticultural Economies of the Eastern Woodlands Conference. Southern Illinois University, Carbondale.
- Munson, Patrick J., Paul W. Parmalee, and Richard A. Yarnell
1971 Subsistence Ecology of Scovill, a Terminal Middle Woodland Village. *American Antiquity* 36(4):410-431.
- Parmalee, Paul W.
1994 Freshwater Mussels from Dust Cave and Smith Bottom Caves. *Alabama. Journal of Alabama Archaeology* 40(1 and 2):135-163.

- Parmalee, Paul W., and Walter E. Klippel
1981 Remains of the Wood Turtle *Clemmys insculpta* (Le Conte) from a Late Pleistocene Deposit in Middle Tennessee. *American Midland Naturalist* 105(2):413-416.
- Pearsall, Deborah M.
2000 *Paleoethnobotany: A Handbook of Procedures*. Academic Press Inc, San Diego.
- Pearson, Mike Parker
1999 *The Archaeology of Death and Burial*. Texas A&M University Press, College Station.
- Petruso Karl M., and Jere M. Wickens
1984 The Acorn in Aboriginal Subsistence in Eastern North America: A Report on Miscellaneous Experiments. In *Experiments and Observations on Aboriginal Wild Plant Food Utilization in Eastern North America*, edited by P. Munson, pp. 360-378. Prehistory Research Series Vol. 6, no. 2. Indiana Historical Society, Indianapolis.
- Prentice, Colin I., and Patrick J. Bartlein, Thompson Webb III
1991 Vegetation and Climate Change in Eastern North America since the Last Glacial Maximum. *Ecology* 72(6):2038-2056.
- Popper, Virginia S.
1988 Selecting Quantitative Measurements in Paleoethnobotany. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, edited by Christine A. Hastorf and Virginia S. Popper, pp. 53-71. University of Chicago Press, Chicago.
- Popper, Virginia S. and Christine A. Hastorf
1988 Introduction. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, edited by Christine A. Hastorf and Virginia S. Popper, pp. 1-17. University of Chicago Press, Chicago and London.
- Pyke, Graham H.
1984 Optimal Foraging Theory: A Critical Review. *Annual Review of Ecology and Systematics* 15:523-575.
- Pyke, G. H., H. R. Pulliam, and E. L. Charnov
1977 Optimal Foraging: A Selective Review of Theory and Tests. *The Quarterly Review of Biology* 52(2):137-154.
- Radford, Albert E., Harry E. Ahles, and C. Ritchie Bell
1964 *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, Chapel Hill.

Randall, Asa R.

2001 Untangling Late Paleoindian and Early Side-Notched Stone Tool Assemblages at Dust Cave, Alabama. Paper presented at the 58th Annual Southeastern Archaeological Conference, Chattanooga.

2003 Archaic Technological Practice at Dust Cave, Alabama. Paper presented at the 60th Annual Southeastern Archaeological Conference, Charlotte, North Carolina.

Reidhead, Van A.

1981 *A Linear Programming Model of Prehistoric Subsistence Optimization: A Southeastern Indiana Example*. Prehistory Research Series, Volume 6, No. 1. Indiana Historical Society, Indianapolis.

Russo, Michael

1996 Southeastern Shell Mounds. In *Archaeology of the Mid-Holocene Southeast*, edited by K. E. Sassaman, a. D. G. Anderson, pp. 259-228. University of Florida, Gainesville.

Sassaman, Kenneth E.

1995 The Cultural Diversity of Interactions among Mid-Holocene Societies of the American Southeast. In *Native American Interaction: Multiscalar Analysis and Interpretations in the Eastern Woodlands*, edited by Michael S. Nassaney and Kenneth E. Sassaman, pp. 174-205. University of Tennessee Press, Knoxville.

2005 Structure and Practice in the American Southeast. In *North American Archaeology*, edited by Timothy R. Pauketat and Diana DiPaolo Loren, pp. 79-107. Blackwell Studies in Global Archaeology. Blackwell Publishing, Malden, Massachusetts.

