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The University of Michigan PH.D. 1986

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CHANGE IN PLANT PROCUREMENT AND PRODUCTION DURING THE EMERGENCE OF THE MOUNDVILLE CHIEFDOM

by

Clara Margaret Scarry

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Anthropology)
in The University of Michigan
1986

Doctoral Committee:

Professor Richard I. Ford, Chairman
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Associate Professor Christopher S. Peebles, Indiana University
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For John and Clara JoAnn

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My study is part of a broad research program focused on the Moundville system. In 1977, Dr. Christopher S. Peebles invited me to combine my interests in Mississippian chiefdoms and archaeobotany by participating in the University of Michigan Museum of Anthropology (UMMA) Moundville project he was at that time designing. My part in the project was to be director of small-scale excavations at Moundville to recover subsistence remains. I accepted Chris's offer and have never regretted my decision. From the beginning the UMMA project has been a challenging and rewarding experience. I have benefited not only from the work and knowledge of my colleagues, but also from their friendship. It goes without saying that my study would not have been possible without the help of others. I want to take this opportunity, however, to thank the many people who helped me along the way.

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CHAPTER I

INTRODUCTION

Throughout most of the southeastern United States, Mississippian chiefdoms were the latest and most complex prehistoric societies. In the archaeological record, the emergence of Mississippian systems seems to mark the transition from subsistence strategies based on foraging/gardening to strategies in which field agriculture played a central role. The emergence of Mississippian systems also appears to coincide with the transition from egalitarian to hierarchically organized societies. Indeed, current constructs use dependence on maize agriculture and rank organization as major criteria for defining Mississippian systems (Griffin 1985:63; Peebles and Kus 1977:434; Smith 1978:486).

Explaining the development and operation of Mississippian societies has long been a preoccupation of archaeologists who deal with the late prehistory of the Southeast. Because the changes in subsistence economies and social organizations seem to co-occur, attempts to explain the emergence of Mississippian systems usually seek a link between dependence on agriculture and rank organization. In most cases (e.g., Ford 1974:405-408, 1977:180-182; Peebles and Kus 1977:443; Smith 1974:30), increased crop production is invoked as a causal variable that may have selected, directly or indirectly, for organizational change. Despite this widespread belief that changes in

subsistence economies played a key role in the emergence of Mississippian chiefdoms, our understanding of the changes in plant procurement and production strategies remains surprisingly general.

My research is designed to help remedy this situation by investigating changes in subsistence strategies within the context of a developing Mississippian system, the Moundville system of west-central Alabama. I examine changes in plant procurement and production that occur during the Late Woodland-Mississippian transition in that region, and address the role of agriculture as a selective factor in the emergence of the Moundville chiefdom. To accomplish this, I use archaeological, archaeobotanical, and ecological data to address questions about the timing and dependability of increased crop production and about changes in the procurement of wild plant resources. The focus on a single system helps me to control the effects of environmental variability, while I examine the evolution and organization of a Mississippian subsistence economy. Because this is the first systematic analysis of plant remains from Moundville and its precursors, the questions I ask are broad and relate to fundamental issues of subsistence change and stability. My immediate goal is to contribute to an explanation of the emergence and operation of the Moundville system by refining our information about its subsistence economy. Nevertheless, the results of my analyses have relevance to broader issues. The data from the Moundville system extend our knowledge about variability in Mississippian subsistence strategies. My analyses also contribute, in

a small way, to our understanding of the processes involved in subsistence change.

The format for my study is as follows. In Chapter II background information critical to an understanding of the general context of my study is presented. First, I summarize our knowledge about Late Woodland and Mississippian cultural systems. Next, I review the role assigned to increased crop production in several current models of Mississippian evolution, and discuss propositions about changes in plant procurement and production strategies. Then, I formulate the questions addressed by this study. In Chapter III, I present the study universe, the Moundville system located in the Black Warrior Valley of west-central Alabama. I define system boundaries and settlement types, and review the history of archaeological research in the Black Warrior Valley. Then, I describe changes in settlement patterns and social organizations during the Late Woodland West Jefferson and Mississippian Moundville I-III phases. In Chapter IV, I present the environmental setting of the Black Warrior Valley. First, I investigate the distribution and abundance of naturally occurring plant resources. To do this, I use early nineteenth-century land survey records to reconstruct forest communities. After discussing wild resource availability, I assess crop dependability by comparing the requirements of maize plants at different stages in their development to climatic variability in the Black Warrior Valley. In Chapter V, I describe the excavations at several West Jefferson sites and at Moundville that produced the data for this study. I also discuss the spatial, temporal, and social contexts of my samples. In

Chapter VI, I present the methods I used in this study. First, I review the effects of preservation and recovery biases on plant data. Next, I describe the procedures I followed to process and analyze my archaeobotanical samples. Then, I present a new approach to quantified analysis of plant data based on exploratory data analysis (Tukey 1977; Velleman and Hoaglin 1981). Finally, I describe the ways in which both archaeological contexts and plant taxa were combined to explore variability in the plant assemblage. In Chapters VII and VIII, I analyze the wood charcoal and plant food remains from the Black Warrior Valley. In each chapter, I analyze the plant remains from West Jefferson and Moundville contexts separately and together and use my results to address the questions formulated in Chapter II. In Chapter IX, I present a cluster analysis of maize cobs and discuss the results in terms of crop production strategies. In Chapter X, I summarize the results of my research, and place them in the broader context of our understanding about Mississippian developments in the Black Warrior Valley and other nearby regions. Finally, I present some speculations about the link between increased crop production and rank organization.

CHAPTER II

BACKGROUND AND PROBLEM FORMULATION

Mississippian societies left behind massive earthworks, exquisite ceramic vessels, elaborate copper and shell ornaments, and a host of more mundane artifacts. It was these material remains that first attracted attention and aroused the curiosity of scholars. Soon, however, archaeologists were also intrigued by more elusive aspects of these cultural systems. Their social and economic organizations have been the subject of almost as much study and speculation as their material remains. In fact, today, classifications and analyses of Mississippian artifacts are largely treated as steps in the investigation of sociocultural variables rather than as ends in themselves.

Explaining the origins of Mississippian phenomena has long been a goal of archaeologists working in the eastern United States. Despite our efforts, data accumulated over the past decade have forced us to reevaluate existing models and to acknowledge that the problem remains unsolved. Most previous attempts to explain the development of Mississippian societies sought to identify a heartland where the Mississippian evolved and from whence it spread. It has become increasingly apparent, however, that this search was futile.

Recently, Griffin (1985) and Smith (1984b) reviewed theoretical constructs applied to the study of Mississippian remains. Both emphasized that the concept of the first Mississippian system is a chimera; there was no such thing as the Mississippian culture, and there was no core area of Mississippian evolution. Rather there were widespread, local developments of cultural systems that had similar material traits, social organizations, and subsistence economies. That these societies influenced and interacted with one another is indisputable. But they were also the products of internal developmental processes.

Rejection of the notion of a first Mississippian system is not a new idea, although it is only now becoming the prevailing opinion. As Smith (1984b:19) noted, Griffin espoused this position, at least about the Mississippi Valley, more than 33 years ago (Griffin 1946:75,79). Recognition that local development was the norm rather than the exception is largely a result of the accumulating data on local developmental sequences. Wherever they are investigated in depth, it becomes apparent that Mississippian systems had their roots in the local cultures that preceded them. This is true even for those Mississippian variants, such as Fort Walton and South Appalachian, that were once cited as classic examples of secondary developments (J. Scarry 1984; Ferguson 1971).

Since, Mississippian systems were largely local developments, our explanatory efforts must be refocused. The problem is not to locate the initial emergence of a Mississippian-like system and document its spread. Rather, we must search for the common elements that would

lead to the roughly simultaneous emergence of similar cultures over a broad geographic region.

Explaining the processes that led to the emergence of Mississippian societies is a problem whose solution lies beyond our immediate grasp. Several models of the development of Mississippian systems have been proposed but they are generalized and difficult to test. The imprecision of these models is in part a result of the state of our knowledge about Late Woodland and Mississippian phenomena. We can enumerate the characteristics that are used to classify Late Woodland and Mississippian systems. We can also cite evidence to demonstrate the great variability subsumed within these classes. We are stymied, however, by the lack of detailed information on developmental sequences of the many regional systems that comprise the Mississippian phenomenon. To refine our models, we need to correct this deficiency, and also to explore the nature and effects of the interactions between the nascent Mississippian systems (Smith 1984b:20).

The Moundville system, located in the Black Warrior River Valley of west-central Alabama, presents an excellent universe for furthering our understanding of developmental processes in Mississippian systems. We have sound criteria both for delineating the boundaries of the system and for identifying sites that belonged to it. The sites themselves are reasonably intact; there has been comparatively minor destruction from urbanization and modern agricultural practices. More importantly, the long history of archaeological research at Moundville, and elsewhere in the Black Warrior Valley, (Peebles 1981)

has built much of the foundation necessary for investigating developmental questions. Indeed, the Moundville system is one of the best documented and understood Mississippian systems.

Despite our wealth of information about the Moundville system, recent research has shown that there is considerable room for refinement in our models of its development and operation (e.g., Bozeman 1982; Steponaitis 1983a; Welch 1987). Among other things, there are still significant gaps in our knowledge about the economic basis the system. My research was designed to help fill these holes by collecting and analyzing data about plant procurement and production strategies during the emergence of the Moundville chiefdom. This chapter outlines the broad background against which the Moundville data presented in later chapters must be viewed.

Culture Descriptions

The descriptions of Late Woodland and Mississippian cultural systems that I present are synoptic sketches. They smooth over the variability among the societies classified by these labels in an effort to provide a general picture of social organizations, settlement patterns, and subsistence economies. They are not, nor do I intend them to be, detailed pictures of any one system or region. The sketches merely set the stage for my discussion of explanatory models of the emergence of Mississippian systems. They also provide the backdrop for my discussion in the next chapter of terminal Woodland and Mississippian manifestations in the Black Warrior River Valley.

Late Woodland

Remains of Late Woodland societies are distributed throughout the Eastern Woodlands of the United States. In the Northeast and the Great Lakes regions, these systems were the final indigenous cultural developments and persisted into historic times. In portions of the Midwest and in the Southeast, they were succeeded by Mississippian systems. The concern here is with describing the Late Woodland societies that existed in these latter areas.

It is difficult to define precise temporal boundaries for Late Woodland manifestations. The chronological placement of these systems varies by region and by the characteristics used to classify them. In rough terms, Late Woodland cultures emerged about A.D. 500 (Asch et al. 1979:84; Braun and Plog 1982:515; Griffin 1967:186). By A.D. 800 characteristics considered Mississippian began to appear in several areas, and by A.D. 1000 recognizably Mississippian systems had developed in most areas of the Southeast (Griffin 1985:60-62). The approximate temporal range for Late Woodland cultures, thus spans the period from A.D. 500-1000. In Illinois, where Late Woodland systems have been intensively studied, changes in settlement pattern and subsistence practices seem to occur around A.D. 700. Based on this, some scholars have suggested that Late Woodland systems should be further classified as early or late (Asch et al. 1979:84; Braun and Plog 1982:516).

Late Woodland culture is generally defined in terms of material traits. Ceramic assemblages are probably the most important criteria for classifying sites as Late Woodland. Late Woodland assemblages are

characterized by low diversity in both decorative techniques and vessel forms (Braun 1977:111-129). In the Midwest and the upper Southeast, Late Woodland ceramics are generally plain or cordmarked (McKern 1939:309). On the southeastern coastal plain, the pattern is similar but the most common decorative technique is check stamping (Brown 1982). Other criteria used to identify Late Woodland cultures are usually phrased in negative terms and used in contrast to preceding and succeeding cultures. Thus the burial mounds and mortuary programs of Late Woodland systems are described as lacking evidence of the elaborate burial activities found in Hopewell and Mississippian contexts. Likewise, the trade goods and exchange networks of Late Woodland systems are described as lacking the evidence of far-flung interactions between systems found in earlier and later sites (Ford 1974:402; Griffin 1967:185; Muller 1983:400-401).

In the past, Late Woodland cultures were almost universally considered to result from a period of cultural decline or at best stasis. Late Woodland cultures were cast in the shade by the more spectacular material remains and earthworks of the cultures that bracketed them. Decline in mortuary ceremonialism, decreased trade, and unimpressive ceramics were seen as symptomatic of the dissolution of regional social networks. Local societies were depicted as isolated, self-sufficient, and perhaps provincial.

In several recent papers, Braun has questioned this traditional interpretation (Braun 1977; Braun and Plog 1982). He has aroused considerable debate by proposing an alternative, and almost

diametrically opposed, interpretation of these phenomena. Braun argues that there was indeed change in social organization, but not in the direction of devolution. Instead, he contends that if one considers the cultures as non-hierarchical systems, the changes in material culture fit with expectations of a move toward greater connectedness. In Braun's model the changes in material culture indicate greater supralocal cooperation and regional social integration, not less (for the logic and details of his arguments, see Braun and Plog [1982]).

When Late Woodland social organizations are discussed they are generally described as tribal. Such organizations are said to be egalitarian, with no permanent offices of authority (Service 1962:114). Status positions are achieved by personal accomplishment within the parameters open to an individual of given age and sex. Social and ecological relations are structured by ritual rather than by personal authority (Rappaport 1971a, 1971b:38). Local communities are autonomous; the links between communities are personal not corporate. If Braun's elegant arguments are valid, it seems likely that within a region Late Woodland communities were linked both by kinship networks and by sodalities that cross-cut kin affiliation.

In many areas settlement patterns seem to change during the Late Woodland period. Within favored habitats, increases in both site sizes and numbers suggest at least increasing population density and possibly overall population growth (Ford 1974:405; Muller 1983:401). Some researchers have proposed a concomitant decrease in population mobility (e.g., Styles 1981:28,266). They argue that territorial size

decreased as preferred locations were filled and spacing between groups was reduced. There is also evidence for settlement in previously unoccupied environments in some areas (Asch et al. 1979:84; Percy and Brose 1974:19).

Late Woodland populations appear to have been semi-sedentary. Shifting settlement from one camp to another (Percy and Brose 1974:20), and seasonal movement from villages to dispersed camps (Welch 1981b:82; Morse and Morse 1983:186; Styles 1981:261) have both been proposed to explain Late Woodland settlement patterns. These are not mutually exclusive models. It is entirely possible that settlement systems differed between various regional cultures. Small temporary extractive camps seem to have been a part of the settlement systems, regardless of the nature of the annual settlement cycles.

The subsistence strategies of Late Woodland populations appear to have combined hunting and collecting wild plant and animal resources with garden plot horticulture (Ford 1974:403, 1977:178). Strategies for procuring faunal resources concentrated on abundant, locally available animals (Kelly and Cross 1984:224-227; Styles 1981:262,266-267). Assemblages from different sites within a region are qualitatively similar but quantitatively distinct as a result of differing patterns of resource availability (Styles 1981:262). Where fine-grained recovery techniques have been employed to collect subsistence remains, analyses indicate deer and aquatic resources, particularly fish, were important (Kelly and Cross 1984:224-227; Styles 1981).

There are indications that Late Woodland utilization of plant resources varied both temporally and spatially. In the Midwest, earlier and later Late Woodland plant assemblages can be distinguished by the occurrence of maize (Asch et al. 1979:83). Maize remains are rare in early components; they are common though not abundant in late components. In other respects, however, earlier and later Late Woodland assemblages appear similar. Nuts, particularly thick-shelled hickories, were heavily exploited. Fruits from successional plants were utilized when available. The frequent recovery of large quantities of small seeds from annual plants suggests that these resources played a significant role in the diet. Three taxa--chenopod (Chenopodium berlandieri), knotweed (Polygonum erectum), and maygrass (Phalaris caroliniana)--contribute the vast majority of these seeds and have collectively been termed the starchy seed complex (Asch et al. 1979:83-84). While previously it was thought that these resources were intensively collected from natural stands, it now seems more likely that they were cultivated, if not domesticated (Asch et al. 1979:83-84; Smith 1985a, 1985b). Sunflower, sumpweed, squash, and gourd were also raised in Late Woodland gardens. In the Southeast, while we lack the data to make chronological distinctions, Late Woodland plant assemblages are generally similar to those from the Midwest. There are, however, some possible differences in the relative importance of the various resources (Yarnell and Black 1985). Nutshells seem to constitute a larger proportion of food remains recovered. Small seeds, including those of the starchy seed complex, seem to occur in fewer contexts and in smaller quantities. Whether

these differences are an artifact of recovery and analytical methods or whether they indicate actual differences in subsistence strategies remains to be determined.

Mississippian

Current definitions of Mississippian culture focus on non-material characteristics as the criteria that set these societies apart from preceding systems. Hierarchical social organizations and agricultural economies are considered new and distinct features of these societies (Griffin 1967:189, 1985:63; Peebles and Kus 1977:435; Smith 1978:486). Current definitions are not wholly satisfactory, but they do serve to direct attention to those changes that require explanation if we are to understand the development of the Mississippian systems. While organizational characteristics are used to define the Mississippian phenomena, most archaeologists still rely on a constellation of material traits to identify Mississippian systems. Pyramidal mounds, shell-tempered ceramics, rectangular wall-trench houses, and Southern Cult paraphernalia are all attributes traditionally associated with Mississippian cultures (McKern 1939:309).

Mississippian systems were more restricted in their distribution than Late Woodland systems. Remains of Mississippian societies are found primarily in the Mississippi and lower Ohio River Valley systems of the Midwest and along major river systems in the Southeast. Although the Mississippian cultures have been described as adaptations to floodplain habitat zones (Smith 1978:480-488), some Mississippian

manifestations were centered on non-floodplain habitats that provided comparable access to agricultural soils and diverse aquatic and terrestrial resources. Examples include the Lake Jackson system, a Fort Walton manifestation located in northwest Florida, and the "Oconee Province", a Lamar system in the Georgia Piedmont (J. Scarry 1984; Shapiro 1983).

Since the emergence and decline of the Mississippian cultural systems were processes not events, it is difficult to specify chronological boundaries for Mississippian phenomena. The various material traits used to recognize Mississippian manifestations begin to appear in the archaeological record about A.D. 800. They did not, however, appear as a set from a single source. The individual elements have disparate histories, and their earliest known occurrences are found in widely scattered areas (Griffin 1985:60-61). By A.D. 1000 the various organizational, economic, and technological innovations had coalesced giving the characteristic Mississippian stamp to numerous systems in the Southeast and Midwest. The apogee of the Mississippian cultural developments appears to have been between A.D. 1200 and 1400. During this period most Mississippian systems reached the height of their complexity. The arrival of the Spanish explorers in the sixteenth century marked the end of the Mississippian cultural systems as indigenous developments. In some areas--e.g., the American Bottom of Illinois and the Black Warrior River Valley--the local Mississippian systems seem to have collapsed due to internal processes before the European intrusion. Elsewhere, what appear to have been fully functional Mississippian systems were described by the

chroniclers of the 1539-1541 de Soto Entrada (Smith 1968). In the wake of the expedition, however, decimation of the native populations by inadvertently introduced European diseases seems to have resulted in the demise of most Mississippian systems.

Most scholars classify Mississippian systems as chiefdoms. This implies that they possessed certain organizational characteristics (Service 1962:144-152). In chiefdoms, personal status and access to positions of leadership are largely determined by an individual's placement within a system of ranked kin groups. Regulatory and control functions are vested in permanent offices that exist separate from the individuals who occupy them. Sanctification, not control of force, sustains the authority of officeholders (Rappaport 1971b:38-39). In other words, the elite are generally considered to be descended from the gods or at the least the gods' earthly representatives. Chiefs and their associates serve as centralized decision-makers; they gather information, often in codified form, about conditions in their territories and have the ability to initiate activities based on that information. Thus, they are potentially faster, more efficient, regulatory mechanisms than the rituals of tribal societies (Rappaport 1971b:38-39). The price of such efficiency lies in the surplus production the society must generate to support the chief and his retinue. Tribute and corvee labor, often collected in the guise of obligations to the deities, are the primary means by which support for the chiefly establishment is extracted. In some chiefdoms, there is a two-level hierarchy. In such cases, a paramount chief has decision-making authority over a large region that

is subdivided into smaller territories, each of which has its own chief. Local chiefs owe allegiance and tribute to the paramount chief, but within their own region they have complete decision-making responsibilities (Wright 1977:381). Decisions made by the paramount (e.g., extract more tribute) are translated by minor chiefs into material actions (e.g., plant more or now) on the local scale. In turn, minor chiefs levy tribute and command labor from the local population, and after extracting a share for themselves, pass the remainder on to the paramount chief. Part-time craft specialization, especially for the manufacture of sumptuary goods for the hierarchy, is another characteristic of chiefdoms. Most artisans must still engage in basic subsistence activities, however. Redistribution, of raw materials and foodstuffs, between communities located in ecologically complementary zones was initially proposed as a primary function of chiefs (Fried 1967:117; Sahlins 1963:296; Service 1962:134-135). Careful examination of the flow of goods in chiefly economies has led to a reevaluation of the role of redistribution. Studies suggest that local self sufficiency is the norm in chiefly societies (Earle 1978; Peebles and Kus 1977; Taylor 1975; Welch 1986). The surplus goods accumulated through tribute are generally used in the performance of chiefly functions and dispensed with an eye to cementing ties within and between chiefly establishments. Surplus foods are occasionally redistributed to compensate for local shortages, but this represents only a fraction of the goods passed up the system.

Mississippian settlement patterns varied considerably over both time and space (Smith 1978:488-498). There are, however, enough similarities in settlement distributions and types to make some general observations possible. The correlation between Mississippian sites and prime agricultural soils is well established (Ward 1965; Lewis 1974:39). Most Mississippian systems were located within or adjacent to the meander belt zone of a river system. Smith (1978:481) has proposed that Mississippian subsistence systems were adapted to these floodplain environments and depended on both their annually renewed soils and their concentrated biotic resources (Smith 1978:481). Those few Mississippian systems that were not located in floodplain environments seem to be situated in regions that provide similar access to good agricultural soils and rich faunal resources (J. Scarry, personal communication 1985; Shapiro 1983). Besides location within floodplains or equivalent zones, Larson (1971:21) has noted that there is a tendency for Mississippian systems to be situated on ecotones formed by the boundaries of major physiographic regions. Ecotones contain a mixture of the resources found in the adjacent zones and are generally richer in resources than the interiors of the regions to either side of them. Subsistence considerations were not the only factors that influenced the locations of the Mississippian systems. Many researchers have pointed out the proximity of major transportation routes, both land and water, to their systems and in fact have proposed that large communities were situated at junctures that commanded nodes in the transportation network (e.g., Brain 1978:348-349; Porter 1973:157-162).

Settlements within individual Mississippian systems can be differentiated on the basis of size and function. Most systems have one or more sites with mounds. These sites, often called ceremonial centers, served as administrative centers and were home to the chief and his retainers. The size of the non-elite population resident at such centers seems to have varied from one system to another. In some areas, population estimates for the ceremonial centers range into the thousands (Fowler 1974:25; Green and Munson 1978:310) in other areas these sites are interpreted as having only minimal resident populations (Brown et al. 1978:187-188; Morse and Morse 1983:266). To what extent this variability is a product of differing behavior patterns as opposed to being an artifact of the quality of the data is unclear. Many Mississippian systems had more than one ceremonial center. In these cases, it is generally possible to divide the mound sites into major and minor centers on the basis of site size, and size and number of mounds. The existence of minor centers is generally considered to indicate a two-level hierarchy. Minor centers are presumed to be local administrative centers whose chiefs act as intermediaries between the paramount chief and the local population. At least one study of the size and location of such secondary centers supports this interpretation (Steponaitis 1978).

The residence patterns of the non-elite strata of Mississippian societies vary over time and space. Unfortunately, until relatively recently non-mound sites were neglected in favor of the more spectacular ceremonial centers. Thus, we are only beginning to document the variability within this class of sites. The classic

picture of a Mississippian site was that of a sizeable village, possibly fortified (Griffin 1967:189-190). Accumulating data from intensive site survey and testing programs, however, suggest that Mississippian settlement patterns frequently included dispersed hamlets and farmsteads (Emerson and Milner 1982; Muller 1978:285). Under agricultural regimes, dispersed residence patterns are energy efficient because they reduce labor expenditures by decreasing transportation requirements. For this reason, hamlets or farmsteads may have been preferred where defense was not a priority (Smith 1978:489). There is some evidence that dispersed residence patterns had temporal priority and that a shift toward nucleated settlements occurred as Mississippian systems matured and violent conflicts became more frequent (Bozeman 1982:302-308; Emerson and Milner 1982; Morse and Morse 1983:256,266).

Most researchers agree that domesticated plants played a major role in the Mississippian diet and that this represented a change in emphasis from preceding subsistence practices. This accord on the general character of Mississippian subsistence strategies masks considerable divergence of opinion about the degree of dependence on agricultural products; the role of wild resources in the diet; and the nature of procurement strategies geared to the collection of wild resources. Resolving such issues is complicated. Like all else in Mississippian studies, there was no one subsistence system. Dietary practices probably varied between status groups within Mississippian societies, they almost certainly varied between systems located in different ecological contexts, and they may well have varied over

time. It is possible, however, to make a few generalizations about Mississippian subsistence practices.

Mississippian faunal exploitation strategies have been the subject of considerable study. Bruce Smith, in particular, has written extensively on this topic (e.g., Smith 1974, 1975, 1978). He argues that Mississippian populations selectively exploited a limited range of animal species/species groups. He contends that the foci of Mississippian procurement efforts were animals that could be obtained under a strategy that attempted to maximize yield per unit of labor expended. In his model, three terrestrial animals (deer, raccoon, and turkey), backwater species of fish, and migratory waterfowl are specified as the faunal resources that meet selection criteria based on energy expenditures. Smith's model was originally constructed using data from the Central Mississippi River Valley; recent data from other areas suggest the details of his model require reexamination. Deer as the most abundant, large, terrestrial animals were probably universally important. The significance of other resources differs with local ecological conditions, however. Location away from a major flyway and proximity to a main river channel as opposed to backwater ponds have obvious impacts on the availability of fish and fowl (Michals 1981:93; Shapiro 1983:263-264). But it is not just aquatic resources that vary in importance. In the American Bottom, terrestrial animals other than deer seem to have been used with considerably less frequency than Smith's model predicts (Kelly and Cross 1984:227-231). At Moundville, squirrel remains were far more abundant than those of raccoon (Michals 1981:93). In sum, while the

energy components of Smith's model may well hold for most Mississippian systems, the animals that were procured varied.

Several lines of evidence indicate the importance of agricultural products in Mississippian subsistence strategies. Accounts written by members of the de Soto expedition describe vast fields of maize interplanted with squash and beans (Smith 1968; Varner and Varner 1981). At various points along their trail, the Spaniards were able to live for months at a time off the surplus crops stored in the chiefs' villages. Archaeologically, the increased dependence on domesticated plants, particularly maize, is attested by large quantities of corn remains (Blakeman 1974:64; Chapman and Shea 1981:72; Ford 1977:168; Johannessen 1984a:203-205); carbon isotope ratios in human skeletal remains indicative of significant consumption of tropical grasses (Bender et al. 1981; van der Merwe and Vogel 1978); by structural remains of corn cribs (Milner 1984:30); and by strong associations between site locations and prime agricultural soils (Ward 1965). Taken together these factors make a strong case for assigning an important dietary role to domesticated plants.

As the preceding descriptions suggest, Mississippian agricultural activities were centered on the tropical cultigens maize, beans and squash. Squash and maize were known, but not extensively utilized, in the Eastern Woodlands long before the appearance of the Mississippian societies (Ford 1981:15). Beans were a new addition to the set of crops. In fact, their introduction may post-date the emergence of Mississippian systems (Ford 1985:353). The indigenous cultigens--including sunflower, sumpweed, chenopod, knotweed, and maygrass--

appear to have declined in importance with the advent of field agriculture. Remains of these plants are found in Mississippian contexts, but only sunflowers continued to be cultivated by the historic period.

We know Mississippian populations also utilized non-domesticated plant resources. Nutshells, seeds from successional fruits, and starchy seeds are frequently recovered from Mississippian deposits (Blakeman 1974; Caddell 1981, 1983; Chapman and Shea 1981; Chmurny 1973; Crites 1978; Johannessen 1984a; Perttula et al. 1982; Smith and Wetterstrom 1978). Our knowledge about the relative importance of these resources, and about the strategies employed in gathering them is limited, however.

Maize Production and Rank Organization in the Emergence of Mississippian Systems

Over the years, numerous explanations have been offered to account for the seemingly dramatic differences between Late Woodland and Mississippian cultures. Not surprisingly, the nature of these explanations changed as data accumulated and paradigms shifted. A comprehensive review of models of Mississippian cultural developments is beyond the scope and requirements of my research. Thus, my discussion concentrates on proposed relationships between the increased production of maize and the emergence of rank organization.

Most models of Mississippian developments attempt to link the apparently concurrent shifts in economic and organizational structure. While a few scholars claim the subsistence system was unimportant in the development of particular regional systems (e.g., Brain 1978:363-

364), they are in the minority. More often, increased crop production is treated as a causal variable; in some instances it is presented as a "prime mover", in others as one of several causal factors. While subsistence change has long been considered a catalyst, explanations of how it served this role have varied.

In the past, explanations were offered that proposed that climatic change, improved crops, or new technology permitted dependence on agriculture and allowed further cultural developments (e.g., Fowler 1969:365, 1974:33; Griffin 1967:189). Though they suggested differing trigger mechanisms, these explanations were based on the assumption that once agriculture was possible it was adopted wholeheartedly. They also depicted cultural advance as the inevitable outcome of this acceptance. In these schemes, agriculture allowed people to settle down, population to increase, and civilization to progress. We now believe that cultural evolution does not work that way. Cultural systems are thought to be adaptive; they change in response to change in their external or internal environments, not because it is preordained that they will evolve (Rappaport 1971a). Moreover, the factors that provided the initial kicks in these models are not supported by the data. Such factors were either not sufficiently widespread to account for the pan-Southeastern emergence of Mississippian systems (e.g., climatic change), or they post-dated the cultural development they are supposed to have stimulated (e.g., the appearance of beans and new maize varieties). Thus, these explanations have been rejected on the grounds of both their mechanisms and their processes.

In the contemporary literature, systemic models have largely replaced possibilistic ones. Within the current paradigm several models have been offered that link subsistence change and the emergence of ranking (e.g., Brown 1974:24; Chmurny 1973:242-257; Ford 1974:405-408, 1977:180-182; Peebles and Kus 1977:443; Smith 1974:30). Though these models differ in detail, scope, and complexity, all incorporate increased crop production as a socio-environmental stress that selects for hierarchical organization.

Stripped of their elaborations, these models are based on the arguments of Flannery (1972) and Rappaport (1971b). Cultures are viewed as adaptive systems. Social organizations and ritual activity are regulatory mechanisms that serve to maintain homeostasis and system survival. They are information-processing and decision-making structures that monitor the status of the various components of the system and maintain them within acceptable ranges (Rappaport 1971b:24). Because the elements of a system are interdependent, action taken to maintain stability in one component may lead to changes in other components or to organizational change.

The various systemic models are based on the premise that increasing crop production was a necessary step. They assume, implicitly or explicitly, that field agriculture, being labor intensive, would not be adopted unless it was required. They propose that an imbalance between population density and resource availability resulted in an inability to meet subsistence needs through the mixed foraging/gardening strategies practiced by Late Woodland populations. Since natural productivity was no longer adequate, populations were

forced to adopt more labor intensive strategies. Land was cleared and planted in crops that raised the carrying capacity per unit of land.

According to these models, the commitment to agriculture posed problems whose solutions had ramifications beyond changes in the subsistence economy. The increased intensity and complexity of agricultural endeavors required greater coordination to insure production levels sufficient for the populations' needs. Moreover, dependence on domesticated plants increased the risk of local subsistence failure. Fields are deliberately simplified ecosystems sensitive to perturbations in the environment; general productivity is high but failures can be catastrophic. Climatic fluctuations, insects, diseases, and raids all can critically reduce yields. These factors may be unpredictable in both frequency and severity.

The need for coordination and the element of uncertainty is thought to have required efficient and flexible control mechanisms capable of fast and effective actions. The argument is that productivity had to be predicted and monitored, and that production disparities had to be countered by generating, storing, and disbursing surplus crops. In this scheme, dependence on field agriculture increased the quantity and complexity of information that systems had to process to survive. This increased information flow exceeded the capacities of tribal regulatory mechanisms and selected for the emergence of hierarchies.

Systemic models based on these propositions have been offered in the context of individual systems and as general explanations of Mississippian developments. Brown (1974:24), and Chmurny (1973:242-

257) have presented explanatory sketches for the Spiro and Cahokia systems respectively. They described particular climatic patterns for those regions that would render crop yields unpredictable and might thereby select for the managerial capabilities of chiefdoms. Ford (1974:405-408, 1977:180-182) and Smith (1974:30) have proposed general models for the emergence of Mississippian systems that use similar arguments. Ford's model is more specific in its discussion of risk factors and their attendant managerial requirements. It presents an essentially linear sequence of events, however. Smith's model is less explicit about the link between dependence on agriculture and the need for centralized decision-making. Its strength lies in the incorporation of subsistence change into an elaborate feedback loop that includes population increase, territorial expansion, and competition as factors that interact and amplify the need for hierarchical organization. While neither Ford nor Smith argues that increased crop production was the sole source of socio-environmental stress, both imply that it was a universal factor.

Data accumulated in the decade since these models were formulated make it difficult to sustain the argument that field agriculture was a universal stress factor contributing to the emergence of Mississippian systems. Both Ford and Smith were working within the prevailing view that Mississippian cultures evolved in the Mississippi Valley and its immediate tributaries and spread out from there. The more recent recognition that most Mississippian systems were local, roughly synchronous developments requires reevaluation of the premises of their models. Positing population pressure as the initial stimulus

becomes a sticky problem. It is difficult to contend that populations simultaneously reached critical levels throughout the region in which Mississippian societies evolved. Therefore, it is also difficult to argue that subsistence change driven by population pressure was a universal stress. It is important to note that both Smith (1984) and Ford (personal communication 1986) have changed their views on the concept of general selective variables.

The probability that increased crop production was not a selective variable for all Mississippian systems, does not mean that it could not have played an important role in the evolution of specific systems. In fact, Peebles and Kus (1977:443) have presented a model that allows just such a possibility by not requiring that the stress factors be the same for all Mississippian systems. Their model is explicitly cybernetic and formulated at a higher level of abstraction than others that have been offered to explain Mississippian developments. It is an adaptation of propositions contained in systemic models of state evolution (e.g., Flannery 1972; Wright 1977) to the case of chiefdoms. They propose that the organizational changes were a response to increases in the quantity and complexity of information the systems had to accommodate. They suggest several potential sources of socio-environmental stress, including warfare, trade, and agriculture. Their explanation of agriculture as a source of stress is based on Ford's model. They contend that any one or all the variables they list might have been instrumental in the development of individual Mississippian systems. Their model is the most flexible of those discussed because it does

not seek to identify universal stress factors operative in all instances of Mississippian emergence.

If Peebles and Kus are right, then the search for universal causes is as futile as our previous attempts to identify the first Mississippian society. Individual variables could, however, still play crucial roles in the emergence of regional systems. We need to investigate potential sources of stress within the context of each system to elucidate local developmental processes.

On a regional scale, evaluation of field agriculture as a stress factor must take into account both timing and predictability. For subsistence change to have played the role the models propose for it, the increased dependence on crops must precede the emergence of rank organization. If the timing is reversed or if increased crop production precedes ranking by a considerable margin then some other explanation must be sought for the presumed link between the two developments. The models also propose that productivity was sufficiently variable that local shortages were recurrent but unpredictable facts of life. If crop yields were dependable, agricultural endeavors would not have required coordination above the basic economic unit.

These considerations can be reformulated into two questions: 1) when in the transition from Late Woodland to Mississippian systems did crop production increase, and 2) was agricultural productivity, given the available technology, dependable and predictable? These questions can help to focus subsistence studies so that the results can be used to investigate whether dependence on agriculture was a selective

factor in the evolution of a particular system. The questions are deceptively simple. It is difficult, if not impossible, to marshal sufficient evidence to arrive at definitive answers. It is, however, possible to weigh the evidence and make informed interpretations.

Change in Procurement and Production Strategies

To this point I have focused on the relationship between change in subsistence systems and change in other elements of the cultural system. This is the perspective generally employed when consideration is given to the role field agriculture played in emerging Mississippian systems. It is not, however, the only interesting aspect of the shift in subsistence strategies.

The internal changes in the subsistence system are interesting and potentially useful fields of investigation. It is fairly well established that the development of Mississippian systems involved a switch from garden plot to field agriculture. The processes involved in such a shift and the ramifications of the shift on other procurement strategies have received considerably less attention. We need to study in greater detail the procurement and production strategies of Late Woodland and Mississippian populations. Such studies should lead to a greater understanding of the specific economic systems investigated. They should also contribute to our understanding of the dynamics of subsistence change in general.

Several models have been offered to explain subsistence strategies (see for example the papers in Earle and Christenson [1980]). These models assume that subsistence behavior reflects a

balance between energy expended in procurement and yield. Constructs such as optimization (Reidhead 1980) and cost-benefit (Earle 1980) draw on economic and ecological theory to predict the resource mix, exploitation patterns, and site distributions expected under varying conditions. A more detailed understanding of Late Woodland and Mississippian exploitation strategies can help us assess the relative utility of such models for understanding changing subsistence strategies.

Although the effect of increased crop production on wild resource procurement has not been explicitly addressed, the literature abounds with general comments on the subject. Interestingly, opinions differ about whether strategies changed and how they changed if they did. The explanatory models of Ford (1974:405-408, 1977:180-182) and Smith (1974:30) exemplify this lack of accord. They agree that production of domesticated resources increased, but they offer different pictures of the effects of this change on other elements of the subsistence system. Ford contends that clearing land for fields altered the availability of wild resources. This in turn affected the utilization of such resources at least so far as plant resources were concerned. On the other hand, Smith proposes that agriculture was grafted onto preexisting procurement strategies. He concedes there may have been changes due to scheduling conflicts but he sees these as minor.

To resolve this lack of accord over wild resource procurement strategies, we need to know both which resources were exploited and to the extent possible their relative importance in the diets of Late Woodland and Mississippian populations. Ultimately, we must

synthesize information about both faunal and botanical resources. The first step, however, is understanding exploitation strategies within the two categories of food resources. Ethnobotanists must go beyond a simple demonstration that maize increased in the diet. We must attempt to detect and measure changes in the procurement of other plant resources over both time and space.

Changes in exploitation strategies can be qualitative or quantitative. The investigation of wild plant procurement by Late Woodland and Mississippian populations must consider both which resources were utilized and the frequency and intensity of their use. That is, we should ask whether the sets of wild plants exploited were significantly different, and whether the relative importance of the various wild plant resources changes. The answers to these questions, interpreted within the context of ecological and energetic factors, should lead to better characterizations of procurement strategies. The answers should also enable us to determine whether increased crop production resulted in significant alterations of strategies directed at wild plant resources. If the questions are asked consistently of regional data sets, the results will not only contribute to a better understanding on local developments but also to our understanding of subsistence change in general.

Research Questions

In this chapter, I presented the background information that provides the context for my research. First, I summarized current knowledge about Late Woodland and Mississippian cultural systems,

focusing on differences in economic and social structures. Second, I discussed the apparent link between increased maize production and chiefly organization and reviewed elements of several current models of Mississippian development that seek to explain that link. Finally, I noted the lack of accord concerning possible changes in the procurement of wild plant resources, and suggested that resolving such disagreements could lead to a greater understanding of both the variability in Mississippian subsistence strategies and the processes of subsistence change.

In the course of my discussions, I presented four broad questions.

1. Was agricultural productivity, given the available technology, dependable and predictable?
2. When in the transition from Late Woodland to Mississippian systems did the emphasis in subsistence strategies shift from wild plant procurement to crop production?
3. Did the shift from wild plant procurement to crop production entail additions to or deletions from the set of plant foods used?
4. Was the increased production of maize accompanied by changes in the proportions in which plant resources other than cultigens were procured ?

My study attempts to answer these questions for the Mississippian and Late Woodland systems in the Black Warrior River Valley. I use archaeological, ecological, and archaeobotanical data in my analyses. As they are intended to, my results contribute primarily to our

understanding of the development of the Moundville system. But my use of the four questions to direct my research means that my results have implications for the broader issues raised in this chapter.

CHAPTER III

LATE WOODLAND AND MISSISSIPPIAN OCCUPATIONS IN THE BLACK WARRIOR VALLEY

The Moundville system of the Black Warrior Valley in west-central Alabama (Figure 3:1) is one of the better known Mississippian chiefdoms. At its apogee, the system included the major ceremonial center at Moundville, at least six minor ceremonial centers, and an unknown, but undoubtedly large, number of dispersed hamlets and farmsteads. My study focuses on the system at earlier and less spectacular stages of its development. The data I use are drawn from contexts assigned to West Jefferson and Moundville I phases. These phases bracket the period in which the distinctive Mississippian adaptation and organization developed in the Black Warrior Valley. The West Jefferson phase is a Late Woodland manifestation that dates to about A.D. 900 to A.D. 1050. Most sites assigned to this phase are located in the Black Warrior drainage, although a few West Jefferson sites have been found in the adjacent Upper Cahaba River drainage. The Moundville I phase (A.D. 1050 to A.D. 1250) is the earliest of three sequential phases defined for the Mississippian manifestation in the valley. All sites assigned to the Moundville I phase are located within the Black Warrior Valley.

Figure 3:1. Location of the study area

History of Archaeological Research in the Black Warrior Valley

The understanding gained through more than 100 years of research makes the Black Warrior Valley a particularly rewarding area in which to work. Not surprisingly, the large, impressive Moundville site (Figure 3:2) has been the focus of research and the subject of the most extensive excavations. Nevertheless, site surveys, test excavations, and salvage projects have produced information about other sites in the valley. Good discussions of both the history of research in the valley and the changes in excavation methods and goals are available (Peebles 1979, 1981; Steponaitis 1983a:6-9, 1983b). Thus, I present only an outline of archaeological investigations in the valley.

As is the case for many areas in the southeastern United States, C. B. Moore initiated archaeological research of significant scope in the Black Warrior Valley (Moore 1905, 1907). Several small excavations conducted at Moundville in the second half of the nineteenth century resulted in an accurate site map and a limited collection of artifacts (Steponaitis 1983b), but this work had little impact on subsequent research. In 1905 and 1906, Moore investigated the valley locating and testing many of the mounds below the Fall-Line. Finding little to interest him except at Moundville, he concentrated his efforts on that site. He placed test excavations in all the mounds and excavated several off-mound areas (Moore 1905, 1907). His excavations produced the only data we have from the majority of the mounds at Moundville.

Figure 3:2. Map of Moundville showing location of mounds

The Depression era was a period of intense archaeological activity in the Black Warrior Valley. Beginning in 1929 and continuing throughout the 1930's, excavations were conducted at Moundville under the auspices of the various federal relief projects (Peebles 1981:79-80). These excavations were ably directed by David DeJarnette, Walter B. Jones, and Maurice Goldsmith. In 1934-35 and again in 1939-40, excavations were conducted at the Bessemer site, a mound center located in the upper reaches of the Black Warrior Valley (DeJarnette and Wimberly 1941). The enormous body of data recovered by the work at Moundville and Bessemer provided the basis for the recognition of the "Moundville Culture" as an aspect of the Mississippian pattern (Jones and DeJarnette nd; DeJarnette and Wimberly 1941:99-111). In conjunction with the excavations, the staff of the Alabama Museum of Natural History began compiling a site file. Jones and DeJarnette visited all known sites in the valley and excavated portions of Mississippian cemeteries at Snow's Bend (DeJarnette and Peebles 1970) and at the White site (Jones and DeJarnette nd; DeJarnette, field notes on file at Mound State Monument).

There was little fieldwork in the valley between 1941 and 1970. Instead, research efforts were directed toward analyzing and describing the extant collections (e.g., DeJarnette 1947, 1952; Wimberly 1956). Douglas McKenzie (1964, 1966) produced the first formal definition of the Moundville phase describing it by ceramic, lithic, and other traits and discussing what he believed were its temporal and spatial boundaries. Christopher S. Peebles organized

the massive excavation records, producing a comprehensive site report that described both the excavations and site structure at Moundville (1979). He used the insights gained by this endeavor to produce analyses of mortuary and settlement patterning (Peebles 1971, 1974, 1978a). These analyses both enhanced our understanding of the Moundville system, and set the background for further research in the valley.

Though generally on a smaller scale than before, fieldwork resumed in the Black Warrior Valley in the early 1970's. Below the Fall-Line site surveys south of Moundville (Nielsen et al. 1973) and at the mouth of Big Sandy Creek (Walthall, unpublished fieldnotes on file at Mound State Monument) yielded information about Late Woodland settlement in the area and produced the first evidence for small Mississippian hamlets and farmsteads (Bozeman 1982:157-159). The University of Alabama began to conduct field schools near Moundville, excavating portions of several small sites (1Ha39, 1Ha11), a Mississippian mound (1Tu50), an apparent Late Woodland component in a field on the western edge of the Moundville site, and a deep Mississippian deposit north of Mound R at Moundville (R. Krause, personal communication 1981; Walthall and Wimberly 1978:122; unpublished field school records on file at Mound State Monument). Meanwhile, above the Fall-Line, extensive salvage excavations were conducted at three Late Woodland sites (Jenkins and Nielsen 1974; O'Hear 1975). Analysis of the collections from these sites resulted in the recognition and definition of the West Jefferson phase, a Late Woodland manifestation in the Black Warrior Valley that could be

distinguished on the basis of ceramics from Late Woodland occupations in nearby river drainages (Jenkins and Nielsen 1974:137-140; Jenkins 1978).

In 1978, Peebles organized and directed a research project designed to take advantage of the rich corpus of data already existing for the Moundville system and to recover additional classes of data that had not been systematically collected previously. The University of Michigan Museum of Anthropology (UMMA) project comprised two seasons (1978-79) of fieldwork and collections research, producing data for a number of interrelated analyses. Vincas Steponaitis performed an analysis and seriation of ceramic vessels from Moundville (Steponaitis 1983a). His results enabled him to produce a three-fold chronological division for the roughly 500 year occupation of Moundville (Steponaitis 1983a:99-114). Peebles and Paul Welch conducted a site survey and testing program using controlled surface collections and small test excavations to gain more precise measures of the size, age, and structure of sites associated with Moundville. The survey collections were analyzed by Tandy Bozeman (1982) leading to the recognition of hamlets and farmsteads as significant elements in the Moundville system settlement pattern, and to refinements in the understanding of the relationships between Moundville and the small mound centers. Margaret Schoeninger (Peebles and Schoeninger 1981) undertook a trace element analysis of human bone from the skeletal collections to explore the nutritional correlates of ranking. Finally, in an effort to retrieve floral and faunal data suitable for subsistence analyses, I directed intensive, small-scale excavations at

Moundville (Scarry 1981b; see Chapter V). These excavations produced the first systematically collected subsistence data from Moundville (Michals 1981; Scarry 1981a, and this volume).

As an outgrowth of the project designed by Peebles, several studies were initiated to follow leads generated by the analyses and to address questions not included in the original research design. Steponaitis's work with the ceramics provided the foundation for studies of ceramic technology and decorative style by Sander van de Leeuw (1981) and Margaret Hardin (1981). Mary Powell (1985) analyzed the human skeletal remains from Moundville to examine questions about the Moundville populations' health and nutritional status. Paul Welch (1983, 1986) conducted excavations at the White site, a single-mound center, to investigate propositions about the tribute relations between paramount and subsidiary centers.

West Jefferson Phase

In Alabama, Late Woodland manifestations are divided into phases primarily on the basis of ceramic attributes. Tempering agent and frequency of plain versus cord-marked surface treatments are the major features used to distinguish assemblages. While there is a temporal dimension to the distribution of phases recognized using these criteria, there is also a strong geographic dimension (Welch 1981b:82-83). In the main, the spatial distribution of Late Woodland phases corresponds to the divisions between major drainage systems (Welch 1981b:82).

Welch (1980, 1981b) has drawn some inferences about social interaction in Alabama in the Late Woodland period from the ceramic data. His propositions are based on Wobst's (1977) theory of style as a message carrier and on learning theory as expounded by Plog (1978) and Voss (1980). Welch argues that, in this case, ceramic temper and surface treatment are not message carrying variables. He suggests the homogeneity observed in the distribution of these attributes within drainage divides results from a "long-term pattern of residential stability and social interaction" (Welch 1981b:82). Welch proposes the tribal model of social organization for explaining these patterns and postulates a situation in which warfare is conducted within a context of shifting political alliances (Welch 1981b:83). He is careful to note, however, that he does not equate sherds with tribes and, in fact, suggests that socio-political divisions may have existed within the major drainage systems (Welch 1980:9).

Most Late Woodland occupations in the Black Warrior Valley are classified as West Jefferson phase components. The primary criteria for distinguishing West Jefferson assemblages from Late Woodland assemblages found in adjacent regions are very high percentages (greater than 90 %) of plain, grog-tempered sherds (Jenkins 1978:21). Based on radiocarbon determinations and ceramic cross-dating, the phase is believed to span the period between A.D. 900 and A.D. 1050 (Ensor 1979:38; Jenkins and Nielsen 1974:141-142; Walthall and Wimberly 1978:119).

While the majority of known West Jefferson sites are located in the Black Warrior Valley, they do not seem to be evenly distributed in

the valley, and there are apparently a few West Jefferson phase sites in the Upper Cahaba River Valley (Figure 3:3). Above the Fall-Line, West Jefferson sites are found on small river terraces. There is a concentration of such sites about 12 km west of Birmingham, on the Locust Fork of the Black Warrior River (Jenkins 1978:21). The Late Woodland component noted by DeJarnette and Wimberly (1941:108) at the Bessemer site near Birmingham has also been classified as West Jefferson (Jenkins and Nielsen 1974:137). In the lower drainage, West Jefferson phase sites are relatively common on the floodplain from the Fall-Line to about 10 km south of Moundville (P. Welch, personal communication 1986).

Our knowledge of settlement patterns, site structures, and site functions is uneven for West Jefferson sites situated in different locales. Most of our information about West Jefferson sites above the Fall-Line is derived from excavations. For this area the main sources of data are salvage excavations at 1Je31, 1Je32, and 1Je33, the three West Jefferson Steam Plant sites (Jenkins and Nielsen 1974; O'Hear 1975). Additional data were collected from excavations at 1Je34 (Ensor 1979), 1Je37 (Brooms 1980), and 1Je20 (Oakley 1971). On the other hand, our data about West Jefferson sites below the Fall-Line are largely from site surveys and surface collections. The only subsurface evidence we have from below the Fall-Line comes from 1Ha39 a small West Jefferson site partially excavated by a University of Alabama field school (Walthall, unpublished field notes Mound State Monument), and from incidental excavation of West Jefferson features

Figure 3:3. Distribution of West Jefferson phase sites

encountered at three sites (1Ha8, 1Ha11, and 1Tu44/45) during investigations of later Mississippian components.

Analyses of the data from the sites above the Fall-Line suggest that four of the excavated sites (1Je31, 1Je32, 1Je33, and 1Je34) were small, seasonally occupied settlements (O'Hear 1975:143-144; Ensor 1979:36). At two of these sites, 1Je32 and 1Je34, postmold patterns indicated the presence of small, round, single-post structures (O'Hear 1975:125; Ensor 1979:5). At the others no clear structure patterns were recognized. All the sites produced a variety of features including ones that have been interpreted as storage and cooking facilities (Jenkins and Nielsen 1974).

O'Hear (1975) performed an innovative analysis of the distribution and contents of the features at 1Je32, producing valuable insights about the site's structure and chronology. He first identified two spatially distinct areas at the site and identified feature clusters within the two areas (O'Hear 1975:131). Using weighted averages of radiocarbon determinations, he was able to demonstrate that features which lacked shell-tempered sherds (a Mississippian trait) were significantly earlier than those containing shell-tempered ceramics (O'Hear 1975:137-139). This allowed him to assign the feature clusters in one area to separate early and late West Jefferson occupations. His analysis of the types and contents of features located in his two spatial divisions led him to postulate that the differences between the areas might be a product of warm versus cold season occupations (O'Hear 1975:139). The small size of the feature clusters (less than .1 hectare), combined with O'Hear's

identification of seasonal and chronological differences between the clusters, suggests the site was used periodically as a base camp for a small group of people.

Information about subsistence practices at West Jefferson sites above the Fall-Line is largely derived from plant remains. Soil conditions in this area are not conducive to the preservation of bone and, except for some shell, virtually no faunal remains have been recovered. C. Earle Smith (in Jenkins and Nielsen 1974:159-161) performed a preliminary analysis of plant remains recovered by the salvage excavations at the West Jefferson Steam Plant sites. Working only with materials hand-picked from the deposit, he identified hickory and acorn nutshell, persimmon and sumac seeds, and a few fragments of maize kernels and cobs. In a general comment on the material, he stated "the predominance of gathered plant products over cultivated plant products is notable" (Smith, in Jenkins and Nielsen 1974:161). A similar plant assemblage was reported for site 1Je34 by Ensor (1979:16). The results of my analyses of flotation samples from the West Jefferson Steam Plant sites (1981a, and presented in detail in Chapters VII and VIII of this work) are in general accord with these earlier reports.

Besides the habitation sites described above, two special purpose West Jefferson sites have been partially excavated. Based on an analysis of materials recovered by salvage work at site 1Je37, Brooms (1980:96-97) suggested the site was a temporary camp, used repeatedly by a large group of hunters. In support of this proposition, he cited the extensive chipped stone assemblage, the scarcity of ceramics

compared to other West Jefferson sites, and the absence of features. The second specialized site is Pinson Cave (1Je20), where excavation of the cave floor uncovered the remains of at least 46 individuals (Oakley 1971). It appeared that fully or partially articulated cadavers were dropped or thrown through a hole in the cave's roof. Artifacts found amongst the skeletal remains suggest a West Jefferson phase affiliation. Without data from other West Jefferson phase cemeteries it is impossible to determine whether this represents a typical West Jefferson mortuary program.

Models of the settlement-subsistence systems of the West Jefferson populations living above the Fall-Line have been proposed by Jenkins (1978:22-23) and Welch (1981b:82). These models are similar, varying more in wording than in detail. The population is depicted as dependent on a foraging/gardening economy. Communities were seasonally mobile, moving in an annual cycle in accordance with regular shifts in economic activities. Settlements were apparently small, comprising only a few households.

In contrast to the area just described, our knowledge about the West Jefferson phase occupation below the Fall-Line is based almost entirely on survey data. These data provide information about the size and distribution of Late Woodland sites in the floodplain zone. Beyond that, however, our evidence is sketchy at best.

From the Fall-Line to approximately 10 km south of Moundville, sites considered to be West Jefferson settlements are fairly densely distributed (Jenkins 1978:23; Nielsen et al. 1973; Walthall unpublished field notes on file Mound State Monument). Paul Welch

(personal communication 1986) has calculated that West Jefferson phase villages were spaced every 5 to 8 km along the river. A few West Jefferson phase sites have been reported in the hills above the floodplain, but virtually nothing is known about them.

Below the Fall-Line, West Jefferson phase sites are generally larger than those upriver. Sites on the floodplain range in size from artifact scatters 10 meters in diameter to sites covering several hectares (Bozeman 1982:159; Alexander 1982:117). However, Welch, who has devoted considerable time and thought to synthesizing the West Jefferson data, suggests that the largest sites are actually a result of "multiple, partially overlapping reoccupations of a particularly favored landform" (1987). He proposes the modal size for West Jefferson settlements on the floodplain was .2 to .5 hectares and that such sites were villages with populations of 50 to 125 people (Welch 1987).

Welch (1987) has proposed that the West Jefferson population on the floodplain followed an annual settlement-subsistence cycle similar but not identical to the one described for the population in the Upper Warrior drainage system. He uses the settlement data and preliminary analyses of botanical and faunal remains (Scarry 1981a; Scott, reported in Welch 1987) from two West Jefferson phase pits to support his admittedly speculative reconstruction. Welch describes the population as foragers/gardeners living for much of the year in floodplain villages. Based on the location of many of the sites in flood prone zones, he suggests that the villages were partially or fully abandoned in the late winter and early spring as the population

dispersed to camps on higher ground to hunt and wait out the floods. When the soil dried sufficiently for gardens to be planted, the people returned to their villages.

The archaeologists most familiar with the data have suggested there may have been differences between the West Jefferson systems in the upper and lower portions of the Black Warrior Valley. Their suggestions are based on the disjunct distribution of sites and the apparent differences in site size in the two regions. Jenkins (1978:23) proposed that the larger villages found on the floodplain might indicate that the West Jefferson population below the Fall-Line had a greater involvement in horticulture. Welch (1981b:82) initially postulated that the sites above the Fall-Line might be primarily winter encampments occupied when the population dispersed from their floodplain villages to hunt and gather nuts. More recently, Welch (1987) has proposed that a distinction should be made between what he terms the Moundville and Bessemer districts. Citing differences in subsequent socio-political developments as well as possible differences in the productivity of the natural environments in the two districts, Welch suggests the populations above and below the Fall-Line may have belonged to separate though related social groups. It is not possible given the available data to adequately assess Welch's propositions. Both Jenkins's and Welch's suggestions make it clear, however, that geographic location must be considered as a potential dimension of variability when analyzing West Jefferson materials.

Despite the possibility that they were distinct social groups, the West Jefferson communities above and below the Fall-Line were

sufficiently alike in social and economic organization that they may be grouped for analytical purposes. The populations were employing foraging/gardening subsistence strategies in similar, though not identical environments. Communities seem to have been egalitarian perhaps organized as tribes; there are no West Jefferson phase mounds and we have no other evidence of ranking. If, as Welch (1981b:82) proposes, the ceramic data indicate greater residential stability and interaction within drainage systems than between drainage systems, then West Jefferson communities whatever their location probably interacted more with one another than with Late Woodland populations in adjacent areas.

Moundville I-III Phases

As elsewhere in the southeastern United States, the Mississippian occupation in the Black Warrior River Valley is distinguished by seemingly sudden changes in material culture, social organization, and economic organization. Beginning about A.D. 1050, mounds were built, rectangular wall-trench houses were constructed, shell-tempered ceramics were manufactured, and new vessel forms and design motifs were used. These changes in material culture appear to mark the transition from egalitarian to rank society and from foraging/gardening to agricultural economic strategies.

Our information about Mississippian occupations in the valley is far more detailed than that for the preceding Late Woodland occupations. This is primarily a result of the attention given to the conspicuous Moundville site and to a lesser extent other mound sites

on the floodplain. For small Mississippian sites without mounds, our knowledge is sketchy and derived largely from site surveys and surface collections. The UMMA survey project gathered data that improved our control over the temporal and spatial dimensions of sites in the Moundville system, but we still know far more about Moundville than about any other site in the system. The data are also better for the Moundville system at its peak than they are for the system in its early growth and late decline stages.

Most of our current conceptualization of the Moundville system is an outgrowth of research by Christopher Peebles. His analysis of mortuary behavior (1971, 1974) demonstrated the existence of a ranked society at Moundville. Peebles (1978a) also examined settlement patterning in the Black Warrior Valley. He proposed a three level settlement hierarchy and employed nearest-neighbor analysis to examine the spatial relationships between sites (Peebles 1978a:393-400). He argued that minor ceremonial centers were administrative intermediaries between the non-mound sites and the large center at Moundville (Peebles 1978a:400). He found that sites believed to belong to the Moundville system were located on prime agricultural soils (Peebles 1978a:405). However, using soil fertility as a measure of agricultural potential, Peebles (1978a:409) found only a moderate relationship between the size of mound centers and catchment productivity. He attributed the lower than expected correlation to the system's organization, arguing that the size of mound sites was determined more by administrative functions than by marginal agricultural costs (Peebles 1978a:410). In an article on the

archaeological detection of rank societies, Peebles and Kus (1977) used ethnographic data to define criteria for recognizing chiefdoms. They then drew together the separate threads of Peebles research and presented a convincing demonstration that the Moundville system met those criteria and should be viewed as a chiefdom.

Steponaitis (1978) used a center of gravity model to analyze the settlement data assembled by Peebles. Accepting Peebles's demonstration that the Moundville system was a complex chiefdom, Steponaitis argued that tribute and labor considerations affected the size and location of the minor mound centers. He proposed that efforts to minimize the costs of passing tribute up the system pulled subsidiary centers toward Moundville and, hence, away from the midpoints of their districts. This centrifugal tendency accounts for the lack of even spacing between small mound centers. Using an index of spatial efficiency, Steponaitis showed that the location of Moundville was highly efficient with respect to minimizing transport costs to all the minor centers under its control. Finally, Steponaitis showed there was an inverse relationship between proximity to Moundville and the size of a minor center's mound. He suggested that as distance increased from Moundville the demands for tribute and corvee labor decreased (or at least compliance with those demands decreased). The elite at minor centers at the end points of the system, thus, had more goods and labor available for their own aggrandizement than did elite closer to Moundville.

The analyses just described produced considerable insights about the form and operation of the Moundville system. They also

highlighted the need for greater spatial and chronological control over the variables being investigated. The UMMA Moundville project was designed by Peebles to redress some of the short-comings in the extant data.

Working primarily with whole vessels recovered by C. B. Moore and by the Depression era excavations, Steponaitis (1983a:79-126) constructed a ceramic chronology for Moundville. This enabled him to divide the roughly 500-year Mississippian occupation in the Black Warrior Valley into three sequential phases: Moundville I (A.D. 1050-1250), Moundville II (A.D. 1250-1400), and Moundville III (A.D. 1400-1550). Steponaitis (1983a:151-161) then used his ceramic data to trace changes in the size and structure of the Moundville site through time.

At the start of the UMMA project it was thought that, besides the multi-mound site at Moundville, there were at least 10 single mound centers and 8 villages located below the Fall-Line. The UMMA survey crew made controlled surface collections at all known or suspected Moundville phase sites and placed test pits in the mounds at most the subsidiary centers. The data gathered by the survey crew were analyzed by Tandy Bozeman (1982). He used Steponaitis's ceramic chronology to assign relative dates to the materials recovered from the test pits placed in the mounds. This allowed him to investigate the temporal relationships between the various mound centers. His analysis of the controlled surface collections led to the recognition that dispersed hamlets or farmsteads were an important element in the Moundville settlement system. Moreover, he was able to show that

nucleated villages were comparatively late phenomena in the Moundville system. Putting the evidence together, Bozeman was able to sketch changes in the Moundville settlement system through time. Using the better spatial and temporal control at his disposal, he then reanalyzed both the relationships between site size and catchment productivity and the spatial efficiency of the system.

The development of the Moundville system involved not only new social relations but also new economic strategies. The nature and effects of subsistence changes were addressed through studies of the diet and health of the Moundville population. These issues have been approached using both human skeletal remains and subsistence remains. Schoeninger (Peebles and Schoeninger 1981) used human bone strontium levels to measure protein intake. Powell (1985) assessed dietary stress and nutritional adequacy using physical indicators of osteological health. Both employed Peebles mortuary analyses to divide the burial population by social classes. To investigate dietary composition and economic strategies, Lauren Michals (1981) did a preliminary analysis of faunal remains and I analyzed botanical remains.

The refined chronological and spatial control produced by the UMMA project make it possible to sketch, by archaeological phase, the development of the Moundville system. Peebles (1982, 1984), Steponaitis (1983a:151-169), and Bozeman (1982:302-308) have all presented synoptic phase descriptions. Their sketches are in general agreement, varying in emphasis but not in content.

The phase descriptions I present in the following sections are adapted from those of my colleagues. Since the data and analyses from which these constructs were derived are discussed elsewhere (Bozeman 1982; Peebles 1979, 1982, 1984; Steponaitis 1983a), I present only summary information. The results of the dietary studies by Michals, Powell, and Schoeninger are not included in the phase descriptions. Instead, I will discuss their observations after I have presented my own analyses.

When reading the phase descriptions it should be noted that our ability to monitor the cultural changes that occurred in the Black Warrior Valley between A.D. 1050 and A.D. 1550 still lacks precision. There can be no doubt that the ceramic chronology developed by Steponaitis (1983a) has improved our ability to trace and understand the trajectory of the Moundville system. Nevertheless, the current temporal scheme has limitations. Phases that span periods of 150 to 200 years are cumbersome tools for investigating transformations that may have occurred within one or two generations. We need only consider the changes within our own society in the last century and a half to visualize this problem. There is also no necessary or direct relationship between discernible ceramic change and sociocultural change. Thus, as will become apparent in the following pages, the boundaries between the phases do not entirely coincide with changes in the organization or operation of the polities. These comments on the problems in our chronology for the Black Warrior Valley should not be construed as criticism of my colleagues. Bozeman, Peebles, and Steponaitis are well aware that the phases are simply convenient

chronological divisions. Rather, the issue is raised here as a reminder that the phase descriptions are static pictures of a dynamic situation.

Moundville I

The Moundville I phase spans the period from circa A.D. 1050 to A.D. 1250 (Steponaitis 1983a:106). During this phase, four single mound centers were established on the floodplain below the Fall-Line (Figure 3:4). All were built on sites that had prior West Jefferson occupations (Bozeman 1982:304). The data from the UMMA surface collections indicate that the population was dispersed in hamlets and farmsteads situated on or adjacent to the best agricultural soils; there is no evidence for nucleated villages (Bozeman 1982:304).

Moundville was the southernmost of the four mound centers. The Moundville I occupation at Moundville appears to be concentrated in the western portion of the site (Steponaitis 1983a:152). However, Moundville I ceramics are scattered over much of the site (Steponaitis, personal communication 1985; Wimberly 1956). C. B. Moore's excavations in the mounds produced evidence that at least one mound (Mound O) was constructed during this phase (Steponaitis 1983a:152). Since Moore usually halted excavation at a depth of about 4 feet if he did not find anything of interest, it is possible that some of the other mounds have early stages for which we have no evidence (Steponaitis, personal communication 1985).

Using the ceramic chronology to provide temporal divisions for the burial data, Peebles reassessed the results from his mortuary

Figure 3:4. Distribution of Moundville I-III sites

analyses. He suggested that during the Moundville I phase about one percent of the population were interred in locations or with items indicative of superordinate status (Peebles 1984:6). He also proposed the existence in this period of at least one specialized office occupied by an adult male.

Our data for the Moundville I phase are still quite limited; far more work needs to be done on this early stage in the development of the Moundville system. Nevertheless, it is possible to propose that at least in early Moundville I the Mississippian communities below the Fall-Line were organized as simple chiefdoms. The settlement data suggest that the mound sites were political centers for populations scattered in nearby hamlets (Peebles 1982:9; Bozeman 1982:304). The status of Moundville relative to the other mound centers is ambiguous. Initially, it was probably more or less equivalent to the other single mound sites, by the latter portion of the phase it almost certainly had become primus inter pares and may well have assumed dominance over the others.

One unresolved issue is how the Mississippian occupation at Bessemer relates to these developments below the Fall-Line. Radiocarbon dates (Walthall and Wimberly 1978:118-120) indicate that the Mississippian component at Bessemer is contemporary with the Moundville I phase. The ceramics from the site suggest the occupation was coeval with early Moundville I (Steponaitis 1983a:132; Welch 1981a). It seems plausible, that like its contemporaries below the Fall-Line Bessemer was the focal point of a simple chiefdom. In fact, until very recently Bessemer has been considered simply another

Moundville I phase center. Welch (1987) has argued that the factors affecting the emergence of this Mississippian community above the Fall-Line may have been different from those operative below the Fall-Line. His propositions are admittedly speculative and require further investigation. They do, however, highlight the necessity for caution in comparing data from above and below the Fall-Line. This problem is mentioned here because of Bessemer's probable position as the successor to some of the West Jefferson communities from which data are drawn for my study.

Moundville II

The Moundville II phase spans the period from A.D. 1250 to A.D. 1400 (Steponaitis 1983a:114). During this phase some interesting changes occurred in the location and distribution of sites (Figure 3:4). Except for Moundville, all the mound centers established in the Moundville I phase were abandoned and replaced with new centers constructed across the river from the original sites (Bozeman 1982:305; Peebles 1982:9). Also in this phase a new mound center was established on the floodplain south of Moundville (Peebles 1984:6). While there were shifts in the intermediate levels of the settlement hierarchy, the bottom level did not change. The population remained dispersed in hamlets and farmsteads (Bozeman 1982:306-307).

If it had not already done so, Moundville assumed the role of paramount center early in the Moundville II phase. During this period, the site became quantitatively and qualitatively differentiated from the other mound centers. There was a considerable

increase in mortuary activity at the site, presumably indicating a larger population (Steponaitis 1983a:157). Peebles (1984:7) estimates a four-fold growth in the burial population between Moundville I and Moundville II. Moreover, there seems to have been a significant increase in labor invested in construction activities. At least five mounds, and quite possibly more, were erected by the end of the phase (Steponaitis 1983a:157).

The mortuary data indicate not only general population growth but also changes in the size and structure of the superordinate social stratum. The elite class seems to have comprised about five percent of the population and clearly included all ages and both sexes (Peebles 1984:7). Peebles further proposed that at least two distinct political or religious offices were filled by adult male members of the superordinate class (Peebles 1984:7).

Taken together, the shifts in the settlement patterns, the alterations in the structure and size of Moundville, and the changes in burial programs indicate new relationships between the Mississippian communities in the Black Warrior Valley. Sometime in late Moundville I or early Moundville II, the simple chiefdoms below the Fall-Line were integrated into a complex chiefdom. The single mound centers continued to serve the populations in their hinterlands but they in turn were subsidiary to Moundville.

Moundville III

The Moundville III phase spans the period from about A.D. 1400 to A.D. 1550 (Steponaitis 1983a:126). In the early part of this phase,

the Moundville system was at its peak. By the end of the phase, the system had collapsed; Moundville and most of its subsidiary centers were virtually deserted.

There is continuity in the settlement patterns between Moundville II and early Moundville III (Figure 3:4). The minor centers established in Moundville II continued to be used. The system was expanded, however, through the construction of five new mound sites including two south of Moundville (Bozeman 1982:306). Some of the population resided in small dispersed settlements, but for the first time there is evidence for villages as well (Bozeman 1982:306). Contraction of the population into nucleated settlements increased through time. By the end of Moundville III there were at least six sizeable villages, including Moundville, on the floodplain below the Fall-Line (Bozeman 1982:307).

The site of Moundville reached its full glory in early Moundville III. Construction of 16 additional mounds was initiated either in late Moundville II or early Moundville III. With the completion of these mounds the site attained its final east-west symmetry. Mounds paired by size and content faced each other across the large central plaza, and public buildings stood at the corners of the plaza (Peebles 1982:11). There is also evidence from this period for residential districts segregated by status and for "workshop" areas where specialized craft activities were performed (Peebles 1978:377,381).

Bozeman recalculated both the relationship between catchment productivity and site size, and the spatial efficiency of the mound

centers. For Moundville III sites, there was a significant correlation between catchment productivity and site size for minor centers but for Moundville the relationship was vastly different (Bozeman 1982:288). Bozeman also refined Steponaitis's (1978) calculations of the efficiency of settlement locations for the flow of tribute. He found that Moundville's index of spatial efficiency improved dramatically through time. For Moundville I, when Moundville was the southern most mound site, the index was actually lower than the indices for most of the contemporary mound centers (Bozeman 1982:295). In contrast, Moundville's spatial efficiency index approached the ideal for the Moundville III system, if river distances are used in the calculations (Bozeman 1982:295).