Satake, Akiko, and Yoh Iwasa,

2002 The Synchronized and Intermittent Reproduction of Forest Trees is Mediated by the Moran Effect, Only in Association with Pollen Coupling. *Journal of Ecology* 90:830-838.

Scarry, C. Margaret

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

2003 Patterns of Wild Plant Utilization in the Prehistoric Eastern Woodlands. In *People and Plants in Ancient Eastern North America*, edited by Paul E. Minnis, pp. 50-104. Smithsonian Books, Washington.

Schauber, E. M., D. Kelly, P. Turchin, C. Simon, W. G. Lee, R. B. Allen, I. J. Payton, P. R. Wilson, P. E. Cowan and R. E. Brockie

2002 Masting by Eighteen New Zealand Plant Species: The Role of Temperature as a Synchronizing Cue. *Ecology* 83(5):1214-1225.

- Schopmeyer, C.S. (editor)
1974 *Seeds of Woody Plants in the United States*. Forest Service, U.S Department of Agriculture Agricultural Handbook No. 450, Washington D.C.
- Schott, Michael
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Anthropological Research* 42(1):15-51.
- Schuldenrein, Joseph
1996 Geoarchaeology and the Mid-Holocene Landscape History of the Greater Southeast. In *Archaeology of the Mid-Holocene Southeast*, edited by K. E. S. a. D. G. Anderson, pp. 1-28. University of Florida Press, Gainesville.
- Shennan, Stephen
2002 Archaeology and Evolutionary Ecology. *World Archaeology* 34(1):1-5.
- Sherwood, Sarah C., and Jefferson Chapman
2005 The Identification and Potential Significance of Early Holocene Prepared Clay Surfaces: Examples from Dust Cave and Icehouse Bottom. *Southeastern Archaeology* 24(1):70-82.
- Sherwood, Sarah C., Boyce N. Driskell, Asa R. Randall, and Scott C. Meeks
2004 Chronology and Stratigraphy at Dust Cave, Alabama. *American Antiquity* 69(3):533-554.
- Shettleworth, Sara J.
1984 Learning and Behavioral Ecology. In *Behavioral Ecology: An Evolutionary Approach*, 2nd ed., edited by J. R. Krebs and N. B. Davies, pp. 170-196. Sinauer Associates Inc, Publishers, Sunderland, Massachusetts.
- Shields, Ben M.
2003 An Analysis of the Archaic Human Burials at the Mulberry Creek (1CT27) Shell Mound, Colbert County, Alabama. Unpublished Master's thesis, Department of Anthropology, University of Alabama, Tuscaloosa.
- Smith, Bruce D.
1986 The Archaeology of the Southeastern United States: From Dalton to de Soto, 10,500-500 BP. *Advance in World Archaeology* 5:1-92.
1989 Origins of Agriculture in Eastern North America. *Science* 246(4937):1566-1571.
1993 Prehistoric Plant Husbandry in Eastern North America. In *The Origins of Agriculture: An International Perspective*, edited by C. Wesley Cowan. and Patty Jo Watson, pp. 101-120. Smithsonian Institution Press, Washington.
1997 The Initial Domestication of *Cucurbita pepo* in the Americas 10,000 Years Ago. *Science* 276(5314):932-934.

- 2006 Eastern North America as an Independent Center of Plant Domestication. *Proceedings of the National Academy of Sciences of the United States of America* 103(33):12223-12228.
- Smith, Eric A., and Bruce Winterhalder
1992 Evolutionary Ecology and the Social Sciences. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder Aldine De Gruyter, New York.
- Smith, Monica L.
2007 Territories, Corridors, and Networks: A Biological Model for the Premodern State. *Complexity* 12(4):28-35.
- Sork, Victoria L.
1983 Mast-fruiting in Hickories and Availability of Nuts. *The American Midland Naturalist* 109(1):81-88.
- Speth, John D.
1990 Seasonality, Resource Stress, and Food Sharing in So-Called "Egalitarian Foraging Societies." *Journal of Anthropological Archaeology* 9:148-188.
- Speth, John D., and Katherine A. Spielmann
1983 Energy Source, Protein Metabolism and Hunter-Gatherer Subsistence Strategies. *Journal of Anthropological Archaeology* 2:1-31.
- Stafford, C. Russell
1991 Archaic Period Logistical Foraging Strategies in West-Central Illinois. *Midcontinental Journal of Archaeology* 16(2):212-246.
1994 Structural Changes in Archaic Landscape Use in the Dissected Uplands of Southwestern Indiana. *American Antiquity* 59(2):219-237.
- Stephens, David W., and John R. Krebs
1986 *Foraging Theory*. Princeton University Press, Princeton.
- Steponaitis, Vincas P.
1986 Prehistoric Archaeology in the Southeastern United States, 1970-1985. *Annual Review of Anthropology* 15:363-404.
- Stepp, John R., and Daniel E. Moerman
2001 The Importance of Weeds in Ethnopharmacology. *Journal of Ethnopharmacology* 75:19-23.