The various pieces of evidence indicate that at its zenith in early Moundville III, the Moundville system was a complex chiefdom. The Mississippian communities on the Black Warrior floodplain below the Fall-Line were politically unified under Moundville's hegemony (Steponaitis 1983a:168). Moundville served as the regional center in a three-tiered settlement hierarchy. The single-mound centers were apparently the social and economic link between the rural populations in their territories and the paramount center (Peebles 1984:7). These subsidiary centers were located in situations that facilitated the flow of tribute and corvee labor from the hinterlands to Moundville (Peebles 1982:10).

In late Moundville III this elaborate system seems to have rapidly disintegrated. The reasons for this collapse are a matter of some conjecture but may relate to a decline in long distance trade

that resulted in a loss of power for the elite (Peebles 1984:10; Welch 1986). Whatever the case, in the subsequent Alabama River phase the mound centers were largely abandoned and society seems to have reverted to a more egalitarian form of organization (Steponaitis 1983a:168).

Late Woodland-Mississippian Transition in the Black Warrior Valley

In describing the Late Woodland and Mississippian communities in the Black Warrior Valley, I glossed over some unresolved problems. This enabled me to simplify the discussions, and in most cases the omitted subjects are not germane to my research. However, there is one issue that does impinge on my work and requires recognition.

My presentation is based on the assumption that the Mississippian system in the Black Warrior Valley developed in situ. That is, internal processes led to the reorganization of tribal West Jefferson communities, thereby producing the ranked communities of the Moundville chiefdom. It must be acknowledged that not everyone agrees with this model.

A different model has been proposed by several archaeologists familiar with the data. Jenkins (1978:23-26) and Seckinger (Seckinger and Jenkins 1982) argue that the changes in the ceramic assemblages and in subsistence strategies are too abrupt and too radical to be explained by local developments. Instead, they propose that the observed changes are a result of Mississippian communities or, more likely, small groups of Mississippian elite moving into the area and interacting with the resident Late Woodland populations. They suggest

that there was an extended period of acculturation during which the Late Woodland population moved toward Mississippian norms.

In contrast, both Peebles (1978b:31-33) and Steponaitis (1983a:164-167) have argued that the Moundville system developed in situ. They attribute the sudden appearance of shell tempering, new vessel forms, and new design motifs to changes in the technology and function of ceramics (Peebles 1983:396; Steponaitis 1983:128-132). Moreover, Steponaitis notes that there are continuities in ceramic style, and that some of the contrasts between West Jefferson and Moundville I ceramics may be the product of a chronological gap in our data. That is, our knowledge about Moundville I ceramic types is largely derived from late Moundville I contexts. A second line of evidence they cite in support of a local development is the continuity in settlement location between the West Jefferson and Moundville I phases. The population dispersed to hamlets and farmsteads but the first mound centers were constructed adjacent to locations of earlier West Jefferson villages. These locations thus continued to be the focus of community activities, suggesting that the transition took place in the context of a stable local population (Steponaitis 1983a:167).

In light of the accumulating evidence that most Mississippian systems were local developments, I a proponent of the in situ model of Moundville's development. I believe that much of the discussion about this issue is a result of the limited data we have for the critical, and quite possibly ephemeral, transitional period. Ethnographic parallels can be found for the external origin

explanation offered by Jenkins and Seckinger (e.g., Southall 1956). Given the lack of a clear donor culture for the Moundville system, however, I find the arguments in favor of a local development more plausible. Therefore, I have elected to use an in situ model as the framework for my analyses.

CHAPTER IV

PLANT RESOURCES IN THE BLACK WARRIOR VALLEY

Investigating changes in plant procurement and production strategies requires information about the distribution and availability of resources. The focus of this study is on the transition from a predominantly foraging economy to an agricultural economy. Thus, it is necessary to consider both the distribution of naturally occurring plant foods and the productivity and dependability of crops. In the first portion of this chapter, I use a vegetation reconstruction based on United States General Land Office survey records to examine the availability of non-domesticated plant foods in the Black Warrior Valley. In the second portion of the chapter, I use data on maize requirements and climatic variability to examine the dependability of crop production in the Black Warrior Valley.

The Setting

The Black Warrior Valley transects an area of considerable physiographic and ecological diversity (Figure 4:1). Much of the valley lies within the transition zone between the Piedmont and Coastal Plain regions (Fenneman 1938:67). Above the Fall-Line , the terrain is generally rugged and the river's floodplain is narrow. Below the Fall-Line, upland areas are rolling, the floodplain is broad, and the river follows a meandering course. Mirroring

Figure 4:1. Physiographic setting of the Black Warrior Valley (after Fenneman 1938)

the physiographic transition, the area also includes the ecotone between the temperate Oak-Hickory and Magnolia Maritime forest regions (Shelford 1963:86-87). Portions of Harper's (1943:64-65) Coosa Valley, Coal Basin, Central Short-leaf Pine belt, Eutaw belt, and Black Belt vegetation regions are found within the Black Warrior Valley. Peebles (1978b:43) succinctly summarizes the diversity of the region:

> ...four major physiographic provinces lie within 20 miles of Moundville. To the north of the Fall-Line, in the Ridge and Valley Province and the Cumberland Plateau, the oak-hickory forest is the climax biome. South of the Black Belt, the pine barrens of the Coastal Plain was the dominant forest type. Between these two forests, in the Fall-Line Hills, the interfingering of these two forests plus the floodplain vegetation produced a broad ecotone forest.

The description presented above is adequate for placing the Moundville system and its precursors in a general context. The description is not sufficient for an investigation of subsistence strategies, however. Procurement strategies are adapted to resources, not to ecological zones (Flannery 1968:67). Thus, to study changes in procurement strategies it is necessary to have more detailed information about resource distributions. Modern ecological studies provide some pertinent data, but the distribution and dominance of forest trees have been altered by more than 150 years of Euro-American agricultural and logging activities. Fortunately, for the Black Warrior River Valley we have an excellent record of presettlement/early settlement vegetation communities in the field-notes of the United States General Land Office (GLO) surveyors. These records can be used to reconstruct presettlement forest communities.

Reconstructing Vegetation Using GLO Data

In the late eighteenth century, the GLO was established to survey public lands (Bourdo 1956:757). By the end of the nineteenth century, most of the eastern United States had been surveyed. Survey methods varied depending on the regulations in force when an area was surveyed, but the general procedures remained the same. The surveyors laid out township and range lines that divided the land into townships 36 square miles in area. The townships in turn were subdivided into one square mile sections. To mark section corners, four witness trees (one in each quadrant) were blazed; quarter-sections were marked by blazing two witness trees. The GLO surveyors recorded the common name, direction from the corner, distance from the corner, and in the later surveys diameter at breast height, for each witness tree. Besides recording witness trees, the surveyors made notes about understory vegetation and recorded the common names of trees at points where survey lines crossed bodies of water.

Though the GLO procedures were not designed to survey vegetation communities, Cottam and Curtis (1956) have demonstrated that witness tree records provide a reliable sample for estimating frequency and density of forest trees. In many areas, including the Black Warrior Valley, townships were surveyed either before or shortly after Euro-American settlers began to clear and cultivate the land. In such cases, the GLO witness tree data can be used to reconstruct taxa distributions in presettlement forest communities.

The GLO surveys are a rich source of vegetation information, but witness tree data must be used with caution. There are two potential

problems that must be recognized. First, when a vegetation reconstruction is to be used as the basis for a study of prehistoric man-land interactions, it is necessary to consider whether nineteenth-century vegetation patterns are appropriate models of forest communities in the period being studied. Second, regardless of the use for which the reconstruction is intended, it is important to assess the reliability of the GLO records for a given area.

The GLO surveys generally provide reliable information about the composition of nineteenth-century forest communities, but the data do not necessarily indicate prehistoric vegetation patterns (King 1978, Wood 1976). Because major climatic changes have significant effects on plant distributions, GLO data obviously have little utility for reconstructing pre-Holocene vegetation patterns. Even within the Holocene, however, minor climatic fluctuations may have influenced community composition and boundaries. Most GLO surveys were performed at the end of the "Little Ice Age", a period that appears to have been colder and drier than preceding and succeeding eras (Lamb 1966:11; Oliver 1973:365-367). The effect of this climatic episode on the vegetation observed by the surveyors must be taken into account when using witness tree data. Besides the potential impact of climatic variability, it must also be recognized that anthropogenic factors may not have been constant. For example, prehistoric fire drives or agricultural activities would alter vegetation communities. Because of these potential problems, King and Graham (1981:134-136) suggest that vegetation reconstructions can be used to study general patterns of resource distribution, but not to define precise boundaries between

communities or to make quantitative estimates of the abundance of nuts and other resources. Despite these reservations, the GLO data can be invaluable, particularly for the late prehistoric period, if used cautiously.

Though the GLO surveys followed more or less standard procedures, not all witness tree data are equally reliable. There are several factors that can affect the suitability of GLO data for use in a vegetation reconstruction. First, records from areas where townships were surveyed late in the nineteenth-century or over a considerable period of time are apt to show the impact on vegetation of Euro-American settlement. Second, some surveyors were not skilled at identifying trees. For example, most could distinguish an oak from a pine, but some surveyors could not distinguish different types of oaks or recognize less common trees. The level of detail afforded by the latter surveyors is less than desirable for determining forest composition. Finally, instances of bias in the selection of witness trees have been documented (Bourdo 1956:760). Surveyors were supposed to blaze the closest tree above a certain size in each quadrant, but not all surveyors obeyed this dictate. Because certain types of trees were easier to mark or had wood that was more durable, some surveyors would select such trees over trees that were closer to the section line. Records made by surveyors who had preferences for particular trees do not yield reliable estimates of taxa frequency and density.

Based on her work with GLO records from several areas, Delcourt (1975:3-4), has presented guidelines for assessing whether witness tree data are sufficiently reliable for use in a vegetation

reconstruction. If the goal is to reconstruct presettlement vegetation, then the first step is to determine whether the relevant surveys were conducted early in the period of Euro-American settlement and were completed within a few years of one another. The second step is to evaluate the botanical competence of the individuals who did the surveys, by determining whether they were "...able to recognize a large number of different tree species" (Delcourt 1975:4). These are obvious practical steps.

Delcourt's most important recommendation is a procedure for detecting surveyor bias (Delcourt 1975:3; Delcourt and Delcourt 1974:639-640). She argues that if a surveyor was selecting particular taxa for witness trees, the mean distances from the survey corner to the preferred taxa should be significantly greater than the mean distances to other dominant taxa. This being the case, an analysis of variance with completely random design can be used to evaluate deviance from the mean distance for each of the dominant taxa.

If the criteria discussed above are met (i.e., nineteenth-century vegetation communities are appropriate models, and the relevant GLO data are reliable), then witness tree data can be used to estimate the distribution and abundance of various taxa in presettlement forest communities. To do this soil types and topography are used to divide the area to be reconstructed into ecological zones (e.g., upland, bottomland) and each survey station is assigned to the appropriate

zone. Once this is done, the following formulae can be used to calculate importance values for each taxon (Delcourt 1976:127-128):

$$\text{Relative frequency} = \frac{\text{number of stations at which taxon occurs}}{\text{total number of stations}} \times 100$$

$$\text{Relative density} = \frac{\text{number of individuals of the taxon}}{\text{total number of individuals of all taxa}} \times 100$$

Frequency/Density Index = relative frequency + relative density

These three measures provide different perspectives on taxa distribution and abundance. Relative frequency as used here is a measure of ubiquity; taxa that are common and dispersed will have higher values than taxa that are common but clumped. Relative density is a measure of overall abundance; the most numerous taxon will have the highest value regardless of its distribution. The frequency/density index (maximum value = 200) is a measure of dominance; Delcourt (1976:129) considers a taxon to be a dominant in a community if it has an index value of 10 or more.

Vegetation Reconstruction for the Black Warrior Valley

To obtain information about the distribution and abundance of non-domesticated plant resources, I used GLO data to reconstruct the forest communities in two areas of the Black Warrior Valley. These areas were selected because my study of archaeobotanical remains includes samples from the West Jefferson Steam Plant sites located above the Fall-Line, and samples from sites located within the

boundaries of the Moundville system below the Fall-Line. The portions of the valley in which these sites are located were first settled by Euro-Americans between A.D. 1813 and 1816 (Johnson 1981; Spivey 1982). Throughout the remainder of the nineteenth century, and into the early twentieth century, agriculture and logging were major industries in the valley. Thus, vegetation surveys such as those of Harper (1943) and Mohr (1901) describe forest communities that had been modified by man. Fortunately, the GLO surveys for these areas were conducted between A.D. 1818 and 1821; that is, within ten years of the first permanent Euro-American settlements in the area. Before the settlers' entry, there appears to have been a 140 year hiatus in Native American occupation of the area (Knight 1982:37-77; Curren 1984:238-239). Thus, the vegetation data recorded by the GLO surveyors should indicate forest conditions under minimal anthropogenic disturbance.

This brings us to the question; do early nineteenth-century forest communities provide reasonable models of the environments in which the West Jefferson and Moundville-era populations pursued their subsistence strategies? From the stand point of climatic effects on vegetation the answer is probably yes. Pollen data have been studied from cores taken at two ponds in Alabama (Delcourt 1980; Delcourt et al. 1983). One, Cahaba Pond, is located above the Fall-Line in the Ridge and Valley Province. The other, Goshen Springs, is located on the Coastal Plain. The pollen analyses from both sites indicate that the composition of forest communities in the region has been stable since approximately 5000 BP (Delcourt 1980:384: Delcourt et al. 1983:383-384). Climatic episodes such as the "Little Ice Age" may

have shifted community boundaries somewhat but such episodes do not seem to have altered forest composition. Thus, the GLO data can be considered reasonable approximations of resource distribution in undisturbed forests of the Black Warrior Valley.

This is not to say that the West Jefferson and Moundville-era populations were living in pristine forest communities. To the contrary, it is likely that settlement and subsistence activities of the prehistoric human populations affected resource distributions. Nevertheless, my GLO vegetation reconstructions provide a basis for determining the relative distribution and abundance of mature forest resources and estimating where utilized resources were most likely procured. Moreover, the reconstructions serve as a baseline for examining the impact of the prehistoric settlements on their surroundings.

Because coding and processing witness tree data is a time-consuming process, I did not reconstruct forest communities for the entire Black Warrior Valley. Instead, I reconstructed vegetation patterns for two sections of the valley (Figure 4:2). The section above the Fall-Line is the area in which the West Jefferson Steam Plant sites are located. The second section extends from the Fall-Line to the edge of the Black Belt prairies and encompasses the Moundville system as it is currently defined.

Cross-cultural studies have shown that most foraging activities are conducted within a catchment having a 10 Km radius (Higgs and Vita-Finzi 1972:30; Lee 1968:31). Beyond this distance, transport and labor costs generally are too high to make foraging worthwhile.

Figure 4:2. Locations of townships used in vegetation reconstruction

Recent studies have shown that hunting territories, particularly where long term occupations have depleted fauna close to a settlement, sometimes exceed 10 Km by a considerable margin (see Speth and Scott [1986] and references therein). My research, however focuses on changes in plant procurement and production strategies. It seems reasonable to assume the wild plant resources routinely used by the West Jefferson and Moundville communities would have been procured within a radius of 10 Km from the settlements.

The boundaries of the reconstructed areas thus are set so that the territory within a 10 Km (6 mi) radius of each site is included in the vegetation reconstruction. For the section above the Fall-Line, I collated witness tree data from six townships (Table 4:1). For the section below the Fall-Line, I initially coded witness tree data from 13 townships. Following Delcourt's (1975:3-4) guidelines, however, I did not include two of the townships from the latter area in the analysis. One, located immediately southwest of Moundville, I excluded because it was surveyed 20 years after the others and field-notes about plantations, roads, etc., made it clear that the impact of Euro-American settlement had been felt. The second township, located at the extreme southwest corner of the reconstructed area, I dropped because the surveyor did not recognize as wide a range of trees as the men who surveyed the other townships. The reconstruction for below the Fall-Line is thus based on witness tree data from 11 townships (Table 4:1).

To check for surveyor bias in the witness tree data, I used a one-way analysis of variance (ANOVA) (see above). For these purposes

Table 4:1. Townships used for the vegetation reconstruction.

TOWNSHIP	DATE	SURVEYOR
	Above the Fall-Line	
15S 5W	1819	J. Ralston
16S 4W	1818	H. Clements
16S 5W	1819	W. Lawrence
16S 6W	1821	D. Mitchell
17S 5W	1819	W. Lawrence
17S 6W	1821	D. Mitchell
	Below the Fall-Line	
21S 11W	1820	S. Bell
21S 10W	1820	G. Peevy
22S 11W	1820	J. McGregor
22S 10W	1820	J. McGregor
24N 5E	1818	H. Washington
24N 4E	1820	J. Doxey
24N 3E	1820	J. McGregor
23N 4E	1820	J. Doxey
23N 3E	1820	J. McGregor
22N 4E	1820	J. Doxey
22N 3E	1820	J. McGregor

Source: United States General Land Office Survey Records on file, Alabama Department of State, Montgomery.

I created a computer data base containing the identification and distance from the survey station for each witness tree, and computed a one-way (tree by distance) ANOVA using SYSTAT[1] statistical software. To avoid problems associated with the variances of rare taxa, taxa occurring fewer than five times in a township were combined into a miscellaneous category. The 17 townships I used for the vegetation reconstructions were surveyed by nine different men. Because biases by different surveyors might mask one another, I ran a separate ANOVA for each surveyor. Where an individual had surveyed more than one township, I selected one in which several physiographic zones were represented. For each ANOVA, Bartlett's test (Dixon and Massey 1969:308-310) revealed no significant differences in the homogeneity of variances. The results of the ANOVAs (Table 4:2) indicate no significant biases for any of the surveyors.

Fifty-two different kinds of trees were used as survey markers or noted along survey lines in the GLO records from above and below the Fall-Line. The common names the surveyors used for the witness trees and the most likely taxonomic classifications for those trees are listed in Table 4:3. To determine taxonomic identifications, I used a variety of sources including: Delcourt's (1976:129-132; Delcourt and Delcourt 1974:640-641) lists of taxonomic names for witness trees recorded in early nineteenth-century surveys of Louisiana; Harper's

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1 SYSTAT used here and elsewhere in this volume is the registered trademark for the Systat statistical software package of Systat, Inc., Evanston, Illinois.

Table 4:2. Scores for one-way ANOVA for surveyor bias.

SURVEYOR TOWNSHIP	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQ.	F-RATIO	SIGNIFICANCE
		Townships Above the Fall-Line				
Ralston (1819)	Between	3964.24	10	396.42	0.875	0.56
15S5W	Within	96481.75	213	452.97		
Clements (1818)	Between	3878.30	13	298.33	0.802	0.66
16S4W	Within	129440.13	348	371.95		
Lawrence (1819)	Between	8791.98	14	628.00	1.250	0.24
16S5W	Within	153713.37	306	502.33		
Mitchell (1821)	Between	6192.55	13	476.35	0.823	0.63
17S6W	Within	145356.59	252	576.81		
		Townships Below the Fall-Line				
Peevy (1820)	Between	6771.31	15	451.42	0.857	0.61
21S10W	Within	192743.13	366	526.62		
Bell (1820)	Between	7818.62	13	601.43	1.296	0.21
21S11W	Within	138749.79	299	464.05		
McGregor (1820)	Between	5570.40	15	371.36	1.010	0.45
22S10W	Within	88979.44	242	367.68		
Doxey (1820)	Between	10215.18	21	486.44	1.005	0.46
24N4E	Within	156386.25	323	484.17		
Washington (1818)	Between	9652.60	14	689.47	1.145	0.32
24N5E	Within	176448.94	293	602.21		

Table 4:3. Taxa recorded by GLO surveyors.

COMMON NAME	TAXONOMIC NAME
Alder	Alnus serrulata
Ash	Fraxinus spp.
Bay	Magnolia spp. or Persea borbonia
Beech	Fagus grandifolia
Birch	Betula nigra
Black Gum	Nyssa sylvatica
Box Elder	Acer negundo
Catalpa	Catalpa bignonioides
Cedar	Juniperus virginiana
Cherry	Prunus spp.
Chestnut	Castanea dentata
Chinquapin	Castanea pumila or Q. muehlenbergii
Cottonwood	Populus deltoides
Cucumber	Magnolia macrophylla or M. acuminata
Cypress	Taxodium distichum
Dogwood	Cornus florida
Elm	Ulmus spp.
Hackberry	Celtis laevigata
Haw	Viburnum spp. or Crataegus spathulata
Hazel	Corylus americana
Hickory	Carya spp.
Holly	Ilex opaca
Hornbeam	Carpinus caroliniana
Ironwood	Ostrya virginiana
Lin	Tilia spp.
Maple	Acer rubrum or A. saccharum
Mulberry	Morus rubra
Oak	Quercus spp.
Black Oak	Q. velutina
Black Jack Oak	Q. marilandica or Q. catesbaei
Chestnut Oak	Q. prinus
Mountain Oak	Quercus rubra
Post Oak	Q. stellata
Red Oak	Q. falcata, Q. shumardii
Spanish Oak	Q. coccinea, Q. falcata
Swamp Oak	Q. michauxii
Turkey Oak	Q. laevis ?
Water Oak	Q. nigra
White Oak	Q. alba
Willow Oak	Q. phellos
Pawpaw	Asimina triloba
Persimmon	Diospyros virginiana
Pine	Pinus spp.
Poplar	Liriodendron tulipifera
Redbud	Cercis canadensis
Sassafras	Sassafras albidum
Sourwood	Oxydendrum arboreum
Sweetgum	Liquidambar styraciflua
Sycamore	Platanus occidentalis
Tupelo Gum	Nyssa aquatica
Walnut	Juglans nigra
Willow	Salix nigra

(1943: 133-134, 148-149) lists of common forest trees found in the Central Short-leaf Pine Belt and Eutaw Belt sections of the Black Warrior Valley; and Fowell's (1965) and Harrar and Harrar's (1962) general information about species distributions. The taxonomic nomenclature I use follows that of Radford et al. (1968).

As with many regions, the composition of vegetation communities in the Black Warrior River Valley is strongly influenced by topography, soils, and drainage (Harper 1943:63). To reconstruct presettlement forest communities, I divided the areas into several physiographic zones and used USGS topographic maps and USDA soil maps to assign each GLO station (section corner or quarter-section mark) to a zone. It should be emphasized, that I did <u>not</u> use the identifications of the witness trees when assigning stations to zones. Once the zones were defined, I calculated importance values (see above) for all taxa found in each zone. For zones found both above and below the Fall-Line, measures of taxon distribution were calculated separately for each area.

Forest Communities Above the Fall-Line

For the vegetation reconstruction, I divided the area above the Fall-Line into four physiographic zones. The zones are: uplands, plateaus, bottomlands, and riverbanks. Figure 4:3 shows the distribution of these zones within the reconstructed area. To get a rough measure of the relative proportions of the zones, we can use the percentages of stations assigned to each zone. A total of 685 stations were established within the 6 townships. Most stations, 597

Figure 4:3. Distribution of reconstructed vegetation zones above the Fall-Line

or 87.2%, were in the uplands. The remaining 98 stations were divided among the zones as follows: 18 (2.6%) were on plateaus, 51 (7.4%) were in the bottomlands, and 19 (2.8%) were on riverbanks.

The uplands are by far the most extensive zones above the Fall-Line. Topographically, upland zones are characterized by highly dissected tablelands with steep slopes. Soils in the uplands are derived from residuum shale, siltstone, and sandstone (Spivey 1982:7). Due to their steep slopes and excessive drainage, the uplands are not suitable for cultivation (Spivey 1982:32-33, Table 4).

The witness tree data indicate that under conditions of minimal disturbance, the upland forests were covered in mixed hardwood and pine forests. The importance values for tree taxa found in the uplands are listed in Table 4:4. (Note that the common names listed in the forest composition tables are the names used by the surveyors.) Following Delcourt (1976:129), we can use F-D indices of 10 or more to identify the dominant trees in the upland communities. Using this criterion, there were nine dominant taxa, seven of which yield edible nuts. Five of the nine dominants were species of oak; indeed as a group, oaks comprised 54.5% of all trees in the upland forest. Chestnut and pine were the next most abundant taxa, each accounting for slightly more than 11% of the trees (see Table 4:4, relative density column). Hickory and sourwood, comprising 7.7% and 3.3% respectively, also were dominants.

Plateaus are sections of upland where the relief is less pronounced than in surrounding areas. Topographically, plateau terrain can be described as undulating hills (Spivey 1982:Table 4).

Table 4:4. Importance values for trees found in upland forests above the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Black Oak	264	32.49	16.33	48.83
Post Oak	227	27.97	14.04	42.02
Chestnut	184	23.61	11.38	35.00
Pine	183	22.61	11.32	33.93
Red Oak	137	18.25	8.47	26.73
Hickory	125	16.58	7.73	24.31
White Oak	126	16.24	7.79	24.04
Chestnut Oak	88	12.06	5.44	17.50
Sourwood	62	9.38	3.83	13.21
Black Gum	45	7.03	2.78	9.81
Dogwood	40	5.69	2.47	8.17
Spanish Oak	32	4.69	1.98	6.67
Beech	24	3.51	1.48	5.00
Maple	13	2.17	0.80	2.98
Ash	11	1.84	0.68	2.52
Ironwood	10	1.67	0.61	2.29
Poplar	9	1.50	0.55	2.06
Sweetgum	6	0.83	0.37	1.20
Sassafras	5	0.83	0.30	1.14
Elm	4	0.67	0.24	0.91
Lin	3	0.50	0.18	0.68
Cherry	3	0.50	0.18	0.68
Black Jack Oak	3	0.50	0.18	0.68
Mountain Oak	4	0.33	0.24	0.58
Hornbeam	2	0.33	0.12	0.45
Water Oak	1	0.16	0.06	0.22
Persimmon	1	0.16	0.06	0.22
Redbud	1	0.16	0.06	0.22
Sycamore	1	0.16	0.06	0.22
Chinquapin	1	0.16	0.06	0.22
Oak	1	0.16	0.06	0.22

Like elsewhere in the uplands, soils on the plateaus are derived from residuum sandstone, siltstone, and shale. These soils are moderately fertile but the hill slopes cause erosion problems that hamper cultivation (Spivey 1982:5, 43).

Plateau forests were similar to forests in other parts of the uplands. Table 4:5 presents the importance values for tree taxa found in the plateau zones. Half of the dominant taxa (i.e., taxa with F-D indices of 10 or more) were oak species, and oaks comprised 59% of all trees within the plateau forests. Pine was as abundant as it was in other sections of the uplands, again accounting for 11% of the trees in the zone. Chestnut and hickory were less frequent and less abundant on the plateaus than elsewhere in the uplands. Given the comparatively small number of stations on the plateaus, however, the lower importance values for these taxa may not be significant. The plateau and upland forest seem to have differed in two respects. First, holly was a dominant on the plateau, whereas it did not occur at all in the uplands proper. Second, the plateau forest appears to have been less diverse than the rest of the uplands. While this may be a result of differences in sample size, it is also possible, that the steeper slopes of the uplands provided footholds for taxa that could not compete with the dominants on the more level areas.

Bottomlands are not extensive above the Fall-Line. Because the Black Warrior and its tributaries are entrenched, bottomlands occur in narrow bands along river courses and in somewhat larger patches in river bends. The soils in the bottomlands are formed from recent alluvium deposited by frequent floods. Bottomland soils are highly

Table 4:5. Importance values for trees found in plateau forests above the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
White Oak	8	33.33	18.18	51.51
Black Oak	8	22.22	18.18	40.40
Pine	5	22.22	11.36	33.58
Post Oak	5	22.22	11.36	33.58
Red Oak	4	16.66	9.09	25.75
Holly	5	11.11	11.36	22.47
Chestnut	3	11.11	6.81	17.92
Hickory	3	11.11	6.81	17.92
Chestnut Oak	1	5.55	2.27	7.82
Beech	1	5.55	2.27	7.82
Sweetgum	1	5.55	2.27	7.82

fertile and, depending on drainage, are well suited to cultivation (Spivey 1982:Table 4).

The composition of bottomland forests was different from that of the upland and plateau zones. Table 4:6 presents importance values for taxa found in bottomland communities above the Fall-Line. In contrast to the forests described above, only one of the eight dominant taxa in the bottomland was an oak. Moreover, as a group oaks accounted for only 20.5% of all taxa in the bottomlands. Pine, chestnut, and hickory were likewise less common than in the surrounding hills.

Within the bottomlands, the vegetation found on riverbanks formed a distinct community. Note that trees assigned to the riverbank category are ones that the GLO surveyors recorded at points where survey lines crossed rivers. This contrasts with the other forest communities described here for which I determined zone by topographic and soil associations. Importance values for taxa observed in riverbank forests above the Fall-Line are listed in Table 4:7. Hornbeam and elm clearly are dominant, although 14 other taxa have F-D indices greater than 10. Here, the criterion for dominance is misleading; the many taxa with F-D indices greater than 10 is more a measure of the diversity in the community than of dominance.

Forest Communities Below the Fall-Line

Below the Fall-Line, the Black Warrior floodplain broadens and both the topography and the vegetation communities are more complex. For the vegetation reconstruction of this region, I used five

Table 4:6. Importance values for trees found in bottomland forests above the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Beech	29	37.25	19.86	57.11
White Oak	20	29.41	13.69	43.11
Holly	14	19.60	9.58	29.19
Dogwood	11	17.64	7.53	25.18
Ironwood	8	15.68	5.47	21.16
Maple	7	13.72	4.79	18.52
Sourwood	7	11.76	4.79	16.55
Chestnut	6	11.76	4.10	15.87
Red Oak	5	5.88	3.42	9.30
Post Oak	4	5.88	2.73	8.62
Hickory	3	5.88	2.05	7.93
Black Gum	3	5.88	2.05	7.93
Pine	3	5.88	2.05	7.93
Cucumber	3	5.88	2.05	7.93
Birch	3	3.92	2.05	5.97
Ash	2	3.92	1.36	5.29
Hornbeam	2	3.92	1.36	5.29
Cherry	2	3.92	1.36	5.29
Sweetgum	2	1.96	1.36	3.33
Bay	2	1.96	1.36	3.33
Black Oak	1	1.96	0.68	2.64
Poplar	1	1.96	0.68	2.64
Elm	1	1.96	0.68	2.64
Persimmon	1	1.96	0.68	2.64
Lin	1	1.96	0.68	2.64
Chinquapin	1	1.96	0.68	2.64
Hackberry	1	1.96	0.68	2.64
Sassafras	1	1.96	0.68	2.64
Willow	1	1.96	0.68	2.64
Mulberry	1	1.96	0.68	2.64

Table 4:7. Importance values for trees found in riverbank forests above the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Hornbeam	12	52.63	18.18	70.81
Elm	10	36.84	15.15	51.99
Hickory	4	21.05	6.06	27.11
Turkey Oak	4	21.05	6.06	27.11
Pine	5	15.78	7.57	23.36
Ash	4	15.78	6.06	21.85
Holly	4	15.78	6.06	21.85
Beech	3	15.78	4.54	20.33
Black Gum	2	10.52	3.03	13.55
Ironwood	2	10.52	3.03	13.55
Post Oak	2	10.52	3.03	13.55
Red Oak	2	10.52	3.03	13.55
Birch	2	10.52	3.03	13.55
Catalpa	2	10.52	3.03	13.55
Cucumber	2	10.52	3.03	13.55
Hackberry	2	10.52	3.03	13.55
Box Elder	2	5.26	3.03	8.29
Maple	1	5.26	1.51	6.77
Sassafras	1	5.26	1.51	6.77

physiographic divisions: Fall-Line Hills, terrace, bottomland, swamp, and riverbank. Figure 4:4 shows the distribution of these zones within the reconstructed area. Patches of swamp are found throughout the bottomlands, but since defining boundaries for bottomland zones is difficult swamps are not shown in the map. As with the area above the Fall-Line, the proportion of stations assigned to each zone can be used as a rough measure of the extent of the various forest communities in the section below the Fall-Line. A total of 1342 survey stations was established within the 11 townships I used for the vegetation reconstruction of the Moundville area. The Fall-Line Hills zone contains 584 or 43.5% of the stations. The other 758 stations were divided among the zones as follows: 246 (18.3%) were on the terraces; 355 (26.5%) were in the bottomlands, 84 (6.3%) were in swamps; and 73 (5.4%) were on riverbanks.

The Fall-Line Hills bracket the Black Warrior floodplain. Topographically, this zone is characterized by extensive areas of rolling hills with winding ridge tops, steep slopes, and intermittent streams. The soils in the Fall-Line Hills are typical Coastal Plain soils derived from marine sediments. Erosion, excessive drainage, and low fertility render the Fall-Line Hills unsuitable for cultivation (Johnson 1981:6).

Under conditions of minimal disturbance, the Fall-Line Hills supported a forest of mixed hardwoods and pine. Importance values for trees found in the Fall-Line Hills zone are listed in Table 4:8. Eight taxa had F-D indices greater than 10 and were thus dominants in the community. Red oak and pine, however, occurred at more stations

Figure 4:4. Distribution of reconstructed vegetation zones below the Fall-Line

Table 4:8. Importance values for trees found in Fall-Line Hill forests.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Red Oak	307	36.13	19.65	55.78
Pine	315	35.27	20.16	55.44
Hickory	148	19.69	9.47	29.16
Post Oak	142	19.52	9.09	28.61
White Oak	118	15.75	7.55	23.30
Black Oak	78	9.58	4.99	14.58
Chestnut	64	10.27	4.09	14.37
Black Gum	54	8.21	3.45	11.67
Dogwood	40	6.33	2.56	8.89
Sourwood	30	5.13	1.92	7.05
Sweetgum	31	4.28	1.98	6.26
Maple	26	4.10	1.66	5.77
Beech	25	3.08	1.60	4.68
Holly	26	2.73	1.66	4.40
Poplar	16	2.73	1.02	3.76
Willow Oak	20	1.88	1.28	3.16
Spanish Oak	14	2.22	0.89	3.12
Ash	15	1.54	0.96	2.50
Bay	9	1.54	0.57	2.11
Black Jack Oak	10	1.36	0.64	2.01
Hornbeam	8	1.19	0.51	1.71
Water Oak	10	1.02	0.64	1.66
Elm	7	1.02	0.44	1.47
Cypress	9	0.85	0.57	1.43
Ironwood	6	1.02	0.38	1.41
Sassafras	5	0.85	0.32	1.17
Mulberry	5	0.68	0.32	1.00
Chestnut Oak	4	0.68	0.25	0.94
Sycamore	4	0.51	0.25	0.76
Chinquapin	3	0.51	0.19	0.70
Persimmon	3	0.51	0.19	0.70
Cucumber	3	0.34	0.19	0.53
Swamp Oak	2	0.34	0.12	0.47
Tupelo Gum	2	0.17	0.12	0.29
Haw	1	0.17	0.06	0.23
Alder	1	0.17	0.06	0.23
Hazel	1	0.17	0.06	0.23

and were more abundant than the other "dominants". Oaks comprised 45% of all trees in the Fall-Line Hills. Hickory was slightly more abundant than in the upland forest above the Fall-Line, but chestnut was much less common.

The terrace zones, as I use the term here, are high stream terraces above the escarpment of the Black Warrior River (Johnson 1981:16, 27-28). There are large expanses of terrace on both sides of the river just below the Fall-Line. There is also a discontinuous band of terraces along the interface of the Fall-Line Hills and bottomlands on the east side of the Black Warrior River. Moundville, itself, sits on a broad terrace at a point where the river cuts close to the Fall-Line Hills. Terrace lands are comparatively high, standing above all but the most severe floods. The terrain in these areas is level to gently sloping. Most terrace soils are suitable to cultivation, though they vary from moderately to well-drained, and from moderately to highly fertile (Johnson 1981:Tables 5 and 15).

Terrace forests were similar to those found in the Fall-Line Hills. Table 4:9 lists importance values for tree taxa found in the terrace zones. Oaks were abundant in the terraces, comprising four of the eight dominant taxa and accounting for 50% of all trees in the zone. Pine was about as common as it was in the Fall-Line Hills. Hickory was slightly less abundant than in the Fall-Line Hills, but not markedly so.

The Black Warrior floodplain is well developed below the Fall-Line. The bottomlands are a complex mosaic of levees and ridges, which drain rapidly after floods; first bottoms, which have standing

Table 4:9. Importance values for trees found in terrace forests below the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Pine	139	39.02	21.12	60.14
Post Oak	98	26.82	14.89	41.72
Red Oak	88	26.01	13.37	39.39
White Oak	69	21.95	10.48	32.43
Black Oak	65	19.91	9.87	29.79
Hickory	50	16.26	7.59	23.85
Chestnut	25	9.34	3.79	13.14
Dogwood	21	8.13	3.19	11.32
Sourwood	21	6.50	3.19	9.69
Sweetgum	19	6.50	2.88	9.39
Black Gum	10	4.06	1.51	5.58
Willow Oak	10	3.25	1.51	4.77
Chinquapin	6	2.43	0.91	3.35
Maple	6	2.43	0.91	3.35
Beech	5	2.03	0.75	2.79
Poplar	4	1.62	0.60	2.23
Holly	4	1.21	0.60	1.82
Spanish Oak	4	1.21	0.60	1.82
Swamp Oak	3	1.21	0.45	1.67
Bay	3	0.81	0.45	1.26
Chestnut Oak	2	0.81	0.30	1.11
Sassafras	2	0.81	0.30	1.11
Ash	2	0.81	0.30	1.11
Persimmon	1	0.40	0.15	0.55
Hornbeam	1	0.40	0.15	0.55

water for extended periods after floods; and swamps, which are wet year-round. Most bottomland soils are highly fertile because nutrients are replenished by frequent floods, but the alluvial soils differ markedly in drainage characteristics (Johnson 1981: Tables 5 and 15). The differences in elevation and drainage within the bottomlands affect the distribution of vegetation (Braun 1964:290-296). The precision of the available topographic maps and the GLO data, however, precludes separating levee and ridge communities from first bottom communities for the vegetation reconstruction. Moreover, even if it were possible to make such distinctions, the greater precision might be misleading. Minor changes in rainfall patterns or shifts in the course of the river would alter the distribution of bottomland forest communities. Therefore, the first bottoms, levees and ridges were treated as a unit for the reconstruction.

Bottomland forests contained a diverse array of deciduous and evergreen hardwoods. The importance values for taxa found in bottomland communities below the Fall-Line are listed in Table 4:10. There are 12 taxa that would be considered dominants on the basis of their F-D indices. Holly, the most abundant of the dominants, accounted for only 11% of the trees found in the bottomlands, however. Two oak species, pine, and hickory were found among the dominants, but the importance values of these taxa are about half of the values for the same taxa in the Fall-Line Hills. Oaks comprised 22.6% of all trees in the bottomlands.

Swamps are the lowest, most poorly drained areas within the bottomlands. Stations were assigned to the swamp zone if the

Table 4:10. Importance values for trees found in bottomland forests below the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Holly	107	20.56	11.01	31.58
Sweetgum	95	20.56	9.78	30.34
White Oak	92	19.43	9.47	28.91
Beech	94	19.15	9.68	28.83
Pine	69	12.67	7.10	19.78
Red Oak	55	12.95	5.66	18.62
Maple	53	12.39	5.45	17.85
Hickory	46	10.98	4.73	15.72
Black Gum	38	8.16	3.91	12.08
Bay	34	7.60	3.50	11.10
Dogwood	34	7.32	3.50	10.82
Ash	31	7.32	3.19	10.51
Hornbeam	28	6.76	2.88	9.64
Elm	27	6.19	2.78	8.97
Black Oak	23	5.91	2.36	8.28
Willow Oak	21	4.22	2.16	6.38
Ironwood	15	3.66	1.54	5.20
Post Oak	17	3.38	1.75	5.13
Mulberry	12	2.25	1.23	3.48
Sassafras	9	2.53	0.92	3.46
Water Oak	9	2.25	0.92	3.18
Poplar	9	2.25	0.92	3.18
Sourwood	8	2.25	0.82	3.07
Chestnut	5	1.40	0.51	1.92
Persimmon	7	1.12	0.72	1.84
Sycamore	6	1.12	0.61	1.74
Chinquapin	4	1.12	0.41	1.53
Hackberry	4	1.12	0.41	1.53
Box Elder	4	0.84	0.41	1.25
Lin	3	0.84	0.30	1.15
Tupelo Gum	2	0.56	0.20	0.76
Swamp Oak	2	0.56	0.20	0.76
Oak	1	0.28	0.10	0.38
Cypress	1	0.28	0.10	0.38
Cucumber	1	0.28	0.10	0.38
Walnut	1	0.28	0.10	0.38
Pawpaw	1	0.28	0.10	0.38
Willow	1	0.28	0.10	0.38
Cherry	1	0.28	0.10	0.38
Hazel	1	0.28	0.10	0.38

topographic and soil maps indicated they were located in areas that are permanently wet. Table 4:11 lists the importance values for tree taxa found in the swamps. The swamp forest was quite different from the other forest communities, though it contained taxa that were found scattered in other zones. Not surprisingly, water tolerant taxa such as sweetgum, holly, and black gum were common. Oaks comprised 25.4% of all trees, but the proportions of the various oak species differed from the other forest communities. The hickories found in the swamps were probably bitternut and water hickories (*Carya cordiformis* and *C. aquatica*) rather than hickories that produce palatable nuts.

The riverbank community was different not only from the forests of the surrounding bottomlands but also from the riverbank vegetation in the area above the Fall-Line. Importance values for riverbank taxa found below the Fall-Line are listed in Table 4:12. Maple, ash, hackberry, and sycamore were so closely associated with the riverbank communities that when reading the GLO records, I could tell the surveyors were approaching a river by the presence of these taxa. Including the 4 taxa just discussed, there were 11 dominant taxa in the riverbank forests, none of which was an oak. As with the swamp forest, the hickories found on the riverbanks were probably not species that produced desirable nuts.

Potential Plant Foods Found in the Black Warrior Valley Forests

The vegetation reconstruction provides a basis for evaluating the availability of potential plant foods in unmodified forests within the Black Warrior Valley. Because a tree had to be above a certain size

Table 4:11. Importance values for trees found in swamp forests below the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Sweetgum	22	19.04	10.18	29.23
Holly	24	16.66	11.11	27.77
Black Gum	19	16.66	8.79	25.46
Maple	15	15.47	6.94	22.42
Willow Oak	20	13.09	9.25	22.35
White Oak	16	11.90	7.40	19.31
Beech	16	10.71	7.40	18.12
Hornbeam	8	8.33	3.70	12.03
Red Oak	7	8.33	3.24	11.57
Ash	11	5.95	5.09	11.04
Cypress	9	5.95	4.16	10.11
Hickory	6	5.95	2.77	8.73
Water Oak	6	4.76	2.77	7.53
Elm	5	4.76	2.31	7.07
Mulberry	5	4.76	2.31	7.07
Bay	4	4.76	1.85	6.61
Sycamore	4	3.57	1.85	5.42
Black Oak	3	3.57	1.38	4.96
Dogwood	3	3.57	1.38	4.96
Ironwood	2	2.38	0.92	3.30
Sassafras	2	2.38	0.92	3.30
Tupelo Gum	2	1.19	0.92	2.11
Post Oak	1	1.19	0.46	1.65
Spanish Oak	1	1.19	0.46	1.65
Swamp Oak	1	1.19	0.46	1.65
Pine	1	1.19	0.46	1.65
Persimmon	1	1.19	0.46	1.65
Haw	1	1.19	0.46	1.65
Alder	1	1.19	0.46	1.65

Table 4:12. Importance values for trees found in riverbank forests below the Fall-Line.

TAXA	COUNT	RELATIVE FREQUENCY	RELATIVE DENSITY	F-D INDEX
Maple	52	41.09	21.22	62.32
Ash	28	34.24	11.42	45.67
Hackberry	26	27.39	10.61	38.00
Sycamore	22	24.65	8.97	33.63
Beech	16	16.43	6.53	22.96
Hickory	12	16.43	4.89	21.33
Elm	11	15.06	4.48	19.55
Mulberry	11	15.06	4.48	19.55
Sweetgum	12	13.69	4.89	18.59
Sassafras	11	10.95	4.48	15.44
Holly	10	10.95	4.08	15.04
Poplar	6	6.84	2.44	9.29
Hornbeam	5	6.84	2.04	8.89
Box Elder	5	5.47	2.04	7.52
Black Oak	3	4.10	1.22	5.33
Red Oak	2	2.73	0.81	3.55
Pine	2	2.73	0.81	3.55
Black Gum	2	2.73	0.81	3.55
White Oak	2	1.36	0.81	2.18
Birch	2	1.36	0.81	2.18
Willow Oak	1	1.36	0.40	1.77
Bay	1	1.36	0.40	1.77
Ironwood	1	1.36	0.40	1.77
Willow	1	1.36	0.40	1.77
Cottonwood	1	1.36	0.40	1.77

to be used as a witness tree, the GLO data are primarily a record of canopy vegetation. The distribution of potential plant foods from overstory forests is of obvious importance for investigating procurement strategies. To gain a more complete picture, however, understory trees, shrubs, and herbs must also be considered as potential food producers.

Many taxa recorded in the GLO surveys produce edible nuts or fruits. Tables 4:13 and 4:14 present the distribution by forest community of food-producing trees. The percentages listed are relative density values, that is, the proportion of all trees within a zone belonging to a given taxon. To simplify this discussion, the oaks are combined by subgenus in the tables. The white oak group (Lepidobalanus) includes chestnut oak, post oak, swamp oak, and white oak. The red oak group (Erythrobalanus) includes black oak, black jack oak, mountain oak, red oak, spanish oak, turkey oak, water oak, and willow oak.

Based on the GLO data, the forests above and below the Fall-Line contained abundant nut resources. Within the forests of the two regions, however, nut taxa were not evenly distributed. Except for beech, nut producing trees were more common in the upland, plateau, Fall-Line Hill, and terrace forests than in bottomland communities. Nut trees were not only less abundant in the floodplain forests, but nut groves were located on levees and ridges separated by tracts of backswamp. Nuts might well have been collected from trees growing near a bottomland settlement, but to harvest nuts in quantity, the

Table 4:13. Distribution of food-producing trees above the Fall-Line.

UPLANDS		PLATEAU		BOTTOMLAND		RIVERBANK	
TAXA	%	TAXA	%	TAXA	%	TAXA	%
White Oaks	27.3	White Oaks	31.8	Beech	19.9	Red Oaks	9.1
Red Oaks	27.3	Red Oaks	27.3	White Oaks	16.4	Hickory	6.1
Chestnut	11.4	Chestnut	6.8	Red Oaks	4.1	Beech	4.5
Hickory	7.7	Hickory	6.8	Chestnut	4.1	White Oaks	3.0
Cherry	0.2	Beech	2.3	Hickory	2.1	Hackberry	3.0
Persimmon	0.1			Cherry	1.4		
				Persimmon	0.7		
				Hackberry	0.7		
				Mulberry	0.7		

Table 4.14. Distribution of food-producing trees below the Fall-Line.

FALL-LINE HILLS		TERRACE		BOTTOMLAND		RIVERBANK		SWAMP	
TAXA	%	TAXA	%	TAXA	%	TAXA	%	TAXA	%
Red Oaks	28.1	White Oaks	26.1	White Oaks	11.5	Hackberry	10.6	Red Oaks	17.1
White Oaks	17.0	Red Oaks	25.4	Red Oaks	11.1	Beech	6.5	White Oaks	8.3
Hickory	9.5	Hickory	7.6	Beech	9.7	Hickory	4.9	Beech	7.4
Chestnut	4.1	Chestnut	3.8	Hickory	4.7	Mulberry	4.5	Hickory	2.8
Beech	1.6	Beech	0.8	Mulberry	1.3	Red Oaks	2.4	Mulberry	2.3
Mulberry	0.3	Persimmon	0.2	Persimmon	0.7	White Oaks	0.8	Persimmon	0.5
Persimmon	0.2			Chestnut	0.5			Haw	0.5
Hazel	0.1			Hackberry	0.4				
Haw	0.1			Walnut	0.1				
				Pawpaw	0.1				
				Cherry	0.1				
				Hazel	0.1				

most efficient strategy would be to concentrate collection activities in forest zones lying outside the bottomlands.

Identifying the areas where nuts were most likely harvested is not sufficient for understanding procurement strategies. Nut taxa vary in several important respects; among other things, nut taxa differ in frequency of large masts, in collection and processing requirements; and in nutritional composition. Nut procurement strategies would have to be adjusted to these factors.

Most nut trees do not produce large masts every year, and within a grove trees tend to have synchronized production cycles (Table 4:15). Thus, the quantities and kinds of nuts available for harvest in the Black Warrior Valley would vary from one year to the next, and from one section of the hills to another. Therefore, nut groves would have to have been monitored periodically. Information gathered before the nuts ripened could be used to decide: which taxa to collect, where to collect, and whether to harvest nuts before they dropped to minimize losses to animal competitors or whether to wait for natural seed dispersal.

Nut procurement strategies also had to be adjusted to the collection and processing requirements of the available nut taxa. Because chestnuts and acorns from the white oak group rapidly germinate or spoil if left on the ground or in the shell unprocessed (Schopmeyer 1974:274,698-699), nuts from these taxa would have to be gathered and dried soon after they fell. Thus, there would have been little flexibility to the scheduling of either the harvest or processing of chestnuts and acorns from white oaks. Acorns from the

Table 4:15. Frequency of large nut crops for taxa found in the Black Warrior Valley.

TAXA	SEASON	YEARS BETWEEN GOOD CROPS
Chestnut	Aug-Sept	1
Beech	Sept-Nov	2-3
White Oak Group		
Chestnut Oak	Aug-Nov	2-3
Post Oak	Sept-Nov	2-3
Swamp Oak	Sept-Oct	3-5
White Oak	Sept-Oct	4-10
Red Oak Group		
Black Oak	Sept-Nov	2-3
Mountain Oak	Sept-Oct	3-5
Red Oak	Sept-Nov	2-5
Spanish Oak	Sept-Nov	3-5
Water Oak	Aug-Oct	1-2
Willow Oak	Aug-Oct	1
Hickories		
Bitternut	Sept-Dec	3-5
Mockernut	Sept-Dec	2-3
Pignut	Sept-Dec	1-2
Shagbark	Sept-Dec	1-3
Water Hickory	Sept-Nov	1-2

Sources: Fowells 1967; Schopmeyer 1974.

red oak group have dormancy mechanisms that delay germination and high levels of tannic acid that act as preservatives (Schopmeyer 1974:700). There was thus somewhat less urgency to the harvesting of acorns from red oaks. To store acorns from red oaks for more than a season, however, they would have to be dried to prevent germination. In addition, to make the nuts palatable the tannin would have to be leached. Beech nuts are not dispersed until after the first autumn frost, and do not germinate until the following spring (Fowells Table 1965:174). Thus like red oak acorns, there would have been some flexibility to timing the harvest of beech nuts. Beech nuts, however, are much smaller than the other nuts found in the Black Warrior Valley. The time required to collect and extract beech nut kernels may have made the nuts from this taxon a less attractive resource than the other nuts available in the valley. Hickory nuts have dormancy mechanisms and their thick shells help prevent spoilage (Schopmeyer 1974:271-272). Provided there were sufficient nuts to accommodate losses to animals, harvesting of hickory nuts could have been delayed, if necessary. Unshelled hickory nuts could also be stored in dry conditions for several years (Schopmeyer 1974:271). Because of the convolutions on the interior walls of their shells, hickory nutmeats are difficult to extract. Indeed, according to ethnohistoric accounts, Native Americans often rendered hickory oil simply by smashing the nuts and boiling them shell and all (Swanton 1946:243).

The final, and perhaps most important, factor that may have affected nut procurement strategies is that the nut taxa available in

the Black Warrior Valley vary significantly in their food values (Table 4:16). Hickory nuts are good sources of protein and fat but their carbohydrate content is low. In contrast, acorns, chestnuts, and beech nuts have lower levels of protein and fat, but are good sources of carbohydrates. The kinds of nuts harvested and the proportions in which they were harvested were probably dependent on the relative availability and quality of other protein and carbohydrate sources (see, for example, the discussion by Speth and Spielmann [1983] about the benefits of adding carbohydrates to a diet when the available animal protein is low quality).

Nut trees were by far the most abundant food-producing taxa recorded by the GLO surveyors, but they were not the only ones. Some fruit-producing trees were also found in the canopy vegetation. In contrast to nut trees, however, fruit trees were primarily found in the bottomland forests (see Tables 4:13 and 4:14).

Understory trees, shrubs, and herbs that were potential food resources were also more abundant in the bottomland communities. Table 4:17 lists potential plant food resources other than nuts that are found in the Black Warrior Valley. Plants included in the table are known to have been used for food by Native Americans in the Southeast. The list is by no means exhaustive, but it does indicate the kinds of wild plants that might have been collected and the habitats in which those resources would have been found. The distributions of potential food resources by general habitat are summarized in Table 4:18. Two things are readily apparent from this table. First, under conditions of minimal anthropogenic disturbance,

Table 4:16. Nutritional composition of nuts per 100 grams edible portion.

TAXA	WATER (g)	TOTAL ENERGY (calories)	PROTEIN (g)	FAT (g)	CARBOHYDRATES Total (g)	CARBOHYDRATES Fiber (g)
Hickory Nut (dried)	2.65	657	12.72	64.37	18.25	3.24
Acorns (dried)	5.06	509	8.10	31.41	53.66	3.38
Chestnut * (dried)	9.00	369	5.01	3.91	78.43	5.00
Beechnut (dried)	6.60	576	6.20	50.00	33.50	3.70

* Values for Chestnut based on European Chestnuts; figures for American Chestnuts not available due to blight.

Source: McCarthy and Matthews 1984.

Table 4:17. Habitats and seasonality of potential plant foods.

TAXA	HABITAT	SEASON(S)
Small Grain and Oil Seeds		
Maygrass (*Phalaris caroliniana*)	moist soils, disturbed soils	late spring - early summer
Cane (*Arundinaria* sp.)	alluvial woods, dry woods	summer (sporadic)
Sedge (Cyperaceae)	moist soils, disturbed soils	summer - fall
Chenopod (*Chenopodium* spp.)	disturbed soils, fields	late summer - fall
Amaranth (*Amaranthus* spp.)	disturbed soils, fields	summer - fall
Knotweed (*Polygonum* sp.)	disturbed soils, moist soils, fields	summer - fall
Wild Bean (*Strophostyles* sp.)	fields, woods, clearings	late summer - fall
Purslane (*Portulaca oleracea*)	fields, disturbed soils	summer - fall
Sumpweed (*Iva annua*)	fields, disturbed soils	late summer - fall
Giant Ragweed (*Ambrosia trifida*)	fields, moist soils	summer - fall
Greens		
Pokeweed (*Phytolacca americana*)	disturbed soils, fields	summer - fall
Wood Sorrel (*Oxalis* sp.)	woods, thickets disturbed soils	late spring - fall
Spurge (Euphorbiaceae)	disturbed soils, fields	summer - fall
Carpetweed (*Mollugo verticillata*)	disturbed soils, fields	summer - fall
Peppergrass (*Lepidium virginicum*)	old fields, disturbed soils	spring - summer
Nettle (*Urtica* sp.)	moist soils, disturbed soils	summer
Plantain (*Plantago* sp.)	moist soils, disturbed soils	spring - summer

Table 4.17. Continued.

TAXA	HABITAT	SEASON(S)
Fleshy Fruits		
Persimmon (*Diospyros virginiana*)	dry woods, pinelands, old fields	fall
Maypop (*Passiflora incarnata*)	fields, thickets	late summer
Grape (*Vitis* spp.)	woods, thickets, ravines, river banks	mid-summer - early fall
Cherry/Plum (*Prunus* spp.)	moist woods, thickets old fields	summer
Sumac (*Rhus* spp.)	thickets, old fields, woodland borders	summer - fall
Honey Locust (*Gleditsia triacanthos*)	moist woods, thickets, woodland borders	fall
Blueberry (*Vaccinium* spp.)	dry woods, pinelands, thickets	summer
Bramble (*Rubus* sp.)	old fields, clearings, woodland borders	summer
Elderberry (*Sambucus canadensis*)	moist woods, clearings old fields	late summer
Hackberry (*Celtis* sp.)	river banks, moist woods	late summer - fall
Hawthorne (*Crataegus* spp.)	dry woods, moist woods, thickets	late summer - fall
Mulberry (*Morus rubra*)	moist woods, river banks	summer
Serviceberry (*Amelanchier arborea*)	upland and alluvial woods	early summer
Pawpaw (*Asimina triloba*)	alluvial woods	late summer - fall
Strawberry (*Fragaria virginiana*)	old fields, woodland borders	late spring - early summer
Haw (*Viburnum* sp.)	dry woods, alluvial woods	fall

Table 4:17. Continued.

TAXA	HABITAT	SEASON(S)
Roots and Tubers		
Groundnut (*Apios americana*)	moist woods, thickets	year round
Greenbrier (*Smilax* sp.)	moist woods, thickets, old fields	year round
Wild Sweet Potato (*Ipomoea pandurata*)	old fields, disturbed soils	year round
Wild Onion/Garlic (*Allium* sp.)	moist woods, old fields	spring
Evening Primrose (*Oenothera biennis*)	disturbed ground, old fields	summer
Yellow Nutgrass (*Cyperus esculentis*)	pioneer on sand bars, old fields	summer
Wapato (*Sagittaria latifolia*)	swamp margins	spring - fall

Sources: Harper 1944; Jackson 1986:162-200; Medsger 1966; Radford et al. 1968; Swanton 1946.

Table 4:18. Distribution of potential plant foods by habitat.

UPLAND/HILLS	BOTTOMLANDS	SUCCESSIONAL
Small Grain and Oil Seeds		
Cane	Maygrass	Maygrass
	Cane	Sedge
	Sedge	Chenopod
	Knotweed	Amaranth
	Wild Bean	Knotweed
	Giant Ragweed	Purslane
		Wild Bean
		Sumpweed
		Giant Ragweed
Greens		
Wood Sorrel	Nettle	Pokeweed
	Plantain	Wood Sorrel
		Spurge
		Carpetweed
		Peppergrass
		Nettle
		Plantain
Fleshy Fruits		
Persimmon	Grape	Persimmon
Sumac	Cherry/Plum	Maypop
Blueberry	Honey Locust	Grape
Hawthorne	Elderberry	Cherry/Plum
Haw	Hackberry	Sumac
Serviceberry	Hawthorne	Honey Locust
	Mulberry	Bramble
	Haw	Elderberry
	Serviceberry	Strawberry
	Pawpaw	
Roots and Tubers		
	Groundnut	Greenbrier
	Greenbrier	Wild Sweet Potato
	Wild Onion/Garlic	Wild Onion/Garlic
	Wapato	Evening Primrose
	Yellow Nutgrass	Yellow Nutgrass

the bottomlands contained far more non-nut food resources than the uplands or Fall-Line Hills. Second, clearing land for settlements, gardens, or fields would have a beneficial effect on the availability of many potential food resources.

The greater availability of non-nut food plants in bottomland habitats has some interesting ramifications. Prehistoric populations living above and below the Fall-Line had comparable access to nut resources. In both areas nut trees were abundant within the reconstructed catchments. Moreover, the upland and Fall-Line Hill forests form vast tracts beyond the boundaries of the catchments. In times of stress it would have been possible to go farther afield to harvest nuts, provided competition with other human groups was not a problem. In contrast, access to resources other than nuts was not comparable for human communities living in different sections of the Black Warrior Valley. The bottomlands are far more extensive and more complex below the Fall-Line. Thus, potential non-nut food resources found in bottomland communities would have been more abundant, and perhaps more diverse, in the lower portion of the Black Warrior Valley.

Maize Production in the Black Warrior Valley

This research concerns changes in plant procurement and production strategies during the period when the population in the Black Warrior Valley was shifting from dependence on a foraging/gardening subsistence economy to an agricultural subsistence economy. In the preceding pages, I presented information about the

distribution and abundance of naturally occurring plant foods. Since the subsistence changes I am examining involve increasing use of domesticated plants, it is equally important to consider the availability and dependability of resources from environments manipulated by humans. When discussing the distribution of plant food resources in the reconstructed vegetation communities, I noted that the availability of many non-domesticated plant foods would have been enhanced by human activities. In the remainder of this chapter, I focus on the dependability of domesticated plants, particularly maize.

There is little doubt that maize was the principal crop of Mississippian populations. Accounts from the de Soto entrada describe vast expanses of maize fields, and throughout most of their travels the Spanish soldiers lived off grain commandeered from the stored supplies they found in the territories through which they passed (Smith 1968; Varner and Varner 1981). Other early European observers reported that Native Americans in the Southeast raised several maize cultivars, which they distinguished by when the grain matured and how the grain was used (Swanton 1946:268,274,290). Analyses of carbon isotope ratios in human skeletal remains from several late prehistoric populations indicate that maize was a significant element in the diet during the Mississippian period (Bender et al. 1981; Broida 1984; van der Merwe and Vogel 1978). Thus, for any investigation of a Mississippian subsistence economy, understanding the local productivity and reliability of maize agriculture is critical.

Questions about Mississippian maize production can be divided into two broad categories. The first includes questions about the

relationship between the size and distribution of settlements and variability in production potential within a region (e.g., the extent, distribution, and fertility of soils suitable for growing maize). Several of my colleagues have ably investigated questions of this type for the Moundville system (Peebles 1978a:400-410; Bozeman 1982:279-290; Welch 1986). Their results indicate that Moundville-era sites are located on or near highly productive maize soils (Peebles 1978a:405), and that there is a relationship between the size of the minor ceremonial centers and the potential for maize production within 1 Km radii catchments surrounding the centers (Bozeman 1982:288-290; Welch 1986).

The next step in exploring the relationship between Moundville-era sites and agricultural production is to determine whether there is a relationship between the locations of farmsteads and hamlets and the distribution of prime agricultural soils. Unfortunately, though we know such settlements exist, we lack systematic survey data for this settlement class. Without further information about where farmsteads and hamlets were located and how many were occupied during the various phases, it is fruitless to pursue this line of investigation.

The second category of questions about Mississippian maize production concerns the reliability of the crop. In other words, how dependable is maize production in a particular context? Here, attention is focused on the physiological requirements of the maize plant and fluctuations in the relevant climatic and edaphic variables that affect crop production. This category of questions is particularly germane because several scholars have suggested that the

risk of crop failure may have been a selective factor in the emergence of some Mississippian chiefdoms (Brown 1974:24; Chmurny 1973:242-257; Ford 1974:405-408, 1977:180-182; Peebles and Kus 1977:443; Smith 1974:30; see Chapter II for a discussion of these propositions).

The issue of agricultural dependability has never been explicitly addressed for the Moundville area. In the following pages, I discuss the reliability of maize production in the Black Warrior Valley. To examine the risk of severe crop losses, I describe the needs of the maize plant at different developmental stages and use climatological data to determine what factors posed the greatest threats to maize production and how often these adverse conditions occurred. I use my conclusions to suggest strategies for successful maize production in the Black Warrior Valley and to consider whether agricultural risk was a selective agent in the emergence of the Moundville chiefdom.

Climatic Requirements of Maize

There are several measurement problems that affect the precision with which we can estimate the agricultural risk faced by prehistoric populations in the Black Warrior Valley. Crop yields are influenced by numerous factors; measuring the effects on yield of variability in one or more factors is difficult even in controlled experiments. Besides this, most crop studies present results as percentage reductions in yield compared to yields obtained under optimum conditions. Since optimum conditions are rarely met, translating the reported yield decrements to expectations under field conditions is difficult. Another problem is that maize cultivars differ in both the

rates at which they mature and their tolerance of adverse conditions. Early ethnohistoric accounts indicate that Mississippian populations raised several maize cultivars; and I will offer evidence later (see Chapter IX) that several maize cultivars were grown in the Black Warrior Valley during the Moundville era. We have little information, however, about the maturation rates and tolerances of these cultivars. Finally, the climatic data I use span the period from about A.D. 1880 to 1950. These records are the best estimates we have for weather patterns in the late prehistoric period, but they are undoubtedly not a perfect fit. Because of these problems any attempt to estimate percentage losses under varying circumstances would be misleading. It is, however, possible to investigate how often severe crop reductions would be incurred.

Both the requirements of the maize plant and the effects of adverse conditions on grain production vary over the course of the growing season. Shaw (1977, 1983) has synthesized data on the climatic requirements of maize at different growth stages. His discussions serve as the basis for the sketch presented here.

Maize germination is inhibited at soil temperatures below 50° F. The first fields often are planted a few days after the mean date for the last killing frost (Stringfield 1955:360). The bulk of the crop, however, is sown when the mean temperature reaches about 61° F. Since spring soil temperatures do not fluctuate as widely as air temperatures, a late frost will have little effect provided it is not part of a prolonged cold snap. Warm temperatures at planting are beneficial.

Soil moisture conditions at planting are critical not only to germination and early development but also to events later in the growing season. Too little moisture inhibits germination, though this can be counteracted to some extent by deep planting or soaking seeds before they are planted. Excessive moisture (greater than 80% soil saturation) at planting or shortly thereafter can kill seeds and young plants by oxygen starvation and, at the least, result in poor root development. Thus, saturated soils require delayed planting or use of ridge or hill cultivation to provide adequate drainage. While excessive soil moisture is undesirable, moisture reserves near soil capacity are beneficial. Soils with available moisture capacities of 5 cm/30 cm (.17 in/1 in), can store up to half of the moisture needed for production of a successful maize crop.

During early vegetative growth (from germination through flower differentiation), maize seedlings are fairly resilient. The growing point of the plant is below the ground for the first week or two after germination. Frost at this time will injure above ground vegetation, but has little affect on the future development of the plant or on grain yield. Once the growing point reaches the surface, however, frost occurring any time before the grain is mature can cause serious crop losses. Mild droughts will slow growth but are otherwise beneficial because they encourage root development. This enables the plant to withstand greater moisture stress later in the season. Thus, early droughts are a problem only if they are severe enough to kill plants. As with germination, excessive soil moisture is the greatest threat to seedling development. Very young plants can be severely

injured by even short floods, and root development is poor in saturated soils.

From the late vegetative growth stage through flowering and the early part of grain set, the moisture requirements of the maize crop are much higher than in the early stages of development. Throughout these stages, inadequate moisture supplies result in decreased yields. The extent of yield reductions depends on the timing, severity, and duration of the moisture deficits. Severe drought immediately before or during tasseling and silking can cause massive crop losses and even total crop failure. In contrast, the plant becomes progressively more tolerant of excess moisture. Flooding during late vegetative growth will cause some decrease in yield if combined with low soil fertility. By the time the crop is in flower, however, flooding will have virtually no effect on yield.

Moisture demands decrease once the grain is mature. Hot dry weather after maturity is advantageous because it makes harvesting easier. Such conditions are not essential to successful crop production, however.

Climate and Maize Production in the Black Warrior Valley

The Black Warrior Valley is a highly productive area in which to grow maize. In most years, winter rainfall and floods insure a plentiful supply of preseason soil moisture, summer rainfall is abundant, and the frost-free period is more than sufficient for crop production. Describing conditions in an average year, however, is not very useful for assessing the risk of severe crop failure. Instead,

it is necessary to estimate the timing, severity, and frequency of deviations from the norm and juxtapose these estimates with the agricultural calendar.

To investigate conditions that pose serious threats to crop production in the Black Warrior Valley, I use data on the climate and soils of the area. Though good agricultural soils are limited in distribution above the Fall-Line, the climate and agricultural soils of the relevant portion of that area (Emigh 1941; Smith and Pace 1910; Spivey 1982) are quite similar to conditions found below the Fall-Line. Therefore, it is possible to use data from below the Fall-Line to investigate parameters for crop production in the Black Warrior Valley. The main source of climatological data is Long's (1951) summary of weather and flood records from Tuscaloosa. This document includes monthly rainfall records for 71 years (1881-1951), temperature records for 58 years (1894-1951), and flood records for 66 years (1884-1951). There are also partial records for all three variables for some of the years before the consecutive records begin. Additional flood data are derived from Peirce (1962). The soil data are largely from the early twentieth-century surveys of Hale (Rowe et al. 1912) and Tuscaloosa Counties (Winston et al. 1914), though some additional information is taken from later surveys of these counties (Edwards et al. 1939; Johnson 1981).

A number of good agricultural soils are found on the Black Warrior floodplain (Table 4:19). Under the right conditions these soils will produce moderate to high maize yields. The soils differ, however, in drainage and flooding patterns. Not surprisingly, the

Table 4:19. Average yields of maize per acre by soil type.

Soil type	Yield in bushels per acre		
	Tuscaloosa 1911	Hale 1909	Greene 1923
Group 1			
Waverly clay loam		35.0	
Group 2			
Cahaba silt loam	30.0		
Huntington silty loam	45.0		
Ochlockonee fine sandy loam	17.5	17.5	30.0
Group 3			
Cahaba loam	32.5	32.5	
Cahaba fine sandy loam	27.5	15.0	15.0
Cahaba sandy loam	20.0		
Kalmia fine sandy loam	8.0		8.0
Group 4			
Greenville loam	40.0	17.5	
Ruston fine sandy loam	35.0		
Susquehanna fine sandy loam	20.0		
Group 5			
Guin sandy loam	10.0		
Orangeburg fine sandy loam	17.5	12.0	
Orangeburg gravelly sandy loam	17.5	10.0	

After Peebles 1978a:Table 13.5.

risk of severe crop losses varies according to these differences. Thus, to examine threats to maize production, it is first necessary to divide the soils into groups having similar drainage rates and flood frequencies. For these purposes, I have adopted the classification system used by Welch (1986). Table 4:20 lists the soil groups referred to in the following discussions.

Planting dates on the floodplain of the Black Warrior River are determined as much by the incidence of spring floods as they are by suitable temperatures. The mean date for the last spring temperature below 32° F is March 23; the mean temperature for April is 65° F. If temperature were the only consideration, fields could be planted in late March and early April. The Black Warrior River, however, floods an average of three times a year; March floods occur in three out of four years. For flood-prone zones, saturated soils and the threat of late floods (see below for a further discussion of late floods) push planting dates to mid-April.

It seems reasonable to suggest that in the prehistoric period maize was sown in mid-April. It is, however, difficult to estimate the rest of the agricultural calendar with any precision. Sowing by hand is time-consuming. Gardens may have been planted in a few days, but fields may have taken several weeks to plant. Moreover, ethnohistoric accounts suggest that the maize cultivars raised in the Southeast varied widely in maturation rates (Swanton 1946:268,274,290). At least in some areas, rapid-maturing varieties, used for summer consumption, were planted first, and then slower-maturing varieties, raised for storage, were planted. Thus, it is

Table 4:20. Grouping of soil types by drainage characteristics

Group 1 Poorly drained Frequently flooded	Group 2 Moderately drained Regularly flooded	Group 3 Moderately to well drained Rarely flooded	Group 4 Moderately to well drained Level to rolling uplands	Group 5 Well drained Steep uplands
Waverly clay loam	Huntington silty loam	Cahaba sandy loam	Greenville loam	Guin sandy loam
Bibb fine silty loam	Cahaba silt loam	Cahaba fine sandy loam	Ruston fine sandy loam	Orangeburg gravelly sandy loam
	Ochlockonee fine sandy loam	Cahaba loam	Susquehanna loam	Orangeburg fine sandy loam

After Welch 1986:Table 4.8.

entirely possible that for much of the growing season maize at different growth stages could be found in various fields. Because of these complications, I make no attempt to estimate when the majority of the maize would have been at a particular stage (e.g., tasseling and silking). Instead, I examine adverse spring (April-May) conditions that would affect maize in the planting through early vegetative growth stages, and adverse summer (June-August) conditions that would affect maize in the late vegetative growth through grain maturation stages.