- Struever, Stuart
1968 Flotation Techniques for the Recovery of Small-Scale Archaeological Remains. *American Antiquity* 33:353-362.
- Styles ,Bonnie W., and Walter E. Klippel
1996 Mid-Holocene Faunal Exploitation in the Southeastern United States. In *Archaeology of the Mid-Holocene Southeast*, edited by Kenneth E. Sassaman and David G. Anderson, pp. 115-133. University of Florida Press, Gainesville.
- Swanton, John R.
1946 *The Indians of the Southeastern United States*. Bureau of American Ethnology, Bulletin 137. Smithsonian Institution, Washington, D.C.
- Talalay, Laurie, Donald R. Keller, and Patrick J. Munson
1984 Hickory Nuts, Walnuts, Butternuts, and Hazelnuts: Observations and Experiments Relevant to Their Aboriginal Exploitation in Eastern North America. In *Experiments and Observations on Aboriginal Wild Plant Food Utilization in Eastern North America*, edited by Patrick J. Munson, pp. 338-359. Prehistory Research Series Vol. 6, no. 2. Indiana Historical Society, Indianapolis.
- Thomas, David Hurst
2009 Native American Landscapes of St. Catherines Island, Georgia. Part 1. The Theoretical Framework. American Museum of Natural History, Anthropological papers, Number 88. Pp166-174.
- Tomikel, John
1976 *Edible Wild Plants of Eastern United States and Canada*. Allegheny Press, California, Pennsylvania.
- Turner, James Harvey
2006 An Investigation of Violence-Related Trauma at Two Sites in the Pickwick Basin: Dust Cave (1LU46) and the O'Neal Site (1LU61). Unpublished Master's thesis, Department of Sociology, Anthropology, and Social Work, Mississippi State University, Starkville.
- U.S. Department of Agriculture, Forest Service
1965 *Silvics of Forest Trees of the United States*. Compiled and revised by H. A. Fowells. Agricultural Handbook Number 271. Division of Timber Research, United States Forest Service, Washington D.C.
- Viau, A.E., K. Gajewski, M.C. Sawada, and P. Fines
2006 Millennial-Scale Temperature Variation in North America during the Holocene. *Journal of Geophysical Research*, Vol 111.

- Wagner, Gail E.
1988 Comparability among Recovery Techniques. In *Current Paleoethnobotany*, edited by Christine A. Hastorf and Virginia S. Popper, pp. 17-35. University of Chicago Press, Chicago.
- Wainio, Walter W.
1941 The Chemical Composition of Forest Fruits and Nuts from Pennsylvania. *Journal of Agricultural Research* 62(10):627-635.
- Walker, Renee Beauchamp
1998 The Late Paleoindian through Middle Archaic Faunal Evidence From Dust Cave, Alabama. Unpublished Ph.D. dissertation, Department of Anthropology, University of Tennessee, Knoxville.
- Walker, Renee B., Kandace R. Detwiler, Scott C. Meeks, and Boyce N. Driskell
2001 Berries, Bones, and Blades: Reconstructing Late Paleoindian Subsistence Economy at Dust Cave, Alabama. *Midcontinental Journal of Archaeology* 26(2):169-197.
- Walthall, John A.
1980 *Prehistoric Indians of the Southeast: Archaeology of Alabama and the Middle South*. University of Alabama Press, Tuscaloosa.
1998 Rockshelters and Hunter-Gatherer Adaptation to the Pleistocene/Holocene Transition. *American Antiquity* 63(2):223-238.
- Watson, Patty Jo
1976 In pursuit of prehistoric subsistence: A comparative account of some contemporary flotation techniques. *Mid-Continental Journal of Archaeology* 1(1):77-100.
- Winterhalder, Bruce
1981 Optimal Foraging Strategies and Hunter Gatherer Research in Anthropology: Theory and Models. In *Hunter-Gatherer Foraging Strategies: Ethnographic and Archaeological Analyses*, edited by Bruce Winterhalder and Eric Alden Smith, pp. 13-36. University of Chicago Press, Chicago.
1983 Opportunity-Cost Foraging Models for Stationary and Mobile Predators. *The American Naturalist* 122(1):73-84.
2001 The Behavioral Ecology of Hunter-Gatherers. In *Hunter-Gatherers: An Interdisciplinary Perspective*, edited by Catherine Panter-Brick, Robert H. Layton, and Peter Rowley-Conwy, pp. 12-35. Cambridge University Press, New York.
- Winterhalder, Bruce and Carol Goland
1997 An Evolutionary Ecology Perspective on Diet Choice, Risk, and Plant Domestication. In *People, Plants and Landscapes: Studies in Paleoethnobotany*, edited by Kristen J. Gremillion, pp. 123-160. University of Alabama Press, Tuscaloosa.

Winterhalder, Bruce and Smith Eric A.

1981 New Perspectives on Hunter Gatherer Socioecology. In *Hunter Gatherer Foraging Strategies*, edited by Bruce Winterhalder and Eric Alden Smith. University of Chicago Press, Chicago.

Winterhalder, Bruce and Eric Alden Smith

1992 Evolutionary Ecology and the Social Sciences. In *Evolutionary Ecology and Human Behavior*, edited by Eric Alden Smith and Bruce Winterhalder, pp. 3-24. Aldine de Gruyter, New York.

Wobst, Martin H.

1974 Boundary Systems for Paleolithic Social Systems: A Simulation Approach. *American Antiquity* 39(2):147-148.

Wright, H.E., Jr.

1986 *The Quaternary*. Geological Society of America Inc, Boulder, CO.

1991 Environmental Conditions for Paleoindian Immigration. In *The First Americans: Search and Research*, edited by T. D. D. a. D. J. Meltzer. CRC Press, Boca Raton.

Yarnell, Richard A. and M. Jean Black

1985 Temporal Trends Indicated by a Survey of Archaic and Woodland Plant Food Remains from Southeastern North America. *Southeastern Archaeology* 4(2):93-106.

Young, Cheryl G and James A. Young

1992 *Seeds of Woody Plants in North America*. Dioscorides Press, Portland.

Appendix

A.1: Botanical Remains Recovered from Dust Cave Middle Archaic Column Samples (weights in grams).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
2182	N61W65	5	140	7	D3	1.87	5.82	Hickory	475	3.86
								Acorn	5	0.01
									16(1.4)	0.04
								Acorn Meat	11	0.03
								Pitch	3	0.01
								Unid'd	1	
2077	N61W65	6	145	10	D3	4.92	22.93	Hickory	1950	17.92
								Acorn	8	0.06
									2(1.4)	0
								Hackberry	1	0.01
									2(1.4)	0.02
								Pitch	1	0
								Cucubita cf	1	0

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
2092	N61W65	7	150	10	D3	2.49	13.01	Hickory	919	10.37
								Acorn	5	0.02
									5(1.4)	0.02
								Hackberry	6	0.02
								Pitch	14	0.08
2127	N61W65	8	155	8	D3	3.25	5.89	Hickory	231	2.57
								Acorn	5	0.02
									7(1.4)	0.02
								Hackberry	2	0.02
								Pitch	3	0.01
2138	N61W65	9	160	8	D4	2.73	7.96	Hickory	482	5.12
								Acorn	16	0.09
									16(1.4)	0.2
								Hackberry	2	0
2153	N61W65	10	165	10	D4b	2.05	3.23	Hickory	129	1.15