In the early stages of development, maize is vulnerable to severe droughts, late frosts, and floods. For the Black Warrior Valley, the risk of major crop losses due to either spring droughts or late frosts is extremely low. For the moment, all that needs to be said about drought is that this past growing season (spring-summer 1986) is one of the dryest on record, yet farmers on the Black Warrior floodplain were able to produce a maize crop (see below for further discussion of drought).

Maize yields are affected by late spring frosts only if freezing temperatures occur after the growing points of the plants are above ground. In temperature records from 58 consecutive years, only once did the temperature fall below 32° F after the middle of April. The growing point of maize is underground for the first few weeks after planting. Thus, if maize was planted at the beginning of April, severe crop losses due to late frost might occur once or twice in a century. If, as seems likely, maize was planted in mid-April or

later, the risk of severe losses due to late spring frost would have been virtually nil.

In contrast, late floods are a common problem for some areas of the bottomlands. The Black Warrior floods more often in March than it does in April and May, but floods in the latter two months are by no means rare. Floods occurred in either April or May in 28 of 66 years for which flood data are available (i.e., once every two to three years). Floods occurring in mid-April would probably have delayed planting. Floods occur after mid-April, however, about once in four years. Such late floods might have destroyed or seriously injured crops already in the ground.

While late floods are a risk, the threat of floods at planting or after crops are in the ground is not equal for all bottomland soils. Only five of the April-May floods on record reached levels that would have flooded land lying above the two-year recurrence interval, and only two of the five occurred after mid-April. For low-lying, poorly drained fields (Table 4:20, Group 1), late floods and saturated soils would be a problem every other year. For fields at elevations between the two-year and ten-year recurrence interval (Table 4:20, Group 2 and some of Group 3), late floods might delay planting in 1 year out of 13; only 1 year out of 33, however, would crops planted in mid-April be jeopardized. April-May floods would threaten fields above the ten-year recurrence interval 1 year out of 33, but only 1 year in 66 would such floods be a risk after mid-April.

Late floods clearly posed problems in the early part of the growing season. The risk of severe crop losses due to floods,

however, could be largely eliminated by sensible cropping strategies. Excessive moisture would have been such a constant problem in low-lying, poorly drained areas that it would be foolhardy to raise maize on such soils without routinely deferring planting until at least the end of April, using some form of ridge cultivation, or taking other compensatory steps. Even so, exclusive dependence on the produce from such fields might pose problems because yields would frequently be reduced due to poor root development, and greater exposure to insects and plant diseases. Late floods were not nearly so great a threat to crops in fields at elevations above the two-year recurrence interval. If fields were planted at several different elevations, and the highest fields were planted first, severe crop losses due to April-May floods would be extremely rare.

When maize reaches the later stages of development (late vegetative growth through grain maturation), the greatest threats to yields are early fall frosts and drought. If maize is planted in April or May in the Black Warrior Valley, fall frosts are not a risk. In temperature records from 58 consecutive years, fall temperatures below 32^{0} F never occurred before mid-October. This means that even if maize was planted at the end of May the crop would have had at least 140 frost-free days in which to mature. Thus, frost before maturity would be a risk factor only if low-lying fields were planted exceptionally late or if fields were double cropped.

Prolonged droughts are rare in the Black Warrior Valley. In the rainfall records for the past century, there are 11 years when preseason (November-March) rainfall was at least 25% below normal, and

10 years when growing season (April-August) rainfall was at least 25% below normal. For most of these cases, rainfall in the other portion of the year was adequate to compensate for the shortages. There are, however, three years (1855, 1904, and 1986) on record in which both preseason rainfall and growing season rainfall were almost 50% below the mean for the area (unpublished 1986 Tuscaloosa rainfall records were obtained from the United States Department of Commerce, National Weather Service). In other words, severe droughts have occurred 3 times in 131 years, or once every 40 to 50 years.

Because this past year's drought is one of the worst on record, it provides a fortuitous opportunity to assess the effect of extreme drought on maize yields in the Black Warrior Valley. The available information about crop yields is informal, but nevertheless telling. Despite the drought, the "bottomland" soils produced "record" high maize yields (W. Foster USDA Agricultural Service Center, Tuscaloosa, personal communication 1986; K. McCray USDA Soil Service Field Office, Tuscaloosa personal communication 1986). It appears that the water-table is sufficiently high in the bottomlands that the maize crop is not dependent on rainfall for its moisture supply. Indeed, the dry weather worked in the contemporary farmer's favor because it reduced insect problems. In contrast to the bottomlands, severe crop losses (described as 50 % below normal or a total loss depending on whom you consult) were incurred in maize fields planted at higher elevations.

The above information indicates that, as is the case with floods, the risk of major crop losses due to droughts varies for the available agricultural soils. Prehistoric farmers in the Black Warrior Valley

might not have had "record" yields under drought conditions, but clearly severe crop losses to drought were not a problem for the bottomlands. Since the soils in Group 1 (see Table 4:20) are not extensively farmed today, the soils that produced high maize yields are probably those in Group 2, and, perhaps, some of the lower-lying soils in Group 3. Crop losses probably occurred on many areas that have soils in Group 3, and certainly in areas that have soils in Groups 4 and 5. Of course, given that droughts like this past summer's occur only once or twice in a century, the risk of severe crop losses caused by drought is low for the terrace soils, which have good water holding capacities (Group 3 and Greenville loam in Group 4 [Johnson 1981:Table 14]).

Strategies for Buffering Agricultural Risk in the Black Warrior Valley

Dependence on crops to meet subsistence needs always involves some risk. Plants in individual fields may be destroyed by hail, insects, deer, or other localized hazards. Threats to food supplies from such events can be reduced by planting fields spaced at some distance from one another and/or planting several cultivars at different times so that not all crops are vulnerable at once. Moreover, such misfortunes can be compensated at the level of the household or production unit. The effected individuals can forage for alternative resources, or draw on kinship and other social obligations to see them through the hard times. The concern here is not with individual losses, however. Rather, we are interested in the risk

that crop losses would create food shortages for sizeable portions of the population living in the Black Warrior Valley.

This issue is of interest because of suggestions that agricultural risk may have been a selective factor in the emergence of some Mississippian chiefdoms (Brown 1974:24; Chmurny 1973:242-257; Ford 1974:405-408, 1977:180-182; Peebles and Kus 1977:443; Smith 1974:30). Though they vary in detail, the models that link dependence on crop production with the emergence of hierarchical organizations are built from similar propositions (see Chapter II). In brief, the basic arguments are: 1) maize production was increased because locally high population densities made wild plant procurement strategies too expensive to maintain; 2) maize production increased potential yields per unit of land, but was susceptible to failure due to adverse climatic conditions; 3) the high population densities meant that, when severe crop losses occurred, use of available wild resources and tribal/ritual networks for sharing resources were inadequate mechanisms for coping with food shortages; and 4) these factors, among others, selected for the establishment of the chiefly office, whose occupant served as a buffering agent by collecting provisions as tribute in times of plenty and redistributing foodstuffs when crops failed.

While not denying that agricultural risk may have played a role in the development of some Mississippian systems, I would argue that it is unlikely that the risk of crop failure was a selective pressure in the emergence of the Moundville chiefdom. The examination of maize requirements and climatic conditions makes it clear that severe crop

losses on a valley-wide scale would have been extremely rare events in the Black Warrior Valley.

This is not to say that maize production did not pose some problems. Clearly, maize production would have had to be adjusted to accommodate the frequent spring floods. Additionally, too great a dependence on the produce from fields at higher elevations would lead to occasional shortages due to droughts. The risk of significant crop losses could largely be eliminated, however, by cropping strategies practiced at the level of the production unit (e.g., household or extended kin group). At virtually any point in the bottomlands a 1 km radius agricultural catchment encompasses areas of soil with different drainage rates and flood frequencies. The risk of crop losses could be mitigated by planting fields on more than one soil, staggering planting, and planting more than one cultivar. In other words, risk could be compensated by practicing a divided risk strategy at the level of the production unit rather than at the system level suggested by Chmurny (1973:253-257). Under such a strategy, disasters large enough to require valley-wide solutions would occur at most once or twice a century.

CHAPTER V

DEPOSITIONAL CONTEXTS OF THE ARCHAEOBOTANICAL SAMPLES

In most instances, archaeological data are more abundant for the Moundville system at its peak (Moundville II/III) than for its earlier and later stages. Archaeobotanical data, however, are better for the West Jefferson and Moundville I phases, which span the Late Woodland-Mississippian transition in the Black Warrior Valley. In fact, these are the only phases for which plant data are adequate for studying subsistence strategies. This does not mean that we can answer all questions about plant procurement and production during this critical transition period. Subsistence remains from these phases were collected using fine-grained techniques, but the data do not cover the full range of spatial or social contexts. Nevertheless, the plant data are valuable, and my analyses provide insights about subsistence strategies as well as providing a basis for formulating future research questions.

The varying qualities of subsistence data for the West Jefferson and Moundville I through III phases are historical accidents. Much of our information about the Moundville II and III phases is derived from analyses of materials collected during the Depression-era excavations. Unfortunately, subsistence remains were not recognized as a significant data class when these large-scale excavations were

conducted (Peebles 1981:80). Thus, botanical and faunal remains were not intentionally sought or collected, though large caches or unusual items were saved. On the other hand, most of our information about the West Jefferson and Moundville I phases is a result of excavations conducted since 1970. By that time, the value of subsistence data had been acknowledged by archaeologists, and fine-grained recovery techniques such as flotation had been implemented.

West Jefferson Contexts Sampled for Plant Remains

Samples of plant remains have been recovered from West Jefferson sites located above and below the Fall-Line (Figure 5:1). Most of the excavations that produced these samples were conducted before I began my study. By consulting with the directors of the various field projects, however, I was able to locate archaeobotanical materials from several different spatial, temporal, and functional contexts. My study includes plant remains from 20 West Jefferson features. Twelve of these samples come from three sites located above the Fall-Line. The other eight samples come from four sites located below the Fall-Line.

The plant remains from above the Fall-Line were recovered from the West Jefferson Steam Plant sites, 1Je31, 1Je32, and 1Je33. These sites are located along Village Creek, a tributary that flows into the Locust Fork of the Black Warrior River. The sites are all situated on the edge of Village Creek's narrow floodplain.

The excavation procedures used were essentially the same for all three sites (Jenkins and Nielsen 1974:6-7, 37-40, 84-88). Because

Figure 5:1. Locations of West Jefferson phase sites included in this study

construction of a power plant was expected to destroy the sites, they were totally excavated. Surface collections were made; then heavy equipment was used to strip off the plowzone. The exposed features were mapped and excavated by hand. Besides postmolds, five West Jefferson feature types were distinguished. These include: bell-shaped pits--storage facilities or cooking facilities that used indirect heat; cylindrical pits--multi-purpose cooking facilities; basin-shaped pits--fire receptacles; irregular pits--function unknown; and rock hearths (O'Hear 1975:104-105). Ned Jenkins and Jerry Nielsen, the directors of the salvage project, suspected that the rich organic fill of these features would be a good source of subsistence information. Although neither time nor funds were available for immediate analysis, they had the foresight to collect and save large quantities of unprocessed feature fill.

When I expressed an interest in Late Woodland plant remains from the Black Warrior Valley, these soil samples were graciously offered to me. With the advice of Ned Jenkins and John O'Hear, I selected 12 features for analysis. In choosing features, we gave priority to those for which radiocarbon dates were available. We also attempted to include representatives from all three sites and from the major feature types. Though more features were available for sites 1Je31 and 1Je33, the final sample included features from all sites and from four of the five feature types. No rock hearth samples were available.

To separate the plant remains and other cultural materials from the soil matrix, I used both flotation and water-screening (see

Chapter VI for details of the recovery procedures). The West Jefferson feature fill had been stored in large burlap bags. A three liter sediment sample was extracted from each bag and floated. The fill remaining in the bag was measured by volume, then gently washed through 1/4-inch and 1/16-inch nested screens.

Four sites located on the Black Warrior floodplain below the Fall-Line (Figure 5:1) have also yielded West Jefferson phase plant remains. Two of these sites, 1Ha39 and 1Ha11, were excavated by University of Alabama field schools. The others, 1Tu44/45 and 1Ha8, were investigated by the UMMA project.

Site 1Ha39 was a small West Jefferson phase site located about 6 Km southwest of Moundville. The site was situated near the end of a sand terrace surrounded on three sides by low swampy ground. The University of Alabama conducted a field school at 1Ha39, in 1976, when it became apparent that the site was going to be destroyed by a gravel quarry. The field school excavations uncovered traces of an apparently rectangular, single-post structure with a central hearth (Walthall, unpublished field notes on file, Mound State Monument). Several pits presumably associated with this structure were also excavated. These included a bell-shaped pit, two basin-shaped pits and a cylindrical pit.

Following the precedent set by Jenkins and Nielsen, unprocessed feature fill from 1Ha39 was bagged and saved for later analysis. These soil samples were also made available to me for my research. I extracted the plant remains from the 1Ha39 fill samples by flotation. For these features, I measured the volume of sediment then floated the

entire sample. Sediment samples from five features containing West Jefferson ceramics were processed in this manner. Unfortunately, historic artifacts found in the fill of two of these features indicated that they were disturbed (P. Welch, personal communication 1984). Thus, only three features from 1Ha39 are included in my analyses.

Site 1Ha11 is located about 3 km southwest of Moundville on a sandy terrace adjacent to Elliotts Creek (Nielsen et al. 1973:84). The site consists of a Moundville III hamlet overlying a West Jefferson occupation of unknown extent. The University of Alabama conducted field school excavations at this site in 1980. The excavations focused on the Mississippian component, but a West Jefferson phase bell-shaped pit was also excavated (R. Krause, personal communication 1981). This pit was located within a rectangular wall-trench structure, but 76 of 78 sherds (97%) found in the pit fill were grog-tempered, indicating that the pit predated the structure (P. Welch, personal communication 1981). A one liter soil sample was collected from this feature. I floated this sample to extract plant remains.

Site 1Tu44/45 is located about 8 km north of Moundville on the south bank of the Black Warrior River (Bozeman 1982:142). The site has both West Jefferson and Moundville I phase components, including a Moundville I mound. The UMMA survey team visited 1Tu44/45 in the summer of 1978, but vegetation on the site was too dense to permit a controlled surface collection. Moreover, the site and mound were eroding into the river. Thus, we do not know the extent of either the

Late Woodland or Mississippian occupations, though the latter is believed to have been small (Bozeman 1982:143).

The UMMA survey crew excavated the remnants of a bell-shaped pit they discovered under the mound on the eroding river bank at 1Tu44/45. We processed all the pit fill by flotation, recovering large quantities of shell, bone, and plant remains. An uncorrected radiocarbon date of A.D. 1150± 70 (Beta 1109, Libby half-life) was obtained on a sample of wood fragments from this pit. The ceramics from the pit, however, were predominantly grog-tempered. Moreover, the pit was found about 12 cm below the submound Moundville I midden. Based on the artifact content and location of this pit, Welch (1987) has argued it is a West Jefferson feature and that the date is in error. Welch's assessment seems reasonable, and I have treated the plant remains from this feature as a West Jefferson sample.

Site 1Ha8 (White site) is located about 11 km southwest of Moundville. The site is situated on the edge of an old channel of the Black Warrior River and is surrounded by backswamp. There is a late Moundville III component at the site that includes a platform mound, a cemetery, and a residential area. There is also a West Jefferson phase component underlying portions of the later occupation (Welch 1986). In 1983, Paul Welch directed small-scale excavations focused on the Moundville III community. He collected and floated soil samples from midden and feature contexts. The plant remains from these samples were submitted to me for analysis.

The archaeobotanical materials from this site included samples from three West Jefferson features. The soil samples from which the

plant remains were extracted were six liters in size. One sample was floated in the field by Welch; the other two samples he processed in the lab (see Chapter VI). The West Jefferson plant remains from 1Ha8 are the only samples included in my study that were not floated under my direct supervision.

It is clear from the above descriptions that plant remains have not been systematically collected from West Jefferson contexts. Nevertheless, through the cooperation of colleagues who work in the Black Warrior Valley, I was able to assemble a small but reasonable assemblage of West Jefferson plant remains. The samples represent the major geographic, functional, and temporal dimensions along which West Jefferson materials might vary. There are not enough samples from any site or feature type to examine inter-site differences in feature contents or variability between different feature types. It is possible, however, to investigate spatial variability in plant use during the West Jefferson phase by grouping features according to whether they come from sites located above or below the Fall-Line. Similarly, temporal variability in plant use during the West Jefferson phase can be investigated by using O'Hear's (1975:137-139) ceramic criteria to assign features chronological placements early or late in the West Jefferson phase.

Moundville I Contexts Sampled for Plant Remains

Archaeobotanical samples from Moundville I contexts were collected from Moundville during the UMMA field project. In 1978 and 1979, I directed small-scale, intensive excavations in two residential

deposits at Moundville. This work resulted in the recovery of plant remains from midden, floor, and feature deposits dated to the Moundville I phase.

The explicit goals of our field work at Moundville were to recover subsistence remains and to collect a ceramic sample from a stratified context. We used information from previous work at the site to identify areas likely to contain midden or residential deposits. The original plan was to test several such deposits to gather samples from different spatial and temporal contexts. The deposit we selected as the starting point for our investigations, however, was deep, stratigraphically complex, and required more field time than we had anticipated. As a result, we were able to conduct only very limited tests elsewhere on the site.

There is no master survey grid for the Moundville site. By convention, excavation localities are given labels that indicate their positions relative to mounds, modern structures, or other reference points on the site (see Steponaitis [1983a:11-13] for further explanation of the locality codes). For the UMMA excavations, we established local grid systems in each area tested and tied these grids to a permanent USGS survey datum located on Mound B. Rather than using grid coordinates to indicate location on the site, however, we followed conventions and referred to excavation localities by labels that indicated their positions relative to landmarks on the site.

The major focus of the UMMA excavations and the primary source of my plant data was an area north of Mound R (Figure 5:2). The deposit

Figure 5:2. Locations of UMMA excavations at Moundville

in this area was selected for excavation because previous work had indicated that it contained abundant subsistence remains and ceramics. In 1905, C. B. Moore excavated a ridge north of Mound R. He described the deposit as a dwelling site noting that his workers had encountered charcoal, pottery, and deer bones (Moore 1905:220). He also reported burials in pits intruding into the midden. In 1973 and 1974, the area north of Mound R was again the focus of excavations this time by a University of Alabama field school directed by David DeJarnette (unpublished field notes on file, Mound State Monument). These excavations disclosed a stratified deposit roughly 2 m in depth. Traces of structures as well as numerous pits and post molds were encountered within the deposit. Large quantities of ceramics were collected and, though neither fine-screening nor flotation were employed, both botanical and faunal remains were recovered.

The UMMA excavations north of Mound R (NR) were situated adjacent to the field school excavations. To provide a guide for our work, we removed the backfill from the northern end of DeJarnette's excavations, thereby exposing a profile of the unexcavated portion of the deposit. We used the stratigraphy visible in the profile to select locations for our excavation units. The locations we chose were areas where the stratigraphy was clear and where there was little apparent disturbance.

We excavated two 2 X 2 units (6N2W and 8N2E) in the NR deposit. The excavation methods we used were selected to maximize stratigraphic control and retrieval of small subsistence remains. All excavation was done with trowels. Where natural strata existed, they were used

to define excavation levels. Where there was no clear stratigraphy, we excavated 10 cm arbitrary levels. Features were pedestaled during the excavation of each level. Upon completion of a level, the features were cross sectioned and their profiles were drawn. If a feature continued for more than one level, the process was repeated. To retrieve subsistence remains, both flotation and water-screening were employed. Three liter control samples were floated from every excavation level, and all feature fill was floated. Any deposit from level contexts that was not floated was water-screened through 1/4- and 1/16-inch nested screens (see below).

The stratigraphy in the NR deposit was complex (Tables 5:1-5:3; Figures 5:3 and 5:4). The upper portion of the deposit seemed to be mixed midden or fill. We encountered traces of sand floors 30 to 45 cm below ground surface. Associated with the floors were postmolds, wall trenches, and patches of burnt sand. The relative positions of the wall trenches and floors suggested that units 6N2W and 8N2E were cutting through separate structures.

In both units, there was a stratum composed of large chunks of burnt daub about 75 cm below ground surface. The unconsolidated nature of the daub suggested it was wall fall rather than a burnt floor.

Under the daub, we found a series of superimposed sand floors. These floors were separated into three groups by shallow midden deposits. The close correspondence between the series of floors in the 6N2W and 8N2E suggested that both units were within a single structure. Each set of floors appeared to be the product of resanding

Table 5:1. Excavated levels in unit 6N2W, NR.

Level Number	Type	Thickness (cm)	Depositional Interpretation.
1	Arbitrary	10	Midden and/or fill, probably includes some backfill from previous excavations in the area, along with traces of plowzone.
2	Arbitrary	10	Midden and/or fill.
3	Arbitrary	10	Midden and/or fill.
4	Arbitrary	10	Midden and/or fill, with scattered occupational features (2 possible hearths), but no definite floors.
5	Natural	10-12	Midden and/or fill, interspersed with discontinuous remnants of a sand floor that was not stratigraphically separated.
6	Natural	4-8	Midden and/or fill, along with remnants of about 3 superimposed sand floors that did not cover the full horizontal extent of the excavation.
7	Natural	7	Midden and/or fill.
8	Natural	5-9	At least 1, and probably 2 superimposed sand floors.
9	Natural	3-6	Daub layer, consisting of collapsed wall debris. This stratum corresponds to L. 8B in 8N2E.
10	Natural	2-4	Sand floor with some trampled-in midden debris.
11	Natural	6-8	Sand floor, partially covered by a thin lense of daub and charcoal.
12	Natural	3-5	Sand floor.
13	Natural	3-4	Sand floor.
14	Natural	10	Sand floor, or possibly 2 indistinct floors superimposed, including an area of greyish ash.
15	Natural	10-12	Midden and/or fill.
16	Natural	2	Sand floor.
17-18	Natural	6-12	Sand floor, covered by a discontinuous lense of pink clay.
19	Natural	1-2	Thin lense of midden, trampled into the sand floor below (i.e., L. 20).
20	Natural	2-3	Sand floor.
21	Natural	2-3	Sand floor.
22	Natural	13	Midden and/or fill.
23	Natural	10	Several thin sand floors, interspersed with lensees of ash and midden.
24	Natural	5-10	Sand floor in north end of unit, midden and/or fill in south end.
25	Arbitrary	10	Midden and/or fill.
26	Arbitrary	10	Midden and fill, some of the latter being within the pit-house.
27A-B	Arbitrary	20	Midden and/or fill within pit-house.
28A-D	Natural	20	Midden and/or fill (A); compacted sand floors of pit-house (B-D).

Table 5:2. Excavated levels in unit 8N2E, NR.

Level Number	Type	Thickness (cm)	Depositional Interpretation.
1	Natural	5-12	Midden and/or fill, with considerable recent and nineteenth-century disturbance.
2	Arbitrary	10	Midden and/or fill, with some nineteenth-century disturbance.
3	Arbitrary	10	Midden and/or fill, with some nineteenth-century disturbance.
4	Arbitrary	10	Midden and/or fill, interspersed with discontinuous traces of sand floors; some nineteenth-century disturbance present.
5	Natural	10	Sand floor (or possibly several superimposed floors) with most, but not all, recent disturbances separated out.
6	Natural	2-5	Midden and/or fill; sand floor remnants within this level were excavated separately as L. 6A.
6A	Natural		Discontinuous remnants of 1 or more sand floors within L. 6.
7	Natural	6-9	Midden and/or fill; sand floor remnants within this level were excavated separately as L. 7A.
7A	Natural		Discontinuous remnants of 1 or more sand floors within L. 7.
8A	Natural	3-6	Sand floor (above L. 8B.).
8B	Natural	6-10	Daub layer, consisting of collapsed wall debris; this stratum corresponds to L. 9 in 6N2W.
9	Natural	4-5	Sand floor with a charcoal lense just above it.
10	Natural	2-4	Sand floor.
11	Natural	10-12	Sand floor (or possibly several floors closely superimposed).
12	Natural	4-6	Sand floor (or possibly several floors closely superimposed).
13	Natural	2-3	Sand floor.
14	Natural	20	Midden and/or fill.
15	Natural	3-4	Sand floor, with a thin midden lense just below it.
16	Natural	5	Sand floor (or possibly several floors closely superimposed).
17	Natural	7-8	Midden and/or fill.
18	Natural	2-3	Sand floor, along with some of the midden associated with the floor below it.
19	Natural	2-3	Sand floor with a thin lense of midden above it.
20	Natural	2-3	Sand floor with a thin lense of midden above it.
21	Natural	2-5	Two sand floors with a thin lense of midden between them.
22	Natural	2-5	Hard-packed sand floor.
23	Natural	3-8	Several thin sand floors interspersed with ash and midden lenses.
24	Natural	2-4	Several thin sand floors interspersed with ash and midden lenses.
25	Natural	2-5	Sandy fill, consisting of numerous thin sand lenses interspersed with ash and burned sand.
26	Natural	2-10	Compacted ashy midden and/or fill.

Table 5:3. Depositional correlation between levels in units 6N2W and 8N2E, NR.

6N2W		8N2E
Levels 1-4	with	Levels 1-3
Level 5	with	Level 4
Levels 6-8	with	Levels 5-8A
Level 9	with	Level 8
Levels 10-11	with	Level 9
Level 12	with	Level 10
Levels 13-14	with	Levels 11-13
Levels 15-17	with	Level 14
Levels 18-19	with	Level 15
Levels 20-21	with	Level 16
Level 22	with	Level 17
Level 23	with	Levels 18-22
Levels 24-25	with	Levels 23-24
Level 26	with	Levels 25-26
Level 27	with	_
Level 28	with	_

Figure 5:3. Stratigraphic profile from Unit 6N2W, North of Mound R

Figure 5:4. Stratigraphic profile from Unit 8N2E, North of Mound R

or possibly rebuilding a rectangular, wall-trench structure. Beneath the third series of floors in unit 6N2W, a portion of a semi-subterranean, wall-trench structure was encountered. Three floors and two adjacent wall trenches were associated with this structure. In unit 8N2E, refuse pits, but no structural elements, were encountered at a depth corresponding to that of the "pit house".

In all, the excavation of the two units encompassed 28 levels per square and 201 Mississippian features. The features included 123 post molds, 8 wall trenches, 19 ash and burn lenses, 51 pits, and a portion of a burial. Features were not evenly distributed throughout the deposit. Small postmolds did not show any clear patterning either stratigraphically or horizontally. Six of the wall trenches originated above the daub indicating they were from structures that post-date the deposition of this stratum. The other two wall trenches were associated with the semi-subterannean structure. Most pits were encountered in or immediately below midden zones. This suggests that these features were extra-edificial pits. The artifacts and subsistence debris recovered from these pits indicate that at least their final function was for refuse disposal.

Charcoal samples from eight contexts were submitted for radiocarbon dating (Figure 5:5). The samples comprised small wood fragments and, in some cases, fragments of cane and maize stalk. Those samples known to contain maize stalk were corrected for C12/C13 fractionation. The dates produced by these samples are listed in Table 5:4. The A.D. 1803 date (DIC 1241) for the sample taken from above the daub is obviously spurious. The calibrated midpoints for

Figure 5:5. Stratigraphic contexts of radiocarbon dates

Table 5:4. Radiocarbon dates from units 6N2W and 8N2E, NR.

Lab Number	Sample Description	Age (5568 half life)	Standard Error (years)	C13/C12	Corrected Age	Calibrated Date ** (midpoint)
DIC-1241	MDVL-NR FSM 168 6N2W L9 F45 hardwood/pine	120	60	-	120	1655-1950 (AD 1803)
DIC-1243	MDVL-NR FSM 265 8N2E L8 hardwood/pine	690	60	-	690	1240-1350 (AD 1295)
Beta-1289 *	MDVL-NR FSM 255,261 8N2E L14 hardwood/pine/maize	690	65	-26.60	665	1235-1395 (AD 1315)
Beta-1106 *	MDVL-NR FSM 640,661 8N2E L17 hardwood/pine	1035	80	-26.67	1010	865-1230 (AD 1047)
Beta-1296 *	MDVL-NR FSM 548,612 6N2W L25 F258 hardwood/pine/maize	960	80	-26.74	930	895-1255 (AD 1075)
Beta-1105 *	MDVL-NR FSM 890 8N2E L26 F394 sweet gum	1135	105	-25.47	1130	800-1220 (AD 1010)
Beta-1485	MDVL-NR FSM 801 6N2W L28 hardwood/pine/maize	990	65	-	990	900-1205 (AD 1053)

* Corrected for C13/C12 fractionation.
** Klein et al. 1982.

the remaining dates range from A.D. 1010 (Beta 1105) to A.D. 1315 (Dic 1243). These dates indicate that the deposit below the daub layer accumulated during the Moundville I phase. In fact, Steponaitis (1983a:104) used the A.D. 1315 date in defining the temporal boundary between the Moundville I and II phases. The Beta Analytic dates were not run until after Steponaitis had completed his study.

The ceramics from the excavations were analyzed by Vincas Steponaitis, who integrated the results with his study of the vessels from extant Moundville collections (Steponaitis 1983a). He reported that ceramics representing all three Moundville phases were recovered from the NR deposit (Steponaitis 1983a:96). The stratigraphic order of the excavated sample supports the chronological sequence Steponaitis postulated from his seriation of whole vessels from previous excavations.

While sherds from all phases were recovered, the phases are not equally represented in the NR deposit (Steponaitis 1983a:96-99). Moundville II and III ceramics, with the exception of a few presumably intrusive sherds, are confined to the upper .40 m of midden/fill. Most sherds found in association with the traces of sand floors above the daub are Moundville I types. Below the daub, the ceramics are an essentially pure Moundville I assemblage. Steponaitis (1983a:132) was unable to detect any change in the Moundville I ceramics recovered from below the daub. He suggested on the basis of a comparison with Bessemer materials that the NR ceramics are a predominantly late Moundville I assemblage.

The radiocarbon determinations and the ceramic data provide somewhat conflicting evidence about the rate of accumulation of the Moundville I strata. The radiocarbon dates indicate a 250-300 year span between the initial occupation of the sunken structure and the deposition of the daub layer. In contrast, the lack of discernible change in the ceramics suggests that, despite its depth, the deposit accumulated rapidly. Since the majority of the ceramics were recovered from the sand floors, it is possible that a break in the sequence occurred between the occupation of the "pit house" and the construction of the sand floor structure(s). Alternatively, it is possible that the sherd sample is too small to detect minor stylistic changes within Moundville I ceramic types. Without further excavation in the deposit, however, the apparent discrepancy in the time span indicated by the radiocarbon dates and the ceramics cannot be resolved.

The use of the area north of Mound R changed through time. The debris on the structure floors and in the refuse pits leaves little doubt that the area was used for domestic activities during the Moundville I phase. The evidence further suggests that structure locations shifted through time. The midden zones, which separate the three sets of floors below the daub, seem to have accumulated during intervals when that location was not occupied by a structure. The topography of the area also suggests house sites shifted. Given the depth of the deposit, if house sites were permanent, residence mounds would have developed. Instead, the whole area seems to have built up gradually. It is likely that the residential deposit excavated by

Moore (1905:220) also dates to the Moundville I phase. It was probably part of the same residential area tested by the UMMA excavations.

During the Moundville II phase, the area seems to have been little used. While some of the upper midden/fill zone may have been deposited at this time, the function of the area is uncertain given the available data.

The majority of the upper midden/fill zone seems to date to the Moundville III phase. The area may have been intentionally filled or used as a refuse dump at that time. Steponaitis's analysis of vessels from burials found in prior excavations north of Mound R indicates some use of this area for interment during the Moundville II and III periods (Steponaitis 1983a:156-157). It should be noted that Moore (1905:220) tested Mound R, but he recovered no diagnostic artifacts. Thus we do not know when the mound was constructed, nor how it relates to the excavated area.

The NR deposit included materials from all three Moundville phases, but I limited my analyses of plant remains to samples from Moundville I contexts. My decision was based on several considerations. The contexts of the Moundville II and III materials were ambiguous. The deposits dating to these phases could be primary midden, but they might also be fill. Moreover, my excavation records and Steponaitis's (1983a:96-98) ceramic analyses indicated that the strata producing Moundville II and III materials were disturbed. In contrast, the Moundville I remains could be reasonably attributed to in situ domestic activities. While the stratigraphy below the daub

was complex, it was also clear. We were able to identify features and floors and segregate disturbances during excavation. Based on his work with the ceramics, Steponaitis (1983a:14) reported that "stratigraphic mixture was virtually nonexistent" for these levels.

While the Moundville I floors seemed to be the remnants of domestic structures, there are indications that the NR area was an elite residential zone. Based on the distribution of non-local materials and Southern Cult items, Peebles (personal communication 1978) postulates that the northern portions of the site were high-status precincts. Mound R is located north of the plaza, and the deposit we excavated is on the extreme northern edge of the site on a bluff overlooking the Black Warrior River. Our understanding of the structure of the site in Moundville I is somewhat conjectural, however. Location by itself is an insufficient basis for determining the status of the households that generated the NR deposit.

The artifacts provide a second line of evidence concerning the status affiliation of the NR deposit. The non-ceramic assemblage recovered from Moundville I levels and features includes two projectile points, five "greenstone" celts/hoes, a copper fishhook, and portions of at least one and possibly two carved palettes. Without comparable data from elsewhere on the site it is difficult to assess the significance of the projectile points and celts. Copper fishhooks and palettes, however, were almost certainly high-status items.

Not only did the Moundville I levels yield apparently high-status objects, but they also produced considerable quantities of non-local

lithics. Tables 5:5, 5:6 and 5:7 present the results of a preliminary analysis of the lithics recovered from below the daub layer. The proportion of non-local to local cherts in the assemblage is high. The most abundant non-local cherts are Fort Payne and Bangor, high-quality materials found in the Tennessee River Valley and in other parts of northern Alabama (Jones 1939:11-12). The assemblage also contains significant quantities of worked and unworked greenstone-like metamorphic rock. The closest source for this material is the Hillabee schist formation in eastern Alabama (Jones 1939:16). The high proportions of non-local materials make this an unusual, if not unique, assemblage compared to materials collected by the UMMA survey crew from other sites on the floodplain and to materials from Moundville III deposits at the White site (Welch 1986; M. Pope, personal communication 1985). The residents of the NR area apparently had access to non-local raw materials that were not available to the general populace.

The tabulation of tool and debitage types by raw materials (Table 5:6) suggests the presence of a lithic workshop. All of the finished tools are made from non-local materials. Of more interest, however, is the presence of core shatter and debitage from non-local cherts, as well as unworked and only slightly worked fragments of metamorphic rock. These discarded and unfinished materials suggest that stone tools were manufactured in the NR area. The sample is not large and comparative data are scarce, but the lithic assemblage suggests that the residents of the structures we excavated were part-time craft specialists.