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
2167	N61W65	11	170	8.5	D4b	1.84	10.28	Acorn	3	0.01
									7(1.4)	0.01
								Hackberry	1	0.01
								Hickory	855	8.41
								Acorn	10	0.03
2196	N61W65	12	175	2	D4c	0.27	1.15		6(1.4)	0
								Hackberry	1	0
								Unid'd	8	0
								Hickory	61	0.88
								Acorn	2(0.07)	0
2425	N62W65	13	180	9	E2	5.27	23.09	Seed grass family cf	1(pan)	0
								Unid'd	2	0
								Hickory	1422	17.76
								Acorn	6	0.02
									3(1.4)	0.01

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
2701	N61W65	14	185	2	E5	1.73	3.66	Hickory	143	1.47
								Acorn	6	0.04
									2(1.4)	0.01
								Hackberry	1	0.01
								Bark	7	0.02
								Unid'able	16	0.08
2614	N60W65	15	190	10	E5	0.14	7.72	Hickory	566	7.55
								Acorn	1	0
									3(1.4)	0
								Hackberry	1	0
								Unid'd	5	0.03
2725	N60W65	16	195	10	E8	2.59	32.26	Hickory	1861	29.07
								Acorn	38	0.09
								Hackberry	22	0.16

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
------	------	-------	-------	--------	------	---------	----------	-------	-------	--------

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

2792	N60W65	17	200	8	E8	0.54	3.57	Pitch	3	0.01
								Unid'able	41	0.28
								Nutmeats?	4	0
								Hickory	271	2.79
								Acorn	11	0.05
									45(1.4)	0.09
								Acorn Cap	1(1.4)	
								Hackberry	2	0.1
2810	N60W65	18	205	10	E8a	0.4	2.37	Unid'd	2	0
								Hickory	139	1.05
								Acorn	8	0.01
								Hackberry	132	0.87
								Persimmon cf	2	0
								Sumac cf	1	0
								Pine Seed	1	0
								Unid'd seed	3	0
								Unid'd	10	0.03

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
------	------	-------	-------	--------	------	---------	----------	-------	-------	--------

								Uncarb. Material		1.3
								Nutmeat	1	0
2826	N60W65	19	210	4	E8	0.78	2.93	Hickory	323	2.02
								Acorn	2	0
								Hackberry	7	0.1
									6(1.4)	0.03
2864	N60W65	20	215	11	J1	1.22	8.71	Hickory	541	6
								Acorn	34	0.06
								Hackberry	183	1.19
								Unid'd seed	3	0
								Unid'able	34	0.24
								Purslane	1	0
								Poke seed coat	2	0
								uncarb. Material		1.74
2885	N60W65	21	220	1.5	J1	0.09	3.32	Hickory	448	2.87
								Acorn	1	0
									11(1.4)	0.04
								Hackberry	19	0.28
									21(1.4)	0.04
								Unid'd	6	0
2892	N60W65	22	225	2.5	J3	0.35	7.78	Hickory	412	6.5
								Acorn	11	0.02
								Hackberry	89	0.83
								Persimmon	2	0.02
								Persimmon cf	6	0.03

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
------	------	-------	-------	--------	------	---------	----------	-------	-------	--------

								Unid'able	2	0.03
								Unid'd seed frag	4	0
								uncarb. Material		1.27
2928	N60W65	23	230	10	J3a	0.07	2.3	Hickory	159	1.38
								Acorn	4	0
								Hackberry	134	0.81
								Unid'able seed	2	0
								Unid'able	8	0.01
								Nutmeats	9	0.03
								uncarb. Material		1.73
2950	N59W65	24	235	12.5	J3a	0.06	0.42	Hickory	12	0.05
								Acorn	2	0.01
								Hackberry	9	0.24
									17(1.4)	0.06
2957	N59W65	25	240	10	K1	0.01	0.25	Hickory	28	0.24
								Hackberry	1	
								Acorn(.71)	1	
3010	N60W65	26	245	8	K2	0.01	0.2	Hickory	11	0.13
								Hackberry	11	0.06
								uncarb material		0.06
3034	N60W65	27	250	7.5	K2	0.01	0.08	Hickory	4	0.03
								Acorn	1(1.4)	0.01
									1(.71)	0

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
------	------	-------	-------	--------	------	---------	----------	-------	-------	--------

								Acorn	116	0.22
								Hackberry	34	0.17
								Unid'able	12	0.1
								Unid'able seed coat	2	0
								Nutmeats	12	0.06
								Persimmon	2	0.01
								uncarb material		0.25
3060	N60W65	29	260	10	K2	0.29	0.62	Hickory	38	0.25
								Acorn	2	0.01
									1(.71)	0
								Acorn Meat cf	5	0.04
								Hackberry	1	
								Unid'able	4	0.03
3081	N60W65	30	265	10	K7	3.07	34.44	Hickory	2136	30.66
								Acorn	56	0.09
								Hackberry	86	0.48
								Grape	7	0.01
								Sumac	1	0
								Persimmon	1	0
								Pitch	2	0.04
								Unid'able	29	0.16
								Unid'd	9	0.03
								Ashywood	1	0
								Hickory nutmeat	1	0
								Uncarb material		0.41
4819	N60W65	31	270	12	K7	1.35	2.91	Hickory	222	1.48
								Acorn	1	
								Hackberry	4	0.08

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
								Acorn	5	0
								Hackberry	8	0.03
								Unid'able	6	0.03
								Unid'able seed frags	3	0
								uncarb material		0.05
4910	N60W65	33	280	1.3	N8	0.02	0.12	Hickory	11	0.09
								Hackberry	2	0.01
								Pitch	1	0
4967	N60W65	34	285	8	N8	1.37	2.96	Hickory	124	1.5
								Acorn	3	0.01
								Hackberry	7	0.07
								Sumac	1	
								Unid'able	4	0.01
4997	N60W65	35	290	3	N7a	1.62	3.54	Hickory	178	1.57
								Acorn	8(1.4)	0.02
									2(.71)	0
								Acorn meat cf	6	0.02
								Pitch	1	0.31
5009	N60W65	36	295	5	N7a	0.91	4.3	Hickory	255	3.32
								Acorn	3	0.01
								Hackberry	5	0.03
								unid'able	7	0.03

A.1: Table shows botanical remains recovered from Dust Cave Middle Archaic column samples(cont).

Bag#	Unit	Level	Depth	Volume	Zone	Wood Wt	Plant Wt	Other	Count	Weight
------	------	-------	-------	--------	------	---------	----------	-------	-------	--------

5047	N60W65	37	300	3	N7a	1.78	7.11	Hickory	989	5.32
								Acorn	4	0.01
									2(1.4)	
								Hackberry	1	
								Pitch	5	0
								unidable	2	0

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
507	N60W64	4	140	41	CC/Ash Pit -	12	1.89	2.12	Hickory	26	0.23
2302	N59W65	8	172	47	Hearth	3	2.58	4.02	Hickory	191	1.42
									Acorn	5	0
										4(1.4)	0
									Hackberry	2	0.01
									Pitch	1	0.01
2099	N59W65	8	155	121	Hearth	19	6.96	9.57	Hickory	326	2.59
									Acorn	9	0.02

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
										2(1.4)	0
									Hackberry	1	
2440	N60W65	11	170	136	Hearth	5.5	18.56	32.01	Hickory	1375	13.43
									Acorn	3	0.01
									Persimmon	1	0.01
									Pitch	2	0
2462	N59W65	11	170	137	CC Pit / Hea	1.5	0.44	1.13	Hickory	94	0.69
									Acorn (.07)	1	0
									Cucurbita Rind Cf	1	0
2407	N62W65	12	175	123	CC/Ash Pit -	5	3.76	6.82	Hickory	367	2.95
									Acorn	13	0.04