Table 5:5. Miscellaneous mineral materials from Moundville I contexts in units 6N2W and 8N2E, NR.

Material	Worked				Unworked			
	Count	%	Weight (g)	%	Count	%	Weight (g)	%
Metamorphic	23	88	1170.21	83	23	39	48.76	7
Sandstone	2	8	238.30	17	18	31	630.41	92
Mica	0	0	0.00	0	13	22	1.93	0.2
Graphite	0	0	0.00	0	1	2	0.31	<0.1
Copper	1	4	0.25	<0.1	1	2		
Glauconite	0	0	0.00	0	1	2		
Coal	0	0	0.00	0	1	2	4.40	0.6
Total	26		1408.76		58		685.81	

Table 5:6. Quantities of local and non-local chipped stone from Moundville I contexts in units 6N2W and 8N2E, NR.

Type	Count	%	Weight (g)	%
Non-local				
Ft. Payne	43	42	41.32	37
Bangor	27	26	23.74	21
Tallahatta	0	0	0.00	0
Coastal Plain	0	0	0.00	0
Miscellaneous	8	8	18.65	16
Sub-total	78	76	83.71	74
Local				
Tuscaloosa	17	16	10.06	9
Camden	7	7	17.52	15
Quartz	1	1	1.30	1
Sub-total	25	24	28.88	26
Total	103		112.59	

Table 5:7. Chipped stone classes from Moundville I contexts in units 6N2W and 8N2E, NR.

Type	Local				Non-local			
	Count	%	Weight (g)	%	Count	%	Weight (g)	%
Core	0	0	0.00	0	0	0	0.00	0
Shatter	6	24	3.91	14	20	26	40.54	48
Decortication	12	48	21.22	74	7	9	9.52	11
Misc. Flakes	7	28	3.55	12	39	50	26.61	32
Bifacial Trim Flakes	0	0	0.00	0	10	13	3.45	4
Bifacial Tools								
Whole	0	0	0.00	0	2	2	3.50	4
Broken	0	0	0.00	0	0	0	0.00	0
Totals	25		28.68		78		83.62	

In sum, the Moundville I occupation north of Mound R can be characterized as follows. The deposit is an accumulation of superimposed sand floors interspersed with shallow midden layers. Artifacts and subsistence remains recovered from floor, pit, and midden contexts indicate the performance of domestic activities. The residents of the area were probably members of the elite class, and may have specialized in the manufacture of stone tools.

While the NR deposit produced a wealth of data, our excavations there tested only a small fraction of a deposit in one area of a very large site. Clearly, the samples recovered from the deposit cannot be expected to represent the full range of spatial, temporal, or social variability at Moundville.

In our second field season at Moundville (1979), we made an effort to broaden our sample by locating and excavating residential deposits elsewhere on the site. Peebles's (1979) synthesis of previous fieldwork at Moundville provided information about the distribution of domestic debris on the site. Using this as a guide, I selected five areas for investigation (Figure 5:6).

A power auger was used to test for midden deposits. In each area a transect was laid out, then a series of auger holes was drilled. Intervals between auger tests were determined by the shape and topography of each area. Paired holes, 1 m apart, were used to determine whether deposits were localized features or general accumulations. After each hole was drilled, its profile was drawn and the soil was screened.

Figure 5:6. Locations of auger tests at Moundville

The auger tests detected deposits that seemed worthy of further investigation south of Mound I (SI) and in the extreme northwest section of the site in an area where there had been little previous excavation (see Figure 5:2). We called this latter area "south of the conference building" (SCB) because there was no mound sufficiently close to serve as a reference point. To explore these deposits we opened a 2 X 2 m test pit in each area. We followed the same excavation, screening, and flotation procedures we used for the NR deposit.

Previous excavations south of Mound I had uncovered residential structures. The auger tests in this area located a midden deposit approximately one meter in depth. Our test excavations revealed a hearth; a wall trench, which post-dated the hearth; and a line of postmolds, not clearly associated with either the hearth or the wall trench. Unfortunately, few artifacts or subsistence remains were recovered from the SI deposit. Thus, I did not have sufficient data to include the plant materials from the area in my analyses.

The deposit south of the conference building was more productive. In fact, to further investigate the deposit we opened a second 2 X 2 m unit adjacent to our initial test pit. The deposit in the two units (Test Units A and D) was roughly 60 cm deep, and its stratigraphy was considerably simpler than the NR deposit (Tables 5:8-5:10 provide descriptions of the levels excavated in Test Units A and D). A 15-20 cm plowzone was followed by about 25 cm of midden. Beneath the midden, there were two or three superimposed floors. Associated with the floors were three overlapping clay hearths.

Table 5:8. Excavated levels in Test Unit A, SCB.

Level Number	Type	Thickness (cm)	Depositional Interpretation.
1	Arbitrary	15-19	Midden and/or fill, with recent disturbance.
2	Arbitrary	10	Midden and/or fill.
3	Arbitrary	10	Midden and/or fill.
4	Arbitrary	10	Ashy midden.
5	Natural	4	Burned sand floor.
6	Natural	2-3	Thin midden, between sand floors of L. 5 and L. 7.
7	Natural	2-3	Remnants of a sand floor interspersed with ashy midden.
8	Natural	2-3	Burned sand floor, with some trampled-in midden debris.

Table 5:9. Excavated levels in Test Unit D, SCB.

Level Number	Type	Thickness (cm)	Depositional Interpretation.
1	Arbitrary	15	Midden and/or fill, with recent disturbance.
2	Natural	20-28	Midden and/or fill.
3	Natural	10	Ashy midden.
4	Natural	4-5	Burned sand floor.
5	Natural	2	Sand floor, with some trampled in midden debris.

Table 5:10. Depositional correlation between levels in Test Units A and D, SCB.

Test Unit A		Test Unit D
Level 1	with	Level 1
Levels 2-3	with	Level 2
Level 4	with	Level 3
Level 5	with	Level 4
Levels 6-7	with	Level 5

One radiocarbon and three archaeomagnetic samples from the SCB deposit were submitted for dating (Table 5:11). The radiocarbon sample was collected from the base of the midden zone. The archaeomagnetic samples were from the three hearths. Since the hearths were closely superimposed, the 100-year dispersion of the archaeomagnetic dates is somewhat surprising. The general temporal placement, circa A.D. 1100, indicated by all the dates is quite reasonable, however.

The ceramics from the SCB deposit support this date. By far the majority of the sherds recovered from Test Units A and D were Moundville I types. Steponaitis (personal communication 1980) reports most are early Moundville I types similar to the ceramics found at the Bessemer site. The ceramic data suggest that the Moundville I occupation in the SCB area is slightly earlier than that north of Mound R, though it is possible that there is some overlap.

The SCB artifacts indicate domestic activities, but the status of the area's residents is difficult to determine. The lithic materials recovered from the deposit are tabulated by raw material and debitage/artifact types in Tables 5:12, 5:13, and 5:14. The only finished tool from the deposit is a projectile point made from non-local chert. Compared to the NR deposit the proportion of non-local to local chert is not high. There is also less metamorphic material from the SCB deposit than from the NR deposit. The SCB deposit did produce sizable quantities of mica, including some quite large fragments. While mica was used to manufacture high-status objects, the deposition of the mica post-dates the structural remains. Most of

Table 5:11 Radiocarbon and paleomagnetic dates from Test Units A and D, SCB.

Lab Number	Sample Description	Age	Standard Error (years)	C13/C12	Corrected Age	Calibrated Date **** (midpoint)
Beta-1107	MDVL-SCB FSM 988,1005 TUD L3 hardwood/pine	875 ***	80	-	875	915-1290 ** (AD 1103)
Oklahoma-1775	MDVL-SCB TUA F9 fired clay hearth	720	23			AD 1230 *
Oklahoma-1777	MDVL-SCB TUA F10 fired clay hearth	830	46			AD 1120 *
Oklahoma-1778	MDVL-SCB TUA F24 fired clay hearth	810	15			AD 1140 *

* Paleomagnetic dates.
** Radiocarbon date.
*** 5568 Libby half life.
**** Klein et al. 1982.

Table 5:12. Miscellaneous mineral materials from Test Units A and D, SCB.

Material	Worked				Unworked			
	Count	%	Weight (g)	%	Count	%	Weight (g)	%
Metamorphic	2	50	17.60	19	0	0	0.00	0
Sandstone	2	50	73.00	81	7	50	429.37	67
Mica	0	0	0.00	0	7	50	207.66	33
Graphite	0	0	0.00	0	0	0	0.00	0
Copper	0	0	0.00	0	0	0	0.00	0
Glauconite	0	0	0.00	0	0	0	0.00	0
Coal	0	0	0.00	0	0	0	0.00	0
Total	4		90.60		14		637.03	

Table 5:13. Quantities of local and non-local chipped stone from Test Units A and D, SCB.

Type	Count	%	Weight (g)	%
Non-local				
Ft. Payne	3	12	1.20	1
Bangor	4	16	1.26	1
Tallahatta	2	8	3.09	2
Coastal Plain	2	8	3.86	3
Miscellaneous	1	4	117.16	86
Sub-total	12	48	126.57	93
Local				
Tuscaloosa	8	32	8.64	6
Camden	3	12	0.71	0.5
Quartz	2	8	0.58	0.4
Sub-total	13	52	9.93	7
Total	25		136.50	

Table 5:14. Chipped stone classes from Test Units A and D, SCB.

Type	Local				Non-local			
	Count	%	Weight (g)	%	Count	%	Weight (g)	%
Core	0	0	0.00	0	1	7	117.16	92
Shatter	0	0	0.00	0	0	0	0.00	0
Decortication	8	67	8.18	88	1	7	0.31	0.2
Misc. Flakes	2	16	0.51	6	7	50	8.01	6
Bifacial Trim Flakes	2	16	0.56	6	2	14	0.30	0.2
Bifacial Tools								
Whole	0	0	0.00	0	0	0	0.00	0
Broken	0	0	0.00	0	3	21	1.60	1
Totals	12		9.25		14		127.38	

the mica was collected from the upper portions of the midden and from a feature originating in the upper midden zone. Thus, the presence of this material is little help in assessing the status of the structure's inhabitants.

While there is little hard evidence, it is possible that the SCB area was occupied by individuals whose status was lower, or at least less marked, than that of the NR residents. This is not to say that they were commoners. To the contrary, residence at a mound center, rather than in one of the dispersed farmsteads, may in itself have denoted elite status. The SCB deposits, however, seem to date earlier in the Moundville I phase than the NR deposits. It can be argued that at this stage in the development of the system the gulf between commoner and elite was narrow; that is, high status may not have been as strongly marked by differential access to desired goods.

The Moundville Floral Samples

During the course of the UMMA excavations at Moundville, we routinely collected subsistence remains from all contexts, except the plowzone and obvious recent disturbances. We employed both flotation and fine-screening to maximize the recovery of small faunal and botanical remains.

We collected and floated soil from midden, floor and feature contexts. For every excavation level, we floated a three liter soil sample. Besides these control samples, we processed the entire contents of most features by flotation. The few exceptions were wall trenches and a few very large pits. For these features we floated a

three liter fill sample from each level. All sediment that we did not float, we water-screened through 1/4-inch and 1/16-inch nested screens (see Chapter VI for further discussion of our recovery methods).

Using these procedures, we collected a systematic and stratigraphically controlled sample of subsistence remains. Unfortunately, the faunal sample was quite small. In part, this is a result of poor preservation, but it is also possible that carcasses were not generally butchered near the residential areas we excavated (Michals 1980:3-4). Lauren Michals (1980, 1981) was able to make some general observations about faunal exploitation based on her preliminary analysis of bones recovered from the NR deposit. A detailed analysis would require a larger sample of bones than is currently available, however. The situation for my plant analysis is considerably better. Preservation was generally good, and we recovered plant remains from virtually every context we excavated. While some of the samples are small, differential refuse disposal does not seem to be a significant problem (see Chapter VIII).

The excavation and recovery methods I elected to use are not without drawbacks. Techniques that maximize stratigraphic control and recovery of minute remains are labor intensive. Excavation of a deposit such as that we found north of Mound R can be painfully slow. Given a large budget, a large crew, and unlimited field time this is not a problem. Since I did not have these luxuries, my use of such techniques meant that we sacrificed more extensive investigations at the site for well controlled but limited data recovery.

My choice of an intensive excavation strategy produced a sample of plant remains suitable for detailed analysis. It produced data that are limited in several obvious ways, however. These limitations affect the questions that I can address with the plant data and the extent to which my results can be generalized. While these problems by no means negate the value of my data, the constraints on my analyses must be recognized.

The first and least problematical constraint is that my data do not represent the entire span of occupation at Moundville. The only clear and undisturbed contexts for which I have plant samples date to the Moundville I phase and most appear to be late Moundville I. It would be nice to have samples from other phases and to have more samples from the early part of the Moundville I phase. Such data would enable me to examine variability in plant procurement and production strategies at different stages in Moundville's development. In fact, this was my original intention. When it became apparent that my data lacked the necessary temporal depth, however, I reformulated my research questions and focused on problems that could be investigated with the available data.

A second constraint is that I have data from only one Moundville I phase site, and from only a small fraction of that site. Clearly it would be desirable to have samples from contemporary farmsteads and hamlets, as well as from other Moundville I phase mound centers. Unfortunately, neither the UMMA project nor other work in the Black Warrior Valley has produced such samples.

The problems caused by the lack of spatial coverage are twofold. Moundville is an administrative center and by late Moundville I it may have been the paramount center in a three-tiered settlement system. It is quite likely that some foodstuffs consumed at Moundville were provisions sent as tribute from farmsteads/hamlets, or, later in the phase, subsidiary centers. Thus, there might be qualitative and/or quantitative differences between foods consumed by the rural populace and the inhabitants of mound centers. There may also have been differences in food consumption within the community at Moundville. If both commoners and elite lived at Moundville, food consumption may have varied between households due to sumptuary rules and differential access to tributary provisions.

Our inability to pinpoint when the transition from a simple to complex chiefdom occurred further complicates the issue. In simple chiefdoms, the chiefs' households are generally expected to be self-sufficient; tribute is given back to the populace to demonstrate the chief's generosity (Steponaitis 1978:420). This being the case, there may be little difference between foods consumed in elite and non-elite households. However, in complex chiefdoms, chiefs and sometimes their retinues are supported by foodstuffs collected as tribute. In these circumstances patterns of food consumption are more likely to vary with status.

The materials from the SCB deposit seem to date to the early part of the Moundville I phase. It seems reasonable to suggest that the system was a simple chiefdom when this area was occupied. If so, most foods represented in the deposit would have been procured by the

efforts of individual households. Regardless of the status of the area's residents, tributary foodstuffs were probably at most a minor component of their diet.

For the later Moundville I materials from the NR deposit the case is different. We tend to refer to the Moundville I/II boundary as concurrent with the transition from a simple to a complex chiefdom in the valley. This is more a matter of convenience than of archaeological fact, however. Moundville was probably primus inter pares if not the paramount center during the period the Moundville I structures north of Mound R were in use. Moreover, there is evidence that those households were elite. Thus, it is likely that at least some of the foodstuffs represented in the deposit were provisions acquired through tribute. Without comparative data from other sites in the system and from non-elite households it is difficult to assess the effect of such provisions on the quantitative or qualitative composition of the diet. It must be recognized, however, that the picture of subsistence practices derived from the NR samples may depict only the diet of an elite segment of society.

This problem may be more severe for understanding patterns of meat use than for patterns of plant use. There are ethnohistoric and archaeological data that suggest particular meat cuts or specific animals were supplied to the chief and his followers (J. Hann, personal communication 1985; Scott 1981). In contrast, plant foods supplied for the chief's consumption seem to have been the normal agricultural products (e.g., Penicaut in Swanton 1911:121). Sometimes harvests from communal fields were set aside for the chief's use (Hann

1986), and it is conceivable that "first fruits" were likewise set aside. It is also possible that, even if no specific types of plants were reserved for the sole use of the elite, consumption of different plant foods varied with rank. Such practices would be difficult to discern with archaeological samples of plant remains, but they might be detectable with a sufficiently large and broad data base.

Thus far, I have dwelt on the limitations of my Moundville I data. These limitations cannot be ignored, but they also must be kept in perspective. The subsistence remains we collected are the first and only systematically collected samples from Moundville. It is not surprising that they cannot provide answers to all our subsistence questions. The samples do provide a reasonable starting point for investigating the procurement and production of plant foods in the Moundville I phase. Moreover, the nature of the deposits we tested and the excavation methods we used conferred some benefits that should not be overlooked.

Both north of Mound R and south of the conference building, Moundville I materials accumulated as a result of domestic activities. The majority of the strata and features we excavated were primary deposits. The integrity and condition of the samples were better than if the materials had been recovered from secondary contexts. Besides their good condition, we have reason to believe that the samples come from unmixed contexts. The numerous strata and features were clearly distinguished by differences in soil color and texture. Thus, it was possible to recognize and segregate contexts in the field.

We were able to excavate only small portions of the two residential areas. Nevertheless, we encountered and collected samples from numerous, distinct, domestic contexts. Because they were apt to contain mixed materials, I did not include samples from wall trenches, postmolds, or disturbed features in my analysis. Excluding these features, my Moundville I data base includes flotation samples from 28 floors, 26 midden levels, 17 ash/burn lenses, and 34 pits. In addition, I have fine-screen samples from 28 floors and 24 midden levels. Not only are several contexts represented, but each context type is represented by more than one sample. This redundancy in contexts sampled reduces the impact of stochastic variability in sample contents. Thus, I have a firm basis for making comparisons between contexts.

Finally, the recovery of the samples from stratified deposits allows me to investigate temporal variability in plant use within the Moundville I phase. If we had to rely on our ceramic chronology to determine the temporal relationships between samples, then only gross comparisons between early and late Moundville I would be possible. The clear NR stratigraphy permits me to make finer temporal distinctions. The superimposed floor and midden layers form a time series. We do not know the precise intervals of this scale but the relative positions of the strata and their associated features are unambiguous.

CHAPTER VI

ARCHAEOBOTANICAL ANALYSES: PROBLEMS AND SOLUTIONS

The questions that can be addressed with plant data, and the answers produced by their analyses, are affected by several factors. Cultural and natural processes determine what plants are deposited and which of those are preserved. Excavation, laboratory, and analytical methods influence both which plants are recovered and the proportionate representation of those plants in a sample.

In the following pages, I discuss the preservation biases that affect my data and describe my laboratory and analytical methods. The latter subjects I discuss in some detail because my analyses combine standard archaeobotanical methods with measures and graphic techniques that have not previously been applied to plant data. These methods are drawn from a relatively new branch of statistics, exploratory data analysis (Hoaglin et al. 1983; Tukey 1977; Velleman and Hoaglin 1981).

Preservation Biases

Only a fraction of the plants used at a site become part of the archaeological record. The plants present in a deposit are determined by, among other things, preservation conditions, plant characteristics, food preparation techniques, and refuse disposal practices.

Plant material is preserved if it is deposited in an environment that inhibits decomposition or in a form that is resistant to decay. Infrequently, plants are preserved by conditions that are too dry, too wet, too cold, or otherwise inhospitable to organisms that break down organic matter. More often, plants are preserved by carbonization. This occurs when incomplete combustion of plants exposed to fire converts the plants to elemental carbon (Dimbleby 1967:100). Carbonized plants are resistant to decay caused by microorganisms, but they are subject to mechanical destruction. Repeated wetting and drying, freezing and thawing, trampling, or mixing of deposits containing carbonized materials causes progressive disintegration of plant remains.

The West Jefferson and Moundville plant remains used in my analyses were all preserved by carbonization. Though copper artifacts have been recovered from Moundville, no plant materials preserved by copper salts were recovered from the UMMA excavations. Since carbonization is the only preservation agent affecting my data, the following discussion is limited to factors that influence whether a plant part is likely to be burned and preserved.

The chances that plant foods will be carbonized vary with the physical characteristics of the utilized plants. Many plant foods (e.g., berries, bulbs, greens, and some grains) are eaten whole and seldom intentionally discarded. Generally, such foods will be preserved only if they are accidentally burned during preparation or storage. Other plant foods have portions (e.g., nutshells, maize cobs, fruit stones) that are removed when the food is prepared or

consumed. These inedible by-products are usually discarded and, if refuse is burned, are more likely to be carbonized than edible plant structures.

Physical properties determine whether a plant exposed to fire is likely to be preserved in a recognizable form. Large, dense structures are apt to char when subjected to heat, whereas fragile ones are likely to turn to ash, leaving no identifiable structure. Bulbs, tubers, and other structures that have high water contents are often distorted beyond recognition by carbonization (Munson et al. 1971:427).

Food preparation activities also affect which resources are apt to be preserved. Foods eaten raw are far less likely to become carbonized than foods that are cooked. Whole grains that are parched may be scorched and discarded or accidentally spilled in a cooking fire (Yarnell 1982:2). Plants that are boiled may be spilled into a fire, but their carbonized remains are less likely to be recognizable than those of plants that are parched or roasted. Grinding destroys structural features; foods that are routinely ground before cooking are apt to be rare in plant samples. Not only do different plant foods have unequal chances of becoming carbonized through cooking or processing accidents, but changes in the way a particular food is prepared can alter its preservation opportunities.

Besides cooking accidents, carbonization of plant materials can occur in several other situations. Accidental or intentional burning of a structure or entire community can result in the carbonization of construction materials, stored food supplies, and nearby refuse. Such

fires may preserve a wide range of plants, including ones that have few opportunities to become carbonized in other circumstances. Because of differences in density and other physical characteristics, however, some plants are still more likely to be preserved than others.

Deliberately burned refuse is a common source of carbonized plant materials. Occasionally, spoiled food supplies are discarded and burned, but food preparation by-products comprise the majority of subsistence remains in burned refuse. Such by-products include both inedible portions of plant foods and weed seeds or other contaminants cleaned from harvested supplies (Dennell 1976:235-242). Besides subsistence remains, deposits of burned refuse may contain spent fuel, discarded matting or thatching, and miscellaneous plant debris generated by activities unrelated to subsistence. Of course, changes in refuse disposal practices can affect the quantity and variety of preserved plant remains.

Frequently, plant materials used to fuel cooking or heating fires become carbonized. Wood charcoal is, perhaps, the most common fuel residue, but it is not the only one. When herbivore dung is used for fuel, seeds and other indigestible plant parts contained in the dung may be carbonized (Miller and Smart 1984). Food by-products are another potential source of fuel. Such materials may be thrown on a fire during food preparation, but by-products may also be set aside for later use or for special purposes.

There are several plant food by-products that seem to have been used for fuel in the southeastern United States. "Smudge pits" are common features on late prehistoric sites in the Southeast. These pits generally are filled with carbonized maize cobs, though wood, bark, or pine cones also may be present. While the function of these features is a matter of some discussion (Binford 1967), smudge pits are a clear example of the use of food by-products for fuel.

Hickory nutshell is another food by-product that may have been used for fuel in the Eastern Woodlands. Because their dense shells produce a hot, smokeless fire, it has been suggested that hickory nuts were used for fuel, and perhaps even collected for that purpose (Ford 1979b:397; Munson et al. 1971:427). Lopinot (1984:154-157) burned nutshells under controlled conditions to examine this possibility. His results indicate that hickory nutshells ignite rapidly and produce high temperatures, but the fires are short lived. He argues that intentional collection of nutshells for fuel was unlikely, though he concedes shells discarded during food preparation may have been burned for special purposes or to eliminate accumulated waste. Based on Lopinot's work, it is probably safe to assume that carbonized nutshells recovered from archaeological contexts are food by-products. Both nutshells and maize cobs may be over-represented in deposits, however, if they were used for fuel.

Finally, some carbonized plants in archaeological deposits are incidental inclusions. For example, weed seeds can be preserved through burning dung or crop residue, but such seeds may also be blown or dropped in fires as a result of natural seed dispersal. Indeed,

since most plants that colonize disturbed ground are prolific seed bearers, such incidental inclusions should be expected.

The biases caused by differential preservation must be recognized, but they do not preclude quantitative analyses of plant data. Since human behavior is patterned, frequently used resources are apt to be the subjects of accidents or activities that result in deposition and preservation, while resources that are seldom used will be less common (Yarnell 1982:4). It may be impossible to measure the absolute dietary importance of various plant resources using only plant remains. Nevertheless, with adequate collections we can identify the major plant resources used by a community. Moreover, we can measure the proportionate use of those resources between contexts or over time. This, of course, requires that differences in depositional contexts, changes in food processing technologies, and changes in refuse disposal patterns be considered as sources of variability in plant data. That is, the effects of these factors must be considered before attributing observed differences in plant assemblages to changes in subsistence practices.

The plant remains used in my analyses are all carbonized. Cooking accidents seem to be a negligible source of these remains. Nutmeats, whole maize kernels, beans, and edible seeds are present, but not abundant. There are few samples with high seed counts suggestive of spills or other mishaps. Similarly, few remains can be attributed to structure fires. The only samples containing plant remains that may have been carbonized when a structure burned come the daub level and the floor immediately below the daub in the NR deposit

(See Figures 5:3 and 5:4). Overall, the non-wood plant remains are dominated by food by-products, such as nutshells and maize cupules. The composition of the assemblages suggests that the carbonized materials are primarily derived from fuel, burned refuse, and stray food items dropped in fires.

Recovery Procedures

Differential preservation is not the only source of bias in archaeobotanical data. Field and laboratory methods also affect the quantity and variety of identified plant remains. Biases caused by recovery and processing are unavoidable, though use of appropriate techniques can minimize their impact. Such biases influence both the interpretation of a single data set and comparisons between data sets. Thus, information about field and laboratory procedures is essential for evaluating the results of any archaeobotanical study.

Our ability to characterize an archaeological plant assemblage is affected by the contexts sampled for plant remains, as well as by the number and size of samples collected from those contexts. Different functional, spatial, and temporal contexts may vary in their plant contents. Sampling only contexts presumed to relate to subsistence activities, or only deposits which appear to be rich in organic remains, can severely bias plant data. Not only may different contexts vary in their plant contents, but often there is idiosyncratic variability in the plant remains from similar contexts. When few samples are collected, it is difficult to filter such variability and detect underlying patterns. When numerous samples are

collected, general patterns of plant use can be more accurately described, and variability within those patterns can sometimes be examined. The volume of soil processed to recover plant remains can also bias archaeobotanical data. For deposits with abundant plant remains, sample size is seldom a problem. For deposits with few plant remains, however, small soil samples may produce insufficient or inaccurate data. This problem may be acute if few samples are collected.

The contexts from which the West Jefferson and Moundville I plant remains were collected have already been described (Chapter V). To obtain as representative a sample as possible, we collected plant remains from many different contexts. For the West Jefferson phase, no materials from midden or floor deposits were available, but to the extent possible, I selected samples that represent the range of variability in feature contexts. Except for recent disturbances, we collected plant remains from all contexts encountered during the UMMA excavations at Moundville.

Like sampling strategies, recovery methods affect the quantity and quality of archaeobotanical data. Most plant remains pass through the 1/4-inch hardware cloth commonly used to recover artifacts. Samples collected from such screens are subject to severe size biases. Since this problem is widely recognized, most archaeobotanical analyses are based on samples collected by fine-screening or flotation.

Fine-screening is simply the use of a fine mesh screen to recover plant remains and other small items. Often, screen with a 1/16-inch

mesh is used. Water sprayed from a hose is sometimes used to improve the separation of cultural materials from their soil matrix.

While fine-screening is an efficient way to recover large samples, it has several drawbacks. A 1/16-inch sieve will catch most wood, nutshell, and maize fragments, but many seeds will pass through a mesh of this size. Whole taxa (e.g., tobacco, blueberry, purslane) may be lost and other taxa (e.g., chenopod, maygrass) may be represented only by the larger individuals in a population (Munson 1981:124). Another problem is that the screening process can damage fragile plant remains. Carbonized materials are easily abraded or even destroyed by being tumbled amongst heavy artifacts. When nested screens are used, this problem is reduced, though not eliminated. Damage can also result from using water in the screening process. Simply wetting carbonized remains can cause some fragmentation, but far more damage can be inflicted by water pressure that is too high.

Because of the problems with fine-screening, water separation is generally the preferred method for recovering plant remains. Flotation procedures vary, but they all work in basically the same way. A soil sample is immersed in water and agitated. Plant remains and other buoyant materials float and are scooped or poured off. Heavy materials sink and are caught in a fine-mesh screen.

Flotation can result in the recovery of even the smallest seeds, while causing minimal damage to fragile remains. Not all flotation procedures are equally effective, however (see Keeley 1978; Wagner 1982; and Watson 1976 for detailed discussions of the relative merits of various flotation systems). Recovery rates vary depending on the

set-up, the mesh of the scoop or sieve used to collect the light fraction, and the thoroughness of the individuals who process the samples. Machines that use percolating water and overflow systems (e.g., the SMAP machine described by Watson [1976]) have much higher recovery rates than hand operated washtub methods (Wagner 1982).

Though it is usually gentler than fine-screening, flotation can damage plant remains. Too much agitation, or too high water pressure in overflow systems, can cause unnecessary breakage. Plant remains can also be damaged by repeated wetting and drying. Because dry materials float more readily than wet ones, some analysts recommend drying damp soil samples before they are floated (Dye and Moore 1978; Lange and Carty 1975). Recent experiments by Lopinot (1984:108) have shown, however, that this practice may cause considerable damage to plant remains. Since the extent of fragmentation varies between different plant parts and taxa, predrying can be a source of bias.

The procedures used to collect the West Jefferson and Moundville I plant remains were selected to maximize retrieval and minimize biases. My data include materials recovered by fine-screening with water and by flotation.

All fine-screen samples were processed by water-screening. To reduce potential damage, we used nested 1/4-inch and 1/16-inch screens, and adjusted the water pressure to the minimum necessary to wash away the soil matrix. As a result, the plant materials in the screen samples are in generally good condition and seem to have suffered little damage. Size bias is, however, a problem. Comparison of the contents of fine-screen and flotation samples taken from the

same contexts indicates that small seeds are under-represented in the screen samples.

Most float samples were processed using a SMAP type flotation machine (Watson 1976:88-90, 94). Our flotation procedures, however, differed slightly from those described by Watson. Cloth diapers rather than geological sieves were used to strain the overflow. In addition, a scoop was used to collect wood and nutshell fragments suspended in the water. Tap water rather than pumped water was used to drive the system. We also took several steps to minimize processing damage. To avoid unnecessary fragmentation, soil samples were not predried before they were floated. Light fractions were tied in the cloth in which they were caught and slowly air dried. Heavy fractions were rinsed onto cloth and, like the light fractions, air dried.

Tests using carbonized poppy seeds have demonstrated that SMAP systems have consistently high recovery rates, averaging better than 90 percent (Wagner 1982:128-129). The modifications we made to the SMAP system are unlikely to have lowered recovery rates. In fact, they may have enhanced recovery by being gentler and more thorough.

While most flotation samples were processed in the field, two West Jefferson samples from 1Ha8 were processed in the laboratory by Paul Welch. For these samples he used the following procedures (P. Welch, personal communication 1985). The soil was first rinsed through nested 2 mm and .5 mm geological screens. After the material caught in the screens dried, plant remains were hand picked from the 2 mm fraction. Plant remains were separated from the fine-fraction by

pouring it into a beaker under a gentle stream of water. The overflow containing the plant remains was caught in a .5 mm sieve. Inspection of the soil residue left from the second stage of processing the .5 mm fraction, indicated that most plant remains had been extracted.

Laboratory Procedures

Like field procedures, common laboratory practices affect the composition of plant assemblages. Refloating or chemically floating samples that have been water-screened or floated can cause differential fragmentation of plant remains (Lopinot 1984:108). Subsampling large samples can introduce size bias, if the tendency for plant remains to sort by size is not countered by the splitting technique. The problems with refloating and subsampling are generally recognized, and these procedures are used cautiously by most analysts.

Less attention is given to the effects of sorting procedures on plant data. Plant samples are frequently sieved through geological screens to facilitate sorting. The standard practice in the eastern United States is to sort completely those materials greater than 2 mm in size and to scan materials smaller than this for seeds (Asch and Asch 1981:276; Caddell 1983:196; Chapman and Shea 1981:65; Johannessen 1984b:244; Yarnell 1974:114). Most nutshell and maize proportions reported in the literature are based on the quantities of these taxa in the greater-than-2 mm fractions. Recent experiments by Lopinot (1984:111-112), however, have shown that acorn shell is under-represented when sorting stops at this level.

I subsampled and chemically floated the fine-screen samples from Moundville. Because enormous quantities of material were recovered by our screening procedures, hand sorting would have been prohibitively time consuming. Thus, it was necessary to subsample and chemically float the fine-screen materials. Each fine-screen sample was weighed and a 500 gm subsample was removed with a scoop. This may have resulted in the under-representation of some small remains. A more time consuming subsampling technique did not seem worthwhile, however, since small seeds would not have been recovered by the screening process. The subsamples were floated in a zinc chloride solution (cf. Struever 1968:355-356). This separated plant remains from the other fine screen materials, but by rewetting the samples it may have caused some fragmentation. Because of probable size biases and the possibility of undetected bias caused by fragmentation during processing, the fine-screen data are primarily used to supplement the flotation data.

No flotation samples were refloated in the laboratory and few were subsampled. For those that were subsampled, I tried to insure that all size classes were represented in the processed fraction. To split a sample, I spread it on a piece of paper and carefully stirred it. I then drew a line through the sample dividing it into two roughly equal portions. If the split sample was still too large, I repeated the entire procedure.

The sorting, identifying, and quantifying procedures I used were the same for the fine-screen and flotation samples. I weighed each sample and then sifted it through 2.0, 1.4, and 0.71 mm geological

screens. Contrary to standard practice, I sorted completely all material greater than 1.4 mm in size. The counts and weights of wood, nutshell, and maize remains I use in my analyses are the quantities present in the greater than 1.4 mm fractions. These are more accurate estimates of the relative proportions of the taxa than estimates based on 2 mm data. My divergence from standard practice creates some problems, however, for making comparisons between my data and those of other analysts. I scanned the residue caught in the 0.71 mm screen and the bottom pan removing and identifying all seeds and seed fragments. Wood, nutshell, and maize remains in the residue were noted only on a presence/absence basis. The seed counts I use in my analysis are the totals for the entire sample, including the fractions smaller than 1.4 mm.

I used both pictorial guides (e.g., Martin and Barkley 1961; Schopmeyer 1974; Panshin and de Zeeuw 1964) and a comparative collection to identify the plant remains. The comparative collection includes wood and seed specimens collected at Moundville and elsewhere in the Black Warrior River Valley. Some samples were sorted by my laboratory assistant, Michelle Alexander, but I made or confirmed all identifications in those samples. Richard I. Ford and C. Earle Smith provided second opinions on a few identifications about which I was uncertain.

The proportional representation of wood taxa in a sample can be estimated on the basis of 20 identified fragments (Minnis and Ford 1977:82). For each sample, I separated the wood charcoal larger than 1.4 mm--including bark, cane, and maize stalk--from other plant

remains and weighed it. I then identified a minimum of 20 wood fragments from each context for which sufficient wood remains were available. Appendix A lists the taxa identifications for each context used in the wood analysis. The three liter flotation samples from midden and floor levels at Moundville did not contain enough wood to securely identify 20 fragments and are therefore excluded from the wood analysis. Instead, wood data from the fine-screen samples are used for these contexts. Most flotation samples from features contained adequate wood for identification, but a few features are omitted from the wood analysis because they contained too little wood. For features represented by a single flotation sample, 20 fragments of wood were identified. Many of the features were excavated in more than one level for logistical purposes. For these features, 10 wood fragments per level were identified. The counts from all levels of a feature are combined for the analysis. I converted the taxa counts to percentages to examine patterns of wood use.

Nutshell was present in virtually every sample. Thick-shelled hickory and acorn comprised the overwhelming majority of the nutshell. Other nut taxa occurred only in trace amounts. I identified the nutshell fragments larger than 1.4 mm to genus and then counted and weighed each taxon to the nearest 0.01 g. When acorn caps were present, I lumped them with the other acorn shell fragments. Nutmeats were counted and weighed separately.

Like nutshell, maize remains occurred in most samples. I sorted the maize fragments larger than 1.4 mm into three groups: kernels, cupules, and cob fragments. I counted and weighed each group

separately. Where possible, I measured the height and width of cupules, and the height, width, and thickness of kernels. Most kernels and cupules were too fragmentary for metric analysis, however. Cobs with complete cross sections I measured according to the methods described by Ford (1973:188-189; see Chapter IX for a discussion of the attributes measured).

Seeds were treated somewhat differently from the other types of plant remains. I quantified seed taxa only by counts, since the weight of the seeds was usually too small to register on my scale. The seed counts include specimens found in the less-than-1.4 mm fractions. Each seed and seed fragment was counted individually; I did not attempt to determine the number of whole seeds represented by fragments. Because small-seeded taxa are usually represented by whole or nearly whole specimens, the counts for such taxa are reasonable estimates of the number of seeds present. The counts for persimmons and beans are inflated, however, because most specimens from these large-seeded taxa are fragments rather than whole seeds.

Seeds are identified to the lowest possible taxonomic level. Some seeds are identified to family, but most are identified to genus and a few to species. For several taxa where species identification might provide additional economic or cultural information (e.g., Chenopodium, Polygonum), I made an extra effort to determine species. In most instances, however, there are not enough specimens to identify species. In addition to the identified taxa, I recorded two other seed categories. Undamaged seeds that I could not identify to family based on the available comparative materials, are classified as

unidentified. Seeds that had lost their diagnostic features, are classified as unidentifiable.

Many features and some midden and floor deposits were represented by more than one sample. These samples were processed individually in the laboratory. Data from fine-screen and flotation samples were kept separate, but otherwise data from contexts represented by more than one sample are combined for the analyses. Appendix B lists by context the plant remains other than wood identified in the flotation samples. Appendix C presents the same information for the fine-screen samples.

Quantitative Procedures

Analyses of archaeobotanical data are far from standardized. Though studies of archaeological plant remains are not new, there has been a dramatic increase in the number of such studies since the introduction of flotation procedures. Along with this increase, there has been a continuing search for analytical tools appropriate for use on plant data. My analyses employ measures devised and used by other analysts, but I apply these measures in new ways. To investigate the structure and variability in my data, I draw heavily on the basic precepts of exploratory data analysis (Hoaglin et al. 1983; Tukey 1977; Velleman and Hoaglin 1981).

Quantitative analyses of plant remains are made difficult not only by preservation and recovery biases, but also by measurement problems. Weights and counts are the most common quantifiers used for plant data. It is difficult to interpret observations made using these measures, however. In part, this is because different processes

are being measured across the varying categories of plant remains. Counts or weights of nutshells or fruit pits indirectly monitor food consumed, whereas the same measures applied to grains monitor food that was not eaten. Another difficulty is that the measures themselves have inherent biases. Weight over-emphasizes dense plant remains. This causes problems even within a single category of plant remains; a given quantity of hickory shell will almost always outweigh an equivalent amount of acorn shell. Counts are also problematical. In some instances, counts represent fragments (e.g., nutshell), while in others they represent whole entities (e.g., seeds). Variable yields and differences in the size of plant foods also lead to problems in interpreting counts. It is difficult to assess the relative importance of a single large seed, such as a plum pit, versus a larger quantity of small seeds, such as grape pips. Because of these problems, quantified plant data cannot be used to determine the absolute dietary importance of different plant resources.

One solution to the measurement problems in plant data is to work only with frequency of taxa occurrence rather than trying to monitor abundance. This approach, adapted from phytosociology, has been called presence-analysis by Hubbard (1980:51) and ubiquity analysis by Minnis (1981:169-170). A taxon's ubiquity is measured using an index that is simply the proportion of all samples that contain the taxon. To determine the significance of changes in ubiquity indices, Spearman's coefficient of rank-order correlation (Minnis 1981:170, 174) and the standard error of differences in proportions (Hastorf 1983:253-254) have been employed. Ubiquity indices have been used as

the primary analytical tools on plant data from the Middle East (Hubbard 1980), Peru (Hastorf 1983), and the southwestern United States (Minnis 1981). In the eastern United States, both Caddell (1983) and Johannessen (1984a) have used ubiquity along with other measures to analyze late prehistoric plant remains.

Ubiquity analysis solves the measurement dilemma by sidestepping the issue, but the method has several weaknesses that limit its utility. Ubiquity indices can be used to examine differences in the use of a taxon over time or between contexts. Differential preservation opportunities, however, make direct comparisons between taxa inappropriate (Hubbard 1980:53). To examine differences between taxa using ubiquity, the analyst must look for parallel or divergent trends in taxa indices. This is not the most serious problem, however. Valuable information about changes in subsistence practices may be sacrificed by discarding abundance data. For example, the frequency with which a resource is used may remain constant, while the quantity used varies. Ubiquity cannot detect such changes and can therefore mask important differences in resource use or processing. In fact, this is the case for the dominant taxa in the samples from the Black Warrior Valley.

I use ubiquity as a starting point for making comparisons between the plant remains from the West Jefferson and Moundville I phases. Hickory shell, acorn shell, and maize cupules have similar ubiquity ratings for the two phases, but there are clear changes in the relative abundance of nuts and maize. For these taxa, ubiquity

analysis obscures important structure in the data. Ubiquity indices are of some use, however, for examining patterns in the seed taxa.

Ratios provide an alternative approach to the measurement problems encountered with plant remains. Percentages are the ratios most frequently employed in archaeobotany, but taxon-to-taxon and seed-to-nutshell ratios are also common. Analysts who use ratios assume that differences between contexts in the proportions of resources may be informative, despite the problems with the units of measurement. Provided this premise is kept in mind, ratios can be convenient tools for monitoring variability in patterns of plant use. There are also problems with the use of ratios, however.

Ratios cannot be calculated for cases in which the variable used as the denominator has a value of zero. This is not a problem for percentages or standardizing ratios where the divisor is always larger than zero, but for taxon-to-taxon ratios it can cause difficulties. Division by zero can, of course, be avoided by omitting cases with zero values. Dropping too many cases can, however, result in misleading results.

Another problem with ratios is that they can be difficult to interpret. Ratios indicate proportions of plant remains recovered from a deposit; they do not indicate the relative importance of the resources from which those remains are derived. Therefore, while comparisons between ratios from different contexts can provide information about variability in plant use, a single ratio is meaningless. Moreover, comparisons between ratios from several contexts can indicate whether the proportions of the taxa are

different but not why they are different. The taxon values must be examined to determine which variable(s) increased or decreased. For ratios comparing two taxa this is a relatively easy task. It is more difficult for percentage comparisons, particularly when many taxa are involved, because of problems with closure (Speth and Johnson 1976:48-50).

To determine whether there are patterned changes in the values for an individual taxon, differences due to volume of sediment sampled and abundances of plant remains in a deposit must be filtered. Standardizing ratios are frequently used, for these purposes. When the abundance of plant remains is constant, all that is necessary is to control for differences in volume of sediment processed. This can be done simply by using the volume of soil from which the remains were extracted as the standardizer. If plant abundance varies, however, sediment volume is not an adequate standardizer. In such cases, the quantity of wood charcoal or the quantity of plant remains may be a more appropriate standardizer. The use of wood charcoal as a standardizer is based on two assumptions: that wood is the primary source of fuel and fuel use is constant over time (Asch and Asch 1975). The use of total plant remains as a standardizer allows for the possibility that materials other than wood (e.g., dung, nutshell) may have been used for fuel (Miller 1982:145).

My analyses employ both comparison and standardizing ratios. I use comparison ratios to examine relationships between individual taxa and between categories of food resources. I rely most heavily on ratios between pairs of variables, because of the greater ease with

which they can be interpreted. To avoid calculation problems, I dropped cases with zero values for either of the variables being compared. To investigate the behavior of individual taxa, I use values standardized by plant weight.

Though my use of ratios is not new, my analyses diverge from previous archaeobotanical studies in several ways. Most studies of plant remains from the eastern United States use weight to quantify nutshell and maize remains and counts to quantify seeds. I use counts as the measure for all categories of taxa. Instead of using the mean and standard deviation to summarize and compare taxa and ratio distributions, I use medians and measures of dispersion around the median. Usually, my analyses and comparisons are performed using the natural logs of the taxa and ratio values. Finally, rather than using graphs only to summarize results, I make extensive use of several graphic tools to explore the underlying distribution and behavior of the data. For these purposes, I use a combination of scatter plots, stem-and-leaf diagrams, boxplots, and smoothed time-series plots.

My choice of counts as the basic measure for my analyses was based on two considerations. The abundance of plant remains in the midden and floor levels at Moundville was low. Thus, the quantities of plant remains in the three liter flotation samples from these levels are generally small. Often, the nutshell or maize remains weigh less than 0.01 g. To include these samples in analyses with samples from features where plant remains were more abundant, I need a measure that can be applied consistently and accurately to all taxa. Counts fit these criteria better than weight. My decision to use

counts was also influenced by the results of a preliminary analysis of some West Jefferson and Moundville I features (Scarry 1981a). It was evident from this analysis that the proportions of hickory, acorn, and maize remains differed between the phases. Since hickory is much denser than the other taxa, analyses based on weight tend to over-emphasize hickory and mask important changes. I felt that the changes in the use of the three taxa could be demonstrated more effectively using count data.

Exploratory Data Analysis

My use of medians, natural logs, and graphic analyses is an experimental application of exploratory data analysis (EDA) to archaeobotanical data. EDA differs from most traditional approaches to statistical analysis by beginning with a search for pattern rather than attempting to confirm or fit *a priori* models (Hartwig and Dearing 1979:10). The tools of EDA can be used as alternatives to more conventional procedures to gain insights and produce results. They can also be used to select appropriate models from traditional statistics. Essentially, EDA is a method for developing a thorough understanding of data structure and variability.

I believe EDA offers a reasonable, productive approach to quantitative analyses of plant remains. Its techniques have been used to a limited extent on archaeological data (Clark 1982:248-263; V. Steponaitis, personal communication 1986), but never to my knowledge on archaeobotanical data. Because EDA is new, its methods require some discussion. To avoid disrupting the presentation of my analyses

with extended descriptions of the tools I use to manipulate the data, the basic concepts and analytical techniques of EDA are described below. The terminology I use follows that of Velleman and Hoaglin (1981) and Hoaglin et al. (1983).

Proponents of EDA use the term "batch" in place of the more familiar "sample". The distinction between the two terms is that "'batch' does not include the assumptions of independence and identical distribution usually associated with 'sample'" (Hoaglin et al. 1983:4). I use batch to refer to sets of data (e.g., the batch is normally distributed), but retain the term "sample" to refer to individual cases (e.g., the flotation sample).

The emphasis in EDA is on flexibility. The distribution of a batch of data is described using measures of center and spread that are resistant and reasonably robust. Resistant measures are not greatly affected by extreme values or by a change in the value of a single observation. Robust measures are insensitive to departures from a normal distribution (Hoaglin et al. 1983:2-3). The familiar summary statistics mean and standard deviation are neither resistant nor robust. They are good measures for normal distributions, but can be extremely poor descriptors for other distributions.

EDA uses medians and several measures of dispersion around the median in place of the mean and its measures of variance. The median is, of course, the middle value of a batch. Half of the values are less than or equal to the median; the rest are greater than or equal to it. The "hinges" or "fourths" are the middle values for each half of the batch. The "H-spread" or "fourth-spread" is the difference

between the hinges. It describes the range covered by the middle half of the data, and is a resistant measure of the concentration of the observations. The "eighths" are the middle values of the outer quarters of the batch. The "extremes" are the highest and lowest values; they define the entire range of the batch. "Outliers" are values so low or so high that they stand apart from the rest of the batch (Velleman and Hoaglin 1981:67). As a rule of thumb, values are considered outliers if they fall more than 1.5 times the H-spread beyond the upper or lower hinge. Values falling beyond the hinges by more than 3 times the H-spread are considered extreme outliers.

For skewed distributions or batches with a few extreme outliers, the median and H-spread provide better descriptions of the location of the bulk of the data than do mean and standard deviation. For multimodal distributions neither the median nor the mean is a good measure.

Because even resistant statistics can conceal important information, visual displays are used in conjunction with the summary measures. Data are examined using, among other things, scatter plots, probability plots, stem-and-leaf plots, and boxplots.[1] The latter graphic techniques summarize distributions, while preserving information about variability within the data. Scatter plots need no explanation. Probability graphs are simply the values of a variable plotted against corresponding percentage points of a normal distribution. They are an effective tool for determining whether data

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[1] All graphs and plots presented in this dissertation were initially generated on a Kaypro computer using Systat software. Systat uses the algorithm described by Gnanadesikan (1977) for probability plots, and the algorithms described in Velleman and Hoaglin (1981) for stem-and-leaf plots and boxplots.

are normally distributed (Gnanadesikan 1977). Stem-and-leaf displays and boxplots are techniques developed specifically for EDA (Tukey 1977).

Stem-and-leaf displays are similar to histograms, but they preserve more information about data values (Figure 6:1). The number of lines in a stem-and-leaf diagram is determined by the number of observations. To construct a plot, each value is split into leading and trailing digits (see Hoaglin et al. [1983:22-29] for a discussion of the conventions for determining the number of lines and thus for splitting the values to achieve the desired number of lines). The leading and trailing digits are then used to sort and display the data. The stem of the diagram is a list of all possible sets of leading digits ordered from lowest to highest. This includes digit combinations that do not actually occur in the data. The leftmost trailing digits are used in the leaves to represent the values. If there are numerous leaves per stem, each stem can be repeated and the leaves divided accordingly (See Figure 6:1). A heading is used at the top of the diagram to explain how the values are split. The locations of the median (M) and hinges (H) are marked in the column between the stem and leaves. Outside values are identified and separated from the main diagram. The advantage of the stem-and-leaf plot over a histogram is that the former shows any graininess (missing values) in the data as well as their distribution.

Boxplots are visual summaries of the distribution of the batch around the median (Figure 6:2). The scale of the diagram is determined by the minimum and maximum values of the variable(s) being

```
SMALLEST VALUE AT TOP OF PLOT IS:        0.000

 0   00111122233334
 0 H 555556666678899999        H marks hinge
 1   0000111223333334
 1 M 5566667777778888888       M marks median
 2   00001112223
 2   55667
 3 H 011112233                 H marks hinge
 3   55557
 4   013
 4   5688
 5   133
 5   6
 6   024
 6   88
 7   1
***OUTSIDE VALUES***     < upper hinge + (1.5*H-spread)
 7   45
 8   59
 9   06
11   24
13   5
```

Key:

In this example the value 5.1245 that appears on line 11 of the sample stem-and-leaf diagram is displayed in this fashion.

leading digits	trailing digits	
5	1	245
use in sorting	show in display	ignore

Figure 6:1. Example of a stem-and-leaf plot.

```
0                                                    4.54
|------------------------------------------------------------|
|        ---------------                                     |
|--------|  (   +    ) |--------------------        *        |
|        ---------------                                     |
|                         -------------                      |
|                 -------|(    +   ) |---------------    *    |
|                         -------------                      |
|------------------------------------------------------------|
0                                                    4.54
```

Key:

+	median (M)
¦	hinges
--	whisker (values < 1.5*H-spread beyond hinges)
*	outliers (values > 1.5*H-spread beyond hinges)
0	extreme outliers (values > 3*H-spread beyond hinges)
()	95% confidence interval about the median

Figure 6:2. Example of a boxplot.

plotted. The ends of the box are the lower and upper hinges. Thus, half of the values lie within the area defined by the box. The median (M) is marked by a "+". The "whiskers" extend from the box to the farthest value that is not an outlier. Outliers are marked individually by "*"'s. Extreme outliers are marked with "O"'s. When two or more boxplots are compared, parentheses placed around the medians define a simultaneous confidence interval. If the intervals of two boxes do not overlap, there is a 95% probability that the batch medians are different (Velleman and Hoaglin 1981:74). Together, the location of the median, the width of the box, and the length of the whiskers effectively convey the location, spread, and symmetry of the data.

Re-expression is another basic tool used in EDA. Unless there are theoretical reasons to use the original scale of measurement, EDA proponents take the attitude that there is nothing sacred about the units of measurement of raw data. Frequently data are re-expressed to simplify analysis; that is, an arithmetic function is used to change the scale of measurement. Depending on the structure of the batch, re-expression can promote "symmetry, constancy of variability, straightness of relationship, or additivity of effect" (Hoaglin et al. 1983:3). Most often power functions, such as logarithms or roots, are used to re-express data. The function used in any given case is determined by the desired effect on the distribution of the batch. Velleman and Hoaglin (1981:48-49) and Hoaglin et al. (1983:97-127) provide good discussions of how to select the best re-expression for a given data set.

Besides techniques for exploring data distributions, EDA provides tools for detecting pattern. Linear trends can be modeled by using medians to fit resistant lines. To detect pattern in series observations, running medians can be used to smooth data. This filters noise and exposes underlying patterns. Similarly, medians can be used to smooth and fit curves to scatter plots. The algorithms for these procedures are too complicated to discuss here. Clear discussions of resistant lines and smoothing data by running medians can be found in Velleman and Hoaglin (1981). Scatter plot smoothing is described in Cleveland (1985:167-178).

The search for pattern is an iterative procedure in EDA. Whenever lines are fit or data are smoothed, the residuals are examined. By inspecting data that do not conform to the general distribution or variability that is not explained by the fitted model, unusual behavior can be detected. Sometimes, too much variability can indicate an inappropriate model. In other instances, the residuals themselves can be manipulated and the model can be adjusted to better fit the data.

In Chapters VII and VIII, the measures and graphic techniques of EDA are used to analyze the distributions of plant food remains in my samples from the West Jefferson and Moundville I phases. I use stem-and-leaf diagrams primarily to search for multi-modality in taxa and ratio distributions. To examine the relationships between taxa, I use both scatter plots of one taxon against another, and boxplots of taxa ratios and standardized taxon counts.

Fitting and smoothing procedures are not required for most of my investigations. I do, however, use a time-series smoothing routine to examine some of the Moundville data. The smoothing routine fits a reproducible curve to an ordered set of values. Such procedures are most often applied to data spaced at regular intervals. If the order of observations is known and intervals are not too irregular, however, data series that are not evenly spaced can be smoothed (Velleman and Hoaglin 1981:160). I treat the samples from the stratified floor and midden deposits at Moundville as a time-series, and use smoothed sequences to search for trends or fluctuations in the frequency of wood taxa and in the relative proportions of nuts and maize.

For this analysis, I use the compound smoother "4253H,twice". This procedure employs running medians and weighted averages to smooth the sequence. Five passes are made through the sequence. On the first four, data are smoothed using running medians by replacing each value with the median of a specified span of values. For example, if a running median of three is used, each value is replaced with the median value of the segment of the sequence that contains itself and the values on either side of it. In the "4253H,twice" algorithm, values are smoothed using running medians of four observations, then of two observations, then of five observations, and finally of three observations. On the fifth pass, the values are replaced with weighted averages. This step (the "H" in "4253H") is called Hanning after Julius von Hann who devised the formula used to compute the weighted averages (Velleman and Hoaglin 1981:170). To avoid over-smoothing, the residuals are also smoothed using the "4253H" routine

and then added to the initial smoothed sequence. This "reroughing" step is denoted by the "twice" in the title of the compound smoother. Figure 6:3 presents an example of the effects of smoothing a data-series at successive stages in the procedure. The reader is referred to Velleman and Hoaglin (1981:59-177) for a more detailed discussion of smoothing as well as an explanation of the merits of using a compound smoother rather than a simple one.

It is not just graphic tools that I have adopted from EDA. My decision to use plant weight to standardize taxa counts, and natural logs to re-express the standardized counts was guided by the flexible EDA approach to data. Moreover, throughout my analyses I use medians to summarize and compare taxa and ratio distributions. Means are given in some tables, but in virtually every case outside values and skewed distributions make these statistics poor measures of center.

After experimenting with the three denominators commonly used in archaeobotanical analyses I chose plant weight to standardize my data by experimenting with. My initial intent was to use sample volume as the standardizer. Preliminary analyses using counts per liter, however, produced results that were clearly dependent on the abundance of plant remains in the various deposits. Figure 6:4 is a probability plot of the total plant food count (i.e., count of all plant food remains in a sample) per liter for all flotation samples used in my analyses. A population that is normally distributed will result in a straight diagonal line extending across the graph. Clearly, my data are not normally distributed. Similar results were produced when I plotted individual taxon counts per liter. To control the effects of

Figure 6:3. Example of the application of the "4253H,twice" smoothing algorithm.

A - raw values, B - smoothed values, C - residuals, D - smoothed residuals, E - smoothed values reroughed by addition of smoothed residuals

Figure 6:4. Normal probability plot of plant food count standardized by sample volume.

Plant food counts standardized by sample volume in liters plotted against corresponding percentage points of a normal distribution. Numbers on the plot indicate points with more than one observation with the same value.

differential abundance, I first tried using wood weight as a standardizer. Figure 6:5 is a probability plot of total plant food count per gram of wood charcoal for all flotation samples. Using wood weight as a standardizer spreads the clumped values and pulls in most outliers, but does not result in a symmetrical distribution. To see if the distribution could be further improved, I used plant weight (i.e., the weight of all plant remains in the greater-than-1.4 mm fraction) as the denominator and once again plotted the standardized values for total plant food count (Figure 6:6). Plant weight produces a more even spread in the values, but the curve indicates the distribution is skewed to the right.

Curved distributions can be straightened by re-expression. Tukey (1977:83-84) notes that because count data are usually asymmetrically distributed, their analyses are nearly always improved by re-expression on a root or log scale. I used natural logs to re-express the food counts standardized by plant weight. The probability plot in Figure 6:7 displays the effects of this transformation. Logging the values dramatically improves the symmetry of the distribution. When I plotted the natural logs of individual taxa standardized by plant weight the results were similar to those in Figure 6:7.

Based on the results of these trial runs, I chose to use the natural logs of counts standardized by plant weight for my graphic analyses. Because the natural log of zero is undefined, I use a "start" of 1 to avoid calculation problems (Tukey 1977:92; Velleman and Hoaglin 1981:50). That is, I increased all values by 1 before re-expressing them on a log scale. Thus, where taxa are used in graphs,

Figure 6:5. Normal probability plot of plant food count standardized by wood weight.

Plant food counts standardized by wood weight in grams plotted against corresponding percentage points of a normal distribution. Numbers on the plot indicate points with more than one observation with the same value.

Figure 6:6. Normal probability plot of plant food count standardized by plant weight.

Plant food counts standardized by plant weight in grams plotted against corresponding percentage points of a normal distribution. Numbers on the plot indicate points with more than one observation with the same value.

Figure 6:7. Normal probability plot of plant food count standardized by plant weight and logged.

Plant food counts standardized by plant weight in grams and reexpressed as natural logs plotted against corresponding percentage points of a normal distribution. Numbers on the plot indicate points with more than one observation with the same value.

the values plotted are ln[(taxon count/plant weight)+1]. Ratio values are plotted as ln[(taxon/taxon)+1]. Note that these are logs of the ratios, not ratios of log values. Re-expressing the values as logs changes the scale and improves symmetry. The original order of the data is preserved, however. Moreover, medians are transformed to medians and hinges are transformed to hinges (Hoaglin et al. 1983:98).

EDA is not a "miracle solution" to the preservation and measurement problems in archaeobotany, but it provides a framework for working with quantified plant data. My application of EDA barely skims the surface; I rely heavily on the elementary aspects of the approach. Nevertheless, my results suggest that the graphic tools effectively summarize taxa distributions, while preserving information about variability within those distributions. The impact of unusual cases is filtered by the resistant techniques. This permits me to examine and describe underlying patterns. The unusual cases themselves are identified and, where necessary, can be examined individually. This two-pronged approach helps me avoid the pitfalls encountered when quantified data simply are summarized and interpreted.

In the final section of this chapter, I discuss the ways I combine both samples and taxa for use in my analyses. Before continuing, however, a summary of the ways I manipulated my data is in order.

1. All taxa were quantified by counts.
2. To standardize the effects of differential abundance of plant remains in the various deposits, the raw taxa counts were divided by plant weight. Plant weight was calculated as the weight of plant remains in the fractions greater than 1.4 mm in size.
3. Taxon to taxon ratios were calculated on a sample by sample basis. To avoid calculation problems, if the value of either taxon was equal to zero, the ratio was recorded as missing data for that case.
4. Percentages were also calculated for each case. For percentages, however, if a taxon was absent from a sample, its percentage was set to 0.
5. Comparisons between variables and samples are made using medians.
6. Plots of taxa and ratios are made using natural logs of the taxa and ratio values. A start of 1 was used for all values because the natural log of 0 is undefined. For consistency, the logs of ratios were calculated using a start of 1 despite the fact that dropping cases with missing taxa meant that there were no ratios with values equal to 0.
7. Percentages are plotted in their original scale. That is they are not re-expressed.

Sample and Taxa Groups

The goal of my analyses is to determine what changes, if any, occurred in the procurement and production of plant food resources between the West Jefferson and Moundville I phases. To investigate the nature and extent of such changes, I examine the variability in plant use within and between the two phases. For these purposes, I treat each sample as a case with observations on a series of variables (i.e., all taxa). To search for pattern, I combine cases and variables in several ways and analyze the grouped data using the graphic techniques described above. The first division I make separates the samples by phase. To the extent possible, I explore within-phase variability before examining the differences between the phases.

My West Jefferson data base comprises 20 flotation samples collected from features at 7 sites (see Chapter V). These samples can be grouped along several cross-cutting dimensions. To search for pattern, I classify the samples by site, feature type, chronological placement within the West Jefferson phase, and location above or below the Fall-Line. These groups are shown in Table 6:1. Because there are only 20 samples, it is not possible to investigate the distributions of taxa between sites or feature types. Therefore, the analyses presented in Chapters VII and VIII focus on spatial and temporal variability in plant use during the West Jefferson phase.

The recovery strategies used at Moundville produced flotation samples from almost every excavated context, and fine-screen samples from all midden and floor deposits. My reasons for restricting

Table 6:1. Description of groups used in the analyses of the West Jefferson flotation samples.

SITE	FEATURE TYPE	DATE	LOCATION	NUMBER OF FEATURES
1JE31	BELL PIT	EARLY W. JEFF.	ABOVE FALL LINE	2
1JE31	BELL PIT	LATE W. JEFF.	ABOVE FALL LINE	3
1JE32	BELL PIT	EARLY W. JEFF.	ABOVE FALL LINE	1
1JE32	CYLINDRICAL PIT	LATE W. JEFF.	ABOVE FALL LINE	1
1JE33	HEMISPHERICAL PIT	EARLY W. JEFF.	ABOVE FALL LINE	2
1JE33	BELL PIT	LATE W. JEFF.	ABOVE FALL LINE	2
1JE33	IRREGULAR PIT	LATE W. JEFF.	ABOVE FALL LINE	1
1HA8	HEMISPHERICAL PIT	LATE W. JEFF.	BELOW FALL LINE	1
1HA8	HEMISPHERICAL PIT	?	BELOW FALL LINE	1
1HA8	CYLINDRICAL PIT	?	BELOW FALL LINE	1
1HA11	BELL PIT	?	BELOW FALL LINE	1
1HA39	BELL PIT	EARLY W. JEFF.	BELOW FALL LINE	1
1HA39	HEMISPHERICAL PIT	EARLY W. JEFF.	BELOW FALL LINE	2
1TU44/45	BELL PIT	LATE W. JEFF.	BELOW FALL LINE	1

analyses to Moundville I samples are presented in Chapter V. Some samples from Moundville I contexts are not included in my analyses, however, and a few words are necessary about how I selected samples for study. Selection criteria were simple; I eliminated samples from mixed deposits and samples whose stratigraphic positions were unclear. To avoid mixed deposits, I did not analyze samples from contexts with obvious root or rodent disturbances, and I excluded samples from wall trenches and postholes. I also excluded a few samples from pits because I could not determine their stratigraphic associations. A few of these were features whose tops were missed during excavation. The others were features whose tops were destroyed by later intrusions. In several instances, we encountered overlapping pits originating in a single stratum. For analysis, I treat remains from such pits as though they were derived from a single context.

The Moundville I data base used for the analyses includes 105 flotation and 54 fine-screen samples. I analyze the flotation and fine-screen data separately, but use similar criteria for grouping the cases within each batch. I use excavation location, sample context, and stratigraphic position to group the samples. Excavation location and sample context are straightforward divisions. For location, I divide the samples by whether they were recovered north of Mound R or south of the Conference Building. For context, I classify the samples by whether they were collected from midden, floor, pit, or lense deposits.

The stratigraphic divisions are more complex, and require some explanation. I used the sequence of floors separated by midden strata

to divide the NR deposit into nine sections (Figure 6:8). The flotation and fine-screen samples were then divided into nine groups according to where they were collected within the deposit. Samples from the SCB deposit comprise a tenth group. Pits and lenses were assigned to the groups based on the strata in which they were first encountered. Tables 6:2 and 6:3 present these groups for both the flotation and fine-screen samples.

For the time-series analysis, I use an additional classification. To form an ordered sequence, I ranked the fine-screen samples by their stratigraphic positions. Each fine-screen sample was assigned a rank according to the stratum from which it was collected (Table 6:3). To integrate the samples from the two units north of Mound R, I first divided the samples by the stratigraphic groups and then assigned ranks on an alternating basis. For example, for the floor sequence under the daub, the top floor in unit 6N2W was given the rank of 7, rank 8 was assigned to the top floor in 8N2E, rank 10 to the second floor in 6N2W and so on. There are reasons to believe that the SCB deposit is earlier than the NR deposit (see Chapter V). Thus, I ranked the SCB fine-screen samples in a similar manner, and placed them at the bottom of the sequence. I use only the fine-screen samples for the time-series analysis, because the flotation samples from midden and floor contexts do not contain enough plant remains to analyze individually.

As with the samples, I combine the plant taxa in several ways to search for patterned variability. For the analyses of both wood and food remains, I first examine the distribution of individual taxa. I

Figure 6:8. Stratigraphic profile showing midden and floor groups

Table 6:2. Description of stratigraphic groups used in the analyses of the Moundville I flotation samples.

GROUP	DESCRIPTION	NUMBER OF SAMPLES		
		Level	Pit	Lense
1	Midden above daub	3	0	0
2	Daub	2	3	0
3	Top floor sequence	11	2	6
4	Midden	4	7	0
5	Middle floor sequence	6	0	3
6	Midden	2	5	0
7	Bottom floor sequence	8	0	6
8	Midden	6	2	0
9	Pit house	2	7	0
10	SCB	10	6	2

Table 6:3 Description of stratigraphic groups and sequences used in the analyses of the Moundville I fine-screen samples.

GROUP	SEQUENCE	DESCRIPTION	PROVENIENCE
		MDVL-NR	
1	1	Midden above daub	8N2E L7
	2	Floor above daub	6N2W L8
	3	Floor above daub	8N2E L7
	4	Midden above daub	8N2E L8
2	5	Daub	6N2W L9
	6	Daub	8N2E L8
3	7	Floor	6N2W L10
	8	Floor	8N2E L9a
	9	Floor	6N2W L11
	10	Floor	8N2E L9b
	11	Floor	6N2W L12
	12	Floor	8N2E L10
	13	Floor	6N2W L13
	14	Floor	8N2E L11
	15	Floor	6N2W L14
	16	Floor	8N2E L12
	17	Floor	8N2E L13
4	18	Midden	6N2W L15
	19	Midden/floor	6N2W L16
	20	Midden	8N2E L14
	21	Midden/clay	6N2W L17
5	22	Floor	6N2W L18
	23	Floor	8N2E L15
	24	Floor	6N2W L19
	26	Floor	8N2E L16
	27	Floor	6N2W L21
6	28	Midden	6N2W L22
	29	Midden	8N2E L17

Table 6:3. Continued.

GROUP	SEQUENCE	DESCRIPTION	PROVENIENCE
		MDVL-NR	
7	30	Floors	8N2E L18
	31	Floor	8N2E L19
	32	Floor	8N2E L20
	33	Floors	6N2W L23
	34	Floor	8N2E L21
	35	Floor	8N2E L22
	36	Floor	8N2E L23
	37	Floor	8N2E L24
8	38	Midden/floor	6N2W L24
	39	Midden/Fill	6N2W L25
	40	Midden/fill	8N2E L25
	41	Midden	6N2W L26
	42	Midden	8N2E L26
	43	Midden/sterile	8N2E L27
9	44	Pit house	6N2W L27
	45	Pit house	6N2W L28
		MDVL-SCB	
10	46	Midden	TUA L2
	47	Midden	TUA L3
	48	Midden	TUD L2
	49	Midden	TUA L4
	50	Midden	TUD L3
	51	Floor	TUA L5
	52	Floor	TUD L4
	55	Floor	TUD L5

then use ecological, and for the food remains nutritional, characteristics of the plants to divide the taxa into groups for further analysis.

I use the wood data to assess which resource zones were exploited and whether the impact of field clearance can be detected by changes in fuel use. My initial data base for this analysis divides the identified woods into 29 groups. Table 6:4 gives the common and taxonomic names for the identified wood genera, as well as the categories I use for the remains that could not be identified to genus. Most groups are self-explanatory; the only group that requires comment is "other". This group lumps several taxa that occur too infrequently to be treated individually.

Because there are many low frequency taxa, it is difficult to discern patterns in the wood data. To mitigate this problem, I group some taxa by their habitat preferences (Table 6:5). Taxa such as hickory, oak, and pine that are abundant in the samples and that, without species data, cannot be readily assigned to a habitat, I treat individually. For the others, I used my vegetation reconstruction (Chapter IV), Harper's (1943) study of forest distribution in Alabama, and information about the soil and moisture requirements of particular taxa (Fowells 1965; Harrar and Harrar 1962) to form groups of taxa from similar habitats. The categories listed in Table 6:5 serve as the basis for my wood analyses.

Nutshell and maize cupules are by far the most abundant food remains in the plant assemblages, but many other taxa are present. Table 6:6 lists the common and taxonomic names of the taxa I use in

Table 6:4. Wood taxa identified in the West Jefferson and Moundville I samples.

COMMON NAME	TAXONOMIC NAME
Ash	*Fraxinus* sp.
Beech	*Fagus grandifolia*
Chestnut	*Castanea dentata*
Elm	*Ulmus* sp.
Hackberry	*Celtis* sp.
Hickory	*Carya* sp.
Hornbeam	*Ostrya virginiana*
Locust	*Gleditsia* sp.
Magnolia	*Magnolia* sp.
Maple	*Acer* sp.
White Oak Group	*Quercus* sp. (white)
Red Oak Group	*Quercus* sp. (red)
Oak	*Quercus* sp.
Persimmon	*Diospyros virginiana*
Plum/Cherry	*Prunus* sp.
Sassafras	*Sassafras albidum*
Sweetgum/Gum	*Liquidambar/Nyssa* spp.
Walnut	*Juglans* sp.
Other	
Dicot	
Cedar	*Juniperus* sp.
Cypress	*Taxodium distichum*
Pine	*Pinus* sp.
Conifer	
Bark	
Cane	*Arundinaria* sp.
Maize	*Zea mays*
Monocot	
Unidentified	

Table 6:5. Groups of taxa used in the wood analysis.