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
										10(1.4)	0.02
									Hackberry	4	0.05
2894	N61W62	16	195	178		7	8.36	37.41	Hickory	658	27.23
									Acorn	7	0.03
										11(1.4)	0.02
									Acorn Meat	9	0.02
									Hackberry	83	1.41
										61(1.4)	0.25
									Unid'd	3	0.1
3981	N61W62	22	225	282	CC Pit	1	1.41	2.13	Hickory	42	0.69
									Acorn	2(1.4)	0.01
										1(.07)	0
									Hackberry	1	0.02

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
3913	N62W62	23	230	274	CC Pit / Hea	5	1.22	3.56	Hickory	174	2.17
									Acorn	5(.07)	0
									Hackberry	1(1.4)	0
									Pitch	7	0.17
3687	N59W66	24	235	190	CC Pit / Hea	1.5	0.6	1.71	Hickory	77	1.04
									Acorn	3(1.4)	0.01
										26(0.07)	0.02
									Hackberry	2	0.04
3586	N61W66	24	250	231		1.9	1.73	3.48	Hickory	130	1.67
									Acorn	17	0.05

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
------	------	------	-------	---------	------	------	------------	-------------	-------	-------	-----

										21(1.4)	0.03
									Unid'd	1	0
3623	N61W66	25	255	236		4.25	0.94	1.95	Hickory	69	0.95
									Acorn	5	0
										39(1.4)	0.03
									Hackberry	4	0.03
									Bedstraw	1(.07)	
2986	N60W65	25	240	194	CC Pit	5	6.92	19.8	Hickory	1062	12.57
									Acorn	3(1.4)	0.01
										1(0.07)	0
									Hackberry	18	0.23
										20(1.4)	0.07

A.2: Table shows botanical remains recovered from Dust Cave Middle Archaic feature samples (cont).

Bag#	Unit	Lvl.	Depth	Feature	Type	Vol.	Wood Wt(g)	Plant Wt(g)	Other	Count	Wt.
									Acorn	7	0.01
										8(1.4)	0.03

									Hackberry	9	0.19
4379	N62W61	35	245	328	Pit	6	1.55	3.25	Hickory	169	1.64
									Acorn	3	0.01
										3(1.4)	0
									Hackberry	4	0.05
									Unid'd	4	0

A.3: Artifacts recovered from Dust Cave Middle Archaic Column samples (cont).

Bag#	Unit	Level	Depth	Volume	Zone	Shell Wt	Lithics Ct	Lithics Wt	Bone Ct	Bone Wt
				(l)		(g)		(g)		(g)
2182	N61W65	5	140	7	D3	22.39	36	4.09	122	7.12
2077	N61W65	6	145	10	D3	53.94	39	26.52	335	21.39
2092	N61W65	7	150	10	D3	43.31	42	16.96	221	19.63
2127	N61W65	8	155	8	D3	32.15	20	1.4	100	4.32
2138	N61W65	9	160	8	D4	26.66	22	5.92	70	8.59
2153	N61W65	10	165	10	D4b	57.45	14	16.95	81	5.01
2167	N61W65	11	170	8.5	D4b	59.36	27	8.42	141	6.26
2196	N61W65	12	175	2	D4c	13.04	9	5.31	37	1.36
2425	N62W65	13	180	9	E2	22.15	18	44.43	68	3.1

A.3: Artifacts recovered from Dust Cave Middle Archaic Column samples (cont).

Bag#	Unit	Level	Depth	Volume	Zone	Shell Wt	Lithics Ct	Lithics Wt	Bone Ct	Bone Wt
				(l)		(g)		(g)		(g)
2614	N60W65	15	190	10	E5	9.12	21	0.77	43	2.69
2725	N60W65	16	195	10	E8	96.56	102	41.62	370	7.97
2792	N60W65	17	200	8	E8	8.17	24	1.39	29	1.03
2810	N60W65	18	205	10	E8a	135.34	437	138.95	304	17.7
2826	N60W65	19	210	4	E8	8.52	142	24.6	199	19.35
2864	N60W65	20	215	11	J1	86.05	498	55.9	614	19.21
2885	N60W65	21	220	1.5	J1	31.41	7	4.45	178	6.84
2892	N60W65	22	225	2.5	J3	51.97	97	56.81	195	5.5
2928	N60W65	23	230	10	J3a	38.02	310	17.89	674	11.59
2950	N59W65	24	235	12.5	J3a	9.56	20	33.25	131	3.92

A.3: Artifacts recovered from Dust Cave Middle Archaic Column samples (cont).