TAXA NOT GROUPED	OAKS	BOTTOMLAND TAXA	SUCCESSIONAL TAXA	MISCELLANEOUS TAXA
Chestnut	White Oak	Ash	Cedar	Bark
Hickory	Red Oak	Beech	Persimmon	Conifer
Sweetgum/Gum	Oak	Cypress	Plum	Dicot
Pine		Elm	Sassafras	Other
Cane		Hackberry		Unidentified
Maize		Hornbeam		
Monocot		Locust		
		Magnolia		
		Maple		
		Walnut		

Table 6:6. Seed and nut taxa indetified in the West Jefferson and Moundville I samples.

NUTS	**FLESHY FRUITS**
Hickory (*Carya* sp.)	Persimmon (*Diospyros virginiana*)
Acorn (*Quercus* sp.)	Maypop (*Passiflora incarnata*)
Hazel (*Corylus* sp.)	Grape (*Vitis* sp.)
Walnut (*Juglans nigra*)	Cherry/Plum (*Prunus* sp.)
Pecan (*Carya illinoiensis*)	Sumac (*Rhus* sp.)
Chestnut (*Castanea dentata*)	Honey Locust (*Gleditsia triacanthos*)
Beech (*Fagus grandifolia*)	Blueberry (*Vaccinium* sp.)
	Bramble (*Rubus* sp.)
CULTIGENS	Elderberry (*Sambucus canadensis*)
Maize (*Zea mays*)	
Bean (*Phaseolus vulgaris*)	**GREENS**
Squash (*Cucurbita pepo*)	Pokeweed (*Phytolacca americana*)
	Spurge (Euphorbiaceae)***
SMALL GRAINS AND OIL SEEDS	Carpetweed (*Mollugo verticillata*)
Maygrass (*Phalaris caroliniana*)	
Cane (*Arundinaria* sp.)	**OTHERS**
Grass (Poaceae)	Morning Glory (*Ipomoea* sp.)
Sedge (Cyperaceae)*	Composite (Compositae)
Chenopod (*Chenopodium* sp.)	Mallow (Malvaceae)
Amaranth (*Amaranthus* sp.)	Bedstraw (*Galium* sp.)
Knotweed (*Polygonum* sp.)	Yaupon (*Ilex* sp.)
Legume (Fabaceae)**	Clammyweed (*Polanisia* sp.)
Wild Bean (*Strophostyles* sp.)	Evening Primrose (*Oenothera* sp.)
Sunflower (*Helianthus annuus*)	
Sumpweed (*Iva* sp.)	
Purslane (*Portulaca oleracea*)	

* Cyperaceae includes specimens of *Cyperus* sp., *Scirpus* sp., and *Scleria* sp.

** Fabaceae includes specimens of *Lespedeza* sp., *Sesbania* sp., and *Vicia* sp.

*** Euphorbiaceae includes specimens of *Acalypha* sp., *Croton* sp., and *Euphorbia* sp.

the analyses of food resources. Unidentified and unidentifiable seeds are listed by sample in Appendices B and C, but are not included in my quantitative analyses. Three taxa, Magnolia sp., Nyssa biflora, and Sabal minor, were each represented by a single seed. These seeds as well as the lone hickory nutmeat are listed in the appendices, but are not included in the analyses. Finally, I group several low frequency genera by family for analysis (see Table 6:6).

As with the wood taxa, the presence of many low frequency seed taxa in the samples, makes it necessary to group the various plant food remains for analysis. To search for patterns in the use of plant food resources, I use the groups listed in Table 6:7. This classification is a slightly modified version of the classification system used by Yarnell and Black (1985) in their recent synthesis of plant data from the southeastern United States. Because the groups combine information about dietary roles and habitat preferences of the various taxa, the categories are very useful for considering questions about changes in plant procurement and production.

Table 6:7. Groups of taxa used in the plant food analysis.

NUTS	CULTIGENS	SMALL GRAIN AND OIL SEEDS	FLESHY FRUITS	GREENS	OTHERS
Hickory	Maize	Maygrass	Persimmon	Pokeweed	Morning Glory
Acorn	Bean	Cane	Maypop	Spurge	Composite
Hazel	Squash	Grass	Grape	Carpetweed	Mallow
Walnut		Sedge	Cherry/Plum		Bedstraw
Pecan		Chenopod	Sumac		Yaupon
Chestnut		Amaranth	Honey Locust		Clammyweed
Beech		Knotweed	Blueberry		Evening Primrose
		Legume	Bramble		
		Wild Bean	Elderberry		
		Sunflower			
		Sumpweed			
		Purslane			

CHAPTER VII

WOOD CHARCOAL ANALYSIS

Within a given region, procurement and production strategies can focus on the resources of different ecological communities and have varying impacts on those communities. The wood data from the Black Warrior Valley are used here for two purposes. The relative proportions of wood taxa in the samples are examined for clues to which forest zones were exploited. The wood data are also used to investigate whether human activities, such as field clearance, altered the availability of wood resources. The vegetation reconstructions presented in Chapter IV provide a comparative baseline for assessing the wood data.

The wood analysis is based on several assumptions. First, it is assumed that most wood remains in the samples are fuel residue (Chapman et al. 1982:117; Pearsall 1983:122). Second, it is assumed that to reduce transport costs fuel was collected within a restricted radius of a site (Chapman et al. 1982:117; Minnis and Ford 1977:82). Third, it is assumed that fuel collection was often incorporated into routine activities and thus wood was collected from zones that were exploited for other resources. Finally, it is assumed that the GLO data from the early nineteenth century provide reasonable estimates of local forest composition under conditions of minimal anthropogenic disturbance.

While analysis of wood charcoal can provide evidence about local forest composition at the time a site was occupied, it cannot be assumed that the proportions of wood taxa in the samples are direct representations of tree abundance in the forest communities from which fuel was obtained. To the contrary, there were probably several factors other than natural abundance that affected both the proportions of taxa in wood collected for fuel and the proportions of those taxa that were preserved. For example, if fuel was collected from deadwood lying on the forest floor, trees which are good self-pruners are probably overrepresented in the wood assemblages. Another factor that could cause the proportions of fuel wood to differ from tree frequency is cultural selection. Some woods may have been preferred over others because of desirable burning characteristics or specific woods may have been used for different purposes (Ford 1979b:305; Swanton 1946:425-426). Fuel collection is not the only factor that influences the proportions of wood in an archaeological assemblage. Among other things, woods vary in hardness, ashing, and fracturing properties. These differences in physical characteristics affect what remains after burning and what survives recovery procedures (Lopinot 1984:128-131; Pearsall 1983:123; Rossen and Olson 1985).

Although taxa proportions in fuel residue can be expected to differ from species abundance in the forests from which fuel was collected, analysis of wood charcoal can still provide evidence about habitat exploitation and anthropogenic disturbance. In regions where forest zones are distinguished by separate species, proportions of

taxa from different habitats can provide good indications of procurement strategies or human impact on the environment. In regions such as the southeastern United States, where forest zones are distinguished more by the relative proportions of the species they contain than by differences in the species comprising the communities, patterns in wood data can be more difficult to interpret. Nevertheless, variability in taxa proportions can still provide clues to which forest zones were used frequently. Moreover, proportions of fuel residue may provide clues to cultural selection.

This analysis explores variability in the proportions of wood taxa in the West Jefferson and Moundville I plant assemblages. The data analyzed are percentages of counts of identified wood fragments. Summary statistics of the percentage contributions of taxa to each batch are presented. Most comparisons, however, are made using graphic tools (e.g., boxplots) that retain information about the variability in composition of the samples comprising the batches. Usually a boxplot's scale is determined by the extreme values of the variable being plotted. In the figures in this chapter, however, the boxplot scales are set to range from 0 to 100 percent.

West Jefferson Wood Analysis

The West Jefferson wood data comprise 395 identified fragments. For each context included in the analysis, a minimum of 20 fragments were identified (see Chapter VI for an explanation of identification procedures, and Appendix A for lists of wood specimens identified in each sample). One feature from site 1Ha8 did not contain enough wood

to permit reliable identification of 20 fragments. Thus, the wood data represent only 19 of the 20 West Jefferson features included in this study.

The West Jefferson wood assemblage is not very diverse. Table 7:1 presents total count and percentage contribution for each taxon identified in the samples. While 21 taxa are listed, the first 6 taxa in the table account for 87.2 % of the wood. Pine, alone, comprises 62.3 % of the batch.

Because the frequency of most taxa is extremely low, for analysis the wood taxa are combined into groups based on habitat information. The groups used are those described in Chapter VI (see Table 6:5). Table 7:2 lists for each group the percentage contribution to the batch, as well as mean and median percentage per feature.

The analysis focuses on variability in the frequency of four groups--pine, oak, bottomland taxa, and hickory. These groups were selected because each contributes more than 5% of the total assemblage. Together the four groups account for 86.1 % of the wood identified from West Jefferson features. The miscellaneous group also accounts for more than 5% of the assemblage. Analysis of this catchall category, however, would not contribute much to an understanding of wood use, so the group is not included in the graphic analysis.

Patterned variability within the West Jefferson wood assemblage is sought in two dimensions. Spatial patterning is examined by comparing frequencies of wood taxa in features from above and below the Fall-Line. These comparisons permit consideration of whether

Table 7:1. Frequency distribution for wood taxa from West Jefferson contexts.

Taxon	Count	Percentage
Pine	246	62.3
White Oak Group	21	5.3
Red Oak Group	20	5.1
Hickory	20	5.1
Ash	19	4.8
Chestnut	18	4.6
Bark	9	2.3
Sweetgum/Gum	6	1.5
Dicot	6	1.5
Cane	4	1.0
Elm	4	1.0
Locust	3	0.8
Unidentified	3	0.8
Cedar	3	0.8
Conifer	3	0.8
Sassafras	2	0.5
Maize	2	0.5
Beech	2	0.5
Oak	2	0.5
Persimmon	1	0.3
Monocot	1	0.3

Table 7:2. Frequency distribution of groups of wood taxa from West Jefferson contexts.

Taxon	Count	Percentage	Mean Percentage per Sample	Median Percentage per Sample
Pine	246	62.3	64.3	70.0
Oaks	43	10.9	9.6	5.0
Bottomland Group	28	7.1	6.9	0.0
Miscellaneous	21	5.3	4.6	5.0
Hickory	20	5.1	4.6	0.0
Chestnut	18	4.6	4.5	0.0
Successional Group	6	1.5	1.5	0.0
Sweetgum/Gum	6	1.5	1.5	0.0
Cane	4	1.0	1.1	0.0
Maize	2	0.5	0.5	0.0
Monocot	1	0.3	0.3	0.0

differences in site location and forest composition in the two regions influenced wood use and whether there is a common pattern of resource procurement and use. Temporal variability is examined by comparing frequencies of wood taxa in features from early and late West Jefferson contexts. The temporal comparisons aid in evaluating the stability of resource use and in investigating whether forest communities were altered by human activities.

Access to forest resources differed for West Jefferson communities located above and below the Fall-Line (see Chapter IV). The West Jefferson sites above the Fall-Line were located on a small tract of bottomland surrounded by vast expanses of upland forest. Below the Fall-Line, the West Jefferson sites were dispersed over the broad floodplain, and bottomland, terrace, and swamp forests formed significant portions of the nearby vegetation communities. Because of the differences in the distribution of resources, it is logical to explore variability in fuel use along the spatial dimension before investigating chronological variability or attempting to describe a general pattern.

Boxplots comparing percentages of pine, oak, bottomland taxa, and hickory in West Jefferson features from above and below the Fall-Line are shown in Figure 7:1. The medians are not significantly different for any of the illustrated taxa. The taxa distributions deserve some comment, however. Pine clearly dominates the assemblages from both areas, but pine's frequency is far more variable in features from below the Fall-Line. There are also extreme outside values for oak and bottomland taxa in features from below the Fall-Line. These

Figure 7:1. Distribution of wood taxa by location, West Jefferson batch.

Boxplots of percentages of major wood taxa from West Jefferson contexts grouped by location above or below the Fall-Line (Above Fall-Line N = 12; Below Fall-Line N = 7). See Chapter VI for an explanation of the symbols used in the boxplots.

patterns suggest that there was greater variability in fuel use below the Fall-Line.

When wood taxa proportions in features from below the Fall-Line are examined, much of the variability in taxon frequencies can be attributed to differences in site locations. The oak outlier, the highest hickory value, and the lowest pine value are all for the feature from 1Tu44/45. This site is located on a levee well away from the terrace and Fall-Line Hill forests where pine would have been most abundant. The bottomland taxa outlier is for the feature from 1Ha11. The wood remains from this feature were small and badly damaged. The fragments assigned to the bottomland group were all ash and could easily have come from a single piece of wood. The site is located on a terrace edge along Elliotts Creek where ash, a dominant in riverbank communities, would have been readily available. The three features from 1Ha39 all have high pine values. The site is located on a sandy terrace where poor soils favor the growth of pines.

In contrast to the wood frequencies just discussed, those from 1Ha8 are perplexing. The two features from this site have pine values of 50% and 90% respectively. The site is located on the levee of an old river cut-off surrounded by low-lying swamp. The vegetation reconstructions indicate that it would have been at least 2 Km to the nearest forest where pine was abundant. There are two possible explanations for the high pine values. Forest composition at the time the site was occupied may have differed from that in the area at the time the GLO surveys were conducted. Alternatively, the swamps around

the site may have forced the inhabitants to go considerable distances to obtain dry firewood.

While fuel use was affected by site location, the wood assemblages from above and below the Fall-Line are similar. Pine dominates both assemblages. In fact, pine is more frequent than would be expected given its estimated abundance in undisturbed forests of either area. Most other taxa, particularly the bottomland dominants, seem to be underrepresented in the assemblages.

The proportions of taxa in the features do not approximate the frequency of trees in any of the reconstructed forest zones. Thus, it is difficult to say with any certainty where fuel was collected. It seems likely, however, that if fuel was collected from undisturbed habitats, then above the Fall-Line it was primarily collected from the upland forests. Similarly, below the Fall-Line fuel seems to have been procured more often from the hill and terrace forests than from the bottomlands.

Time is the second dimension in which variability in the West Jefferson wood assemblage is examined. Assuming that fuel was collected during other activities, changes in the proportions of wood taxa from mature forests might indicate reorientation of subsistence activities. Similarly, changes in the frequency of successional or disturbance-favored taxa would provide evidence about field clearance or other human activities.

To investigate temporal patterning, features were assigned early and late West Jefferson dates on the basis of their ceramic assemblages (see Chapter V). Chronological position could be

estimated for all features from above the Fall-Line, but dates could not be estimated for two features (one from 1Ha8 and one from 1Ha11) from below the Fall-Line. Thus, the investigation of wood variability in the temporal dimension is based on 17 samples instead of the 19 samples used for the spatial comparisons.

Boxplots comparing percentages of pine, oak, bottomland taxa, and hickory in samples from early and late West Jefferson features are shown in Figure 7:2. The differences between taxa medians are not significant at a 95% confidence level. There may have been some change in taxa frequencies over time, however. Pine percentages are higher in early West Jefferson features, while oak and hickory percentages are higher in late West Jefferson features.

Besides the possible differences in the proportions of the dominant taxa, two of the minor taxa may also vary in time. Only two fragments of maize stalk were identified in West Jefferson contexts. Both occurred in late features from above the Fall-Line. Similarly, four of six specimens identified as successional taxa occurred in late West Jefferson features. Maize stalk and wood from successional species are so scarce in West Jefferson contexts that the differences may be fortuitous. Nevertheless, the possibility that use of these taxa increased needs to be noted.

The chronological comparisons suggest a consistent pattern of fuel use within the West Jefferson phase. The slight differences in taxa frequencies do not suggest that wood was being procured from different forest zones. Similarly, there is little evidence that

Figure 7:2. Distribution of wood taxa by chronological position, West Jefferson batch.

Boxplots of percentages of major wood taxa from West Jefferson contexts grouped by chronological position within the West Jefferson phase (Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

local forest composition in the Black Warrior Valley was altered by human activities during the Late Woodland period.

The results of the analysis of the West Jefferson wood assemblage can be summarized as follows. The dominant wood taxa in the West Jefferson features do not show significant differences in frequency in either the spatial or temporal dimension. There was more variability in fuel use below the Fall-Line and, perhaps, slight changes in taxa frequency over time. These differences are, however, overshadowed by the dominance of pine in the assemblage.

Moundville I Wood Analysis

The Moundville I wood data comprise 2159 identified fragments (see Appendix A for lists of wood specimens identified in each sample). These were drawn from 80 separate contexts, and include samples from 25 midden levels, 26 floor levels, 27 pits, and 2 ash lenses. Twelve of the samples--six midden, two floor, three pit, and one lense--are from the deposits south of the Conference Building. The other 68 samples are from the deposit north of Mound R. The midden and floor remains were recovered by fine-screening, while the pit and lens remains were recovered by flotation. The wood analysis is the only place in this study where data from fine-screen and flotation samples are combined.

The proportions of wood taxa in the Moundville I assemblage are given in Table 7:3. Inspection of this table reveals that most of the 29 taxa listed are infrequent. Therefore, the taxa are grouped for analysis using the same categories employed in the analysis of the

Table 7:3. Frequency distribution of wood taxa from Moundville I contexts.

Taxon	Count	Percentage
Pine	589	27.3
White Oak Group	288	13.3
Hickory	225	10.4
Sweetgum/Gum	194	9.0
Red Oak Group	190	8.8
Cypress	131	6.1
Cane	58	2.7
Persimmon	52	2.4
Ash	50	2.3
Monocot	49	2.3
Oak	45	2.1
Chestnut	44	2.0
Dicot	36	1.7
Maize	32	1.5
Unidentifiable	32	1.5
Cedar	28	1.3
Bark	24	1.1
Locust	19	0.9
Elm	16	0.7
Other	15	0.7
Maple	9	0.4
Conifer	7	0.3
Sassafras	6	0.3
Magnolia	6	0.3
Hornbeam	5	0.2
Beech	5	0.2
Walnut	2	0.1
Plum	1	0.0
Hackberry	1	0.0

West Jefferson wood data. Table 7:4 presents the frequency distributions of the grouped wood taxa in the Moundville I batch.

There are only six groups of taxa that individually account for more than 5% of the Moundville I wood assemblage. The analysis investigates variability in five of these groups: pine, oak, bottomland, hickory, and sweetgum/gum. The sixth group is the miscellaneous category and is not informative.

Moundville is located on a broad terrace at the edge of the river valley. To the north and south there are large tracts of bottomland; to the east the Fall-Line Hills are within easy walking distance. In other words, the firewood used at Moundville could have been collected with little effort from any of the forest communities below the Fall-Line. Not surprisingly, the fuel assemblage from Moundville contains a mixture of taxa from the various forests. Taxa most likely collected in the Fall-Line hills (pine, oak, and hickory) seem to be more frequent, however, than taxa that would have been collected from the floodplain (sweetgum/gum and bottomland group).

The investigation of fuel use within the Moundville I assemblage focuses on temporal variability. The purpose of the wood analysis is to supplement the subsistence data by providing evidence about which resource zones were exploited and about the impact of human activities on resource availability. Since the Moundville I data plant data are from a single site, these issues can be addressed from a chronological perspective without having to allow for geographic differences in the distribution of resources.

Table 7:4. Frequency distribution of groups of wood taxa from Moundville I contexts.

Taxon	Count	Percentage	Mean Percentage per Sample	Median Percentage per Sample
Pine	589	27.3	27.2	25.0
Oaks	523	24.2	24.5	23.1
Bottomland Group	244	11.3	11.0	8.5
Hickory	225	10.4	11.0	10.0
Sweetgum/Gum	194	9.0	10.3	5.0
Miscellaneous	114	5.3	5.2	3.0
Successional Group	87	4.0	3.4	0.0
Cane	58	2.7	2.0	0.0
Monocot	49	2.3	2.1	0.0
Chestnut	44	2.0	1.7	0.0
Maize	32	1.5	1.6	0.0

The stratified deposits at Moundville make it possible to look at wood use through time in a way that is different from that used for the West Jefferson data. Rather than dividing samples into chronological categories, the samples can be ranked in a continuous sequence or time-series. This provides a means to search for trends or fluctuations instead of marked breaks in distribution.

To treat the wood data as a time-series, the midden and floor samples were ranked using the sequence variable described in Chapter VI (see Table 6:3). The ceramics from the two Moundville I deposits we excavated suggest that the SCB occupation was earlier than most of the NR occupation. The values for each of the five groups of taxa were thus plotted in stratigraphic sequence with the values for SCB samples at the bottom of the sequence and the values for NR samples from the Moundville I strata above the daub deposit at the top. The time-series plots were then smoothed using the "4253H,twice" algorithm (see Chapter VI; or Velleman and Hoaglin 1981:171-173).

The reroughed time-series plots for the groups of taxa are shown in Figure 7:3. The figure is actually five adjacent graphs; each vertical section marks a scale from 0 to 100%. The horizontal lines mark the boundaries between the stratigraphic groups.

The time-series plots for the dominant wood taxa indicate a basically stable pattern of fuel use. There are no clear trends in wood use, and each taxon frequency varies within a narrow range. While overall fuel use appears stable, there are some minor fluctuations worth noting. For all taxa, the lower portion of the graph shows more variability than the top. Hickory is frequent only

Figure 7:3. Time-series plots of wood taxa by stratigraphic sequence, Moundville I batch.

Time-series plots of smoothed wood taxa percentages from Moundville I contexts. Percentage data smoothed using the "4253H,twice" procedure.

in the apparently early SCB deposit. The highest frequencies of bottomland taxa and sweetgum/gum are found in stratigraphic groups 6 through 9, that is, in the lower portions of the NR deposit. Overall, taxa frequencies fluctuate less in stratigraphic groups 1 through 5. This suggests that fuel use was more consistent late in the Moundville I phase.

Clearing land for fields might result in the patterns shown in the time-series plots of the dominant wood taxa. According to the GLO records, hickory was most abundant in terrace forests. The higher frequency of hickory in the SCB deposit could indicate that the terrace on which Moundville sat had not yet been cleared for fields and that firewood was being collected from the this nearby forest. Alternatively, the relatively high hickory frequency could be a product of clearing the terrace for fields and using the wood from felled trees for fuel. Similarly, it can be argued that the slightly later surges in the frequencies of sweetgum/gum and other bottomland taxa result from clearing fields on the floodplain. The apparently stable pattern of fuel use in the later strata might indicate a cessation of field clearance activities. That is, such a pattern might be produced if around Moundville land suitable for fields was under cultivation and a new equilibrium in vegetation composition had been established.

There is another, even more speculative, explanation for the patterns seen in the time-series plots. Several lines of evidence indicate that by late Moundville I a complex chiefdom was either developing or already in existence in the Black Warrior Valley (see

Chapter V). The artifacts recovered from the NR deposit suggest that the area was an elite precinct. It is conceivable that the elite were entitled to, or even provided with, fuel with the more desirable burning characteristics. Such a practice might produce the stable wood frequencies seen in the upper portion of the graph.

Comparison of West Jefferson and Moundville I Wood Data

Variability within the wood assemblages from the West Jefferson and Moundville I phases was explored in the preceding sections. The final step in the wood analysis is to combine the data from the two phases and investigate fuel use throughout the time span covered by the samples. For these purposes, three temporal divisions are used: early West Jefferson, late West Jefferson, and Moundville I. The frequency distributions of the groups of taxa that individually contribute more than 5% to both assemblages are examined first. Once variability in the dominant taxa is explored, brief consideration is given to the occurrence of minor taxa the are too infrequent to analyze graphically.

Boxplots comparing the percentage distributions of pine, oak, bottomland, and hickory in the three temporal divisions are shown in Figure 7:4. The most notable difference is the sharp change in the frequency of pine. There is some decrease in the frequency of pine within the West Jefferson phase followed by a significant decrease between late West Jefferson and Moundville I. Because percentages are interdependent, a sharp change in the frequency of one taxon is necessarily accompanied by changes in the opposite direction in one or

Figure 7:4. Distribution of wood taxa by chronological position, West Jefferson and Moundville I batches.

Boxplots of percentages of major wood taxa from West Jefferson and Moundville I contexts grouped by chronological position (Moundville I N = 80; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

more of the other taxa. In this case, oak, bottomland taxa, and hickory all increase in frequency, but the magnitude and tempo of the increases varies by taxon. Oak shows an increase within the West Jefferson phase and then a further significant increase from late West Jefferson to Moundville I. Bottomland taxa show little change within the West Jefferson phase, but increase significantly between the phases. Hickory shows a gradual increase through time: the changes in frequency between adjacent subphases are not significant but the differences between the medians for early West Jefferson and Moundville I are significant at a 95% confidence interval. These taxa distributions by subphase are summarized, dramatically though less precisely, by the bar-graph in Figure 7:5. In this graph the end points of the bars are the median percentages for the taxa.

Clearly there are changes between the West Jefferson and Moundville I phases in the frequency of the dominant wood taxa. While it is difficult to detect, there may also have been changes in the use of minor wood taxa. Table 7:5 compares percentages of each wood group in the total West Jefferson and Moundville I assemblages. Chestnut is the only taxon other than pine that has a higher frequency in the West Jefferson batch than in the Moundville I batch. The difference in the frequency of chestnut is probably a product of site locations. Chestnut was considerably more abundant above the Fall-Line than below (see Chapter IV Tables 4:4 - 4:12), and it is the West Jefferson samples from above the Fall-Line that have the higher chestnut frequencies. The successional group, sweetgum/gum, cane, maize, and the monocot group all have higher frequencies in the Moundville I

Figure 7:5. Median wood taxa percentages by chronological position, West Jefferson and Moundville I batches.

Bar graph showing median percentages of major wood taxa in Early West Jefferson, Late West Jefferson, and Moundville I phases.

Table 7:5. Comparison of percentages of groups of wood taxa from West Jefferson and Moundville I contexts.

Taxon	West Jefferson Percentage	Moundville I Percentage
Pine	62.3	27.3
Oaks	10.9	24.2
Bottomland Group	7.8	11.3
Hickory	5.1	10.4
Chestnut	4.6	2.0
Miscellaneous	4.6	5.3
Successional Group	1.5	4.0
Sweetgum/Gum	1.5	9.0
Cane	1.0	2.7
Maize	0.5	1.5
Monocot	0.3	2.3

batch. These taxa are predominantly found in floodplain or disturbed habitats.

Variability within and between the wood assemblages from the West Jefferson and Moundville I phases has now been examined. During the West Jefferson phase there appears to be some decrease in the frequency of pine and concomitant increases in the frequencies of other taxa. Between the West Jefferson and Moundville I phase there is a further sharp decrease in pine, a marked increase in oak, and smaller but distinct increases in other taxa. Within the Moundville I phase wood use seems stable, though it is more variable in the earlier portion of the phase.

The most puzzling thing about the wood assemblages is the dominance of pine in the West Jefferson batch compared to the greater diversity of taxa in the Moundville I batch. There are several possible explanations for the observed changes, but unfortunately there is no sound evidence for determining which is most likely.

It is possible that the change in the frequency of pine is a result of functional differences in the contexts from which the data are drawn. Pine, oak, and hickory produce comparable heat values, but they burn differently. Pine ignites quickly, burns rapidly, snaps and throws sparks. Oak and hickory, on the other hand, burn slowly, and yield steadier heat (Graves 1919:29-31). The West Jefferson wood remains are from features that appear to be pits located outside of structures. In contrast, much of the Moundville I wood data comes from structural deposits. The lower frequency of pine in Moundville I

contexts might be a result of deliberately avoiding fuel that might spark and accidentally ignite highly flammable thatching or matting.

There is another explanation that pertains to the differences in the burning characteristics of the various fuels. Because pine ignites rapidly, it is a good source of kindling. Dry maize cobs are also good kindling (R. Ford, personal communication 1986). An increase in maize production would increase the supply of cobs readily available for kindling and might lead to a decrease in the collection of other sources of kindling.

Assuming that fuel was collected in the course of other activities, then changes in procurement/production strategies that led to changes in the amount of time spent in the various forest zones might also result in differences in fuel use. Pine is one of the dominant taxa in the upland and terrace forests of the area. Pine is also a good self-pruner and suffers from wind-throws. The taxon might well be overrepresented in wood collected from the uplands and hills. If these areas were visited less often, then pine might well decline as a source of fuel. Of course, more intensive use of bottomlands and by extension more fuel collected from floodplain zones could produce similar changes in wood frequencies.

The final possibility is that the proportions of pine are a result of human impact on the environment. Pines are generally fire tolerant, early colonizers on open ground, and after an initial period of slow growth, fast-growing trees (Fowells 1965:384, 364, 453). It is possible that the activities of the West Jefferson communities produced conditions that favored the growth of pines, while activities

of Moundville I communities produced less favorable conditions. At first glance this explanation seems to contradict common wisdom. That is, the expectation is that field clearance would favor the growth of successional taxa. By this logic, pine should increase not decrease. Indeed, an increase in the frequency of pine has been noted in the late prehistoric period in other areas (e.g., Chapman and Shea 1981:77).

There are two intriguing solutions to this apparent dilemma. Both are admittedly speculative. If West Jefferson communities used fire drives for hunting and Moundville communities did not, or did so less often, then pine might have been more prevalent in the forests during the earlier period. Alternatively, and to my mind more thought provoking, it might be changes in land use that decreased the availability of pine. If West Jefferson communities moved often, and practiced a horticultural system based on a long fallow cycle, then pine would have time to regenerate in old habitation sites and gardens. If Moundville communities moved less often and used a short fallow system--or even for the frequently flooded soils no fallowing--then pine might not have time to establish a foothold in an old field before the field was replanted. The increase in oak would fit with this explanation. Oaks are difficult to eradicate, when cut they sprout from the remaining stump (Fowells 1965:560,571). A shortened fallow system might permit time for an oak thicket to develop but not time for pine seedlings to reach a stage that would produce usable firewood.

CHAPTER VIII

PLANT FOOD REMAINS ANALYSIS

The archaeobotanical remains from the Black Warrior Valley are used in this chapter to examine changes in the use of plant foods during the transition from a foraging/gardening subsistence economy to one in which field agriculture played a central role. My intention is not simply to demonstrate that changes occurred. Rather, my analysis employs EDA techniques to provide better information about the timing and dynamics of changes in plant procurement and production strategies.

EDA is not a confirmatory approach. I do not formulate and test explicit predictions about which resources will vary or how those resources will vary. Nevertheless, my analysis is structured to address propositions about subsistence change within the context of the emerging Moundville system. Several general questions guide my analysis:

1. When in the transition from the West Jefferson to the Moundville system did the emphasis in subsistence strategies shift from wild plant procurement to crop production?
2. Did the shift from wild plant procurement to crop production entail additions to or deletions from the set of plant foods used?

3. Was the increased production of maize accompanied by changes in the proportions in which plant resources other than cultigens were procured?

These questions influence how I group taxa for analysis and which taxa I give most attention. Combined with information about the West Jefferson and Moundville I phases, the general questions also guide my selection of dimensions in which to explore variability.

Analysis of West Jefferson Plant Food Remains

There are several propositions about Late Woodland occupations in the Black Warrior Valley that are relevant to my investigation. First, it has been suggested that settlements above and below the Fall-Line were occupied in different seasons for varying lengths of time, and that the subsistence activities pursued from settlements in the two regions were different (Jenkins 1978:23; Welch 1980:4, 1981b:82). Second, it has been suggested that the sites in the two areas are comparable settlements, though perhaps part of separate systems (Welch 1987). Before we can compare the West Jefferson plant data with those from Moundville, it is essential to examine the nature and extent of spatial variability in plant use within the West Jefferson phase. Finally, it has been suggested that the Late Woodland populations in the Black Warrior Valley may have experienced subsistence stress (Welch 1987). To explore this possibility, and to search for increased reliance on maize, it is necessary to examine temporal variability in plant use within the West Jefferson phase.

Data from all 20 West Jefferson phase features discussed in Chapter V are used in this analysis. Table 8:1 presents descriptive statistics for the plant remains other than wood that I identified in the samples. The ubiquity columns list the number and percent of features in which each taxon was found. Raw counts are presented to give an indication of the magnitude of the batch. The median, mean, minimum, and maximum values are for counts standardized by plant weight (see Appendix B for lists of the taxa identified in each sample).

Before examining variability in the dimensions of interest, it is necessary to consider whether the depositional contexts of the samples are sufficiently similar to permit comparison of their contents. The answer to this question seems to be yes. Though four feature types with supposedly different functions are represented in the batch, the fill in all features appears to be refuse. A few seeds are present in every sample except that from 1Ha11, but by-products of food preparation dominate the assemblage. Hickory shell, acorn shell, and maize remains occur together in 19 of the 20 samples. The exception, again the sample from 1Ha11, contains few remains of any kind. Not only do nutshells and maize co-occur, the quantities of these taxa in the samples do not vary in ways that would suggest distributions resulting from specific activities or specialized processing. In sum, there is no evidence that any of the features contain remains from specialized activities, cooking spills, or accidentally burned supplies.

Table 8:1. Descriptive statistics for plant food remains in the West Jefferson batch.

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Hickory	20	1.00	14110	34.15	37.40	8.14	102.91
Acorn Shell	20	1.00	7974	11.37	20.18	3.82	92.94
Acorn Meat	10	0.50	384	0.19	0.74	0.00	3.87
Hazel Nut	2	0.10	8	0.00	0.01	0.00	0.13
Walnut	1	0.05	1	0.00	0.002	0.00	0.05
Pecan	1	0.05	1	0.00	0.002	0.00	0.05
CULTIGENS							
Maize Cupule	19	0.95	816	0.94	2.04	0.00	15.56
Maize Kernel	18	0.90	1880	1.80	2.69	0.00	15.52
Squash Seed	1	0.05	2	0.00	0.01	0.00	0.09
SMALL GRAIN AND OIL SEEDS							
Maygrass	14	0.70	315	0.25	0.85	0.00	4.58
Grass	5	0.25	17	0.00	0.06	0.00	0.94
Cane	1	0.05	1	0.00	0.002	0.00	0.05
Sedge	1	0.05	1	0.00	0.01	0.00	0.12
Chenopod	8	0.40	75	0.00	0.26	0.00	4.06
Amaranth	6	0.30	10	0.00	0.05	0.00	0.46
Knotweed	3	0.15	3	0.00	0.01	0.00	0.15
Purslane	6	0.30	7	0.00	0.03	0.00	0.19
Legume	6	0.30	6	0.00	0.03	0.00	0.23
Wild Bean	1	0.05	5	0.00	0.004	0.00	0.08
Sunflower	1	0.05	1	0.00	0.002	0.00	0.03
FLESHY FRUITS							
Persimmon	16	0.80	245	0.70	0.81	0.00	2.41
Maypop	2	0.10	2	0.00	0.01	0.00	0.09
Grape	4	0.20	8	0.00	0.17	0.00	3.05
Cherry/Plum	6	0.30	21	0.00	0.03	0.00	0.19
Sumac	6	0.30	317	0.00	1.45	0.00	28.53
Honey Locust	1	0.05	1	0.00	0.01	0.00	0.13
Elderberry	1	0.05	3	0.00	0.002	0.00	0.05
GREENS							
Pokeweed	1	0.05	2	0.00	0.01	0.00	0.18
Spurge	2	0.10	3	0.00	0.01	0.00	0.09
Carpetweed	1	0.05	1	0.00	0.01	0.00	0.10
OTHERS							
Composite	2	0.10	3	0.00	0.01	0.00	0.15
Mallow	1	0.05	3	0.00	0.002	0.00	0.05
Bedstraw	1	0.05	2	0.00	0.002	0.00	0.03
Yaupon	1	0.05	1	0.00	0.01	0.00	0.12
Clammyweed	1	0.05	1	0.00	0.001	0.00	0.02

Seasonal differences in food use almost certainly existed; the question of interest here is whether seasonality is responsible for any of the variability in the plant assemblage. There are two aspects of this question that need to be addressed. The first is whether any individual features are seasonally distinct. The