Bag#	Unit	Level	Depth	Volume	Zone	Shell Wt	Lithics Ct	Lithics Wt	Bone Ct	Bone Wt
2957	N59W65	25	240	10	K1	1.53	35	3.14	210	9.94
3010	N60W65	26	245	8	K2	21.47	138	8.48	529	13.08
3034	N60W65	27	250	7.5	K2	3.43	19	3.98	169	5.2
3013	N60W65	28	255	7	K3	33.4	69	19.35	191	9.04
3060	N60W65	29	260	10	K2	1.33	3	18.64	20	3.23
3081	N60W65	30	265	10	K7	60.71	83	5.73	586	17.42
4819	N60W65	31	270	12	K7	7.87	5	0.75	51	1.37
4833	N60W65	32	275	1	K9	4.13	8	0.39	66	1.41
4910	N60W65	33	280	1.3	N8	0.43	9	1.6	9	2.4
4967	N60W65	34	285	8	N8	11.2	20	10.35	119	3.27
4997	N60W65	35	290	3	N7a	0.71	9	1.27	56	1.79

A.3: Artifacts recovered from Dust Cave Middle Archaic Column samples (cont).

Bag#	Unit	Level	Depth	Volume	Zone	Shell Wt	Lithics Ct	Lithics Wt	Bone Ct	Bone Wt
5047	N60W65	37	300	3	N7a	36.94	24	16.23	160	5.38

A.4: Artifacts Data from Middle Archaic Feature Samples

Bag#	Unit	Level	Depth	Feature#	Type	Volume	Shell Wt	LithicsCt	LithicsWt	BoneCt	BoneWt
						(l)	(g)		(g)		(g)
507	N60W64	4	140	41	CC/Ash Pit -	12	1.17	1	0.57	28	0.46
2302	N59W65	8	172	47	Hearth	3	9.09	5	0.25	55	3.06
2099	N59W65	8	155	121	Hearth	19	52.81	11	51.54	129	35.07
2440	N60W65	11	170	136	Hearth	5.5	16.15	14	7.35	76	3.45
2462	N59W65	11	170	137	CC Pit / Hea	1.5	2.77	11	6.62	23	0.98
2407	N62W65	12	175	123	CC/Ash Pit -	5	32.76	46	8.92	93	13.27
2894	N61W62	16	195	178		7	160.83	467	184.04	543	22.52
3981	N61W62	22	225	282	CC Pit	1	5.1	9	0.35	19	0.66
3913	N62W62	23	230	274	CC Pit / Hea	5	17.5	64	7.13	71	7.35

A.4: Artifacts Data from Middle Archaic Feature Samples (cont).

Bag#	Unit	Level	Depth	Feature#	Type	Volume	ShellWt	LithicsCt	LithicsWt	BoneCt	BoneWt
------	------	-------	-------	----------	------	--------	---------	-----------	-----------	--------	--------

3687	N59W66	24	235	190	CC Pit / Hea	1.5	3.63	29	1.79	62	3.02
3586	N61W66	24	250	231		1.9	3.47	8	0.72	81	10.42
3623	N61W66	25	255	236		4.25	6.46		2.82		7.2
2986	N60W65	25	240	194	CC Pit	5	57.89	56	16.44	228	8.3
3943	N60W62	32	230	275		5	11.03	62	16.43	187	4.89
4379	N62W61	35	245	328	Pit	6	50.97		2.47		6.16

Vita

Stephen Carmody was born in Shreveport, LA on November 26, 1974. In 2006, he received a B. S. in Anthropology with a minor in archaeology from the College of Charleston, in South Carolina. He entered the graduate program at the University of Tennessee, Knoxville in the fall of 2006 where he received his M.A. in Anthropology. Stephen is currently pursuing his doctorate in anthropology at the University of Tennessee, Knoxville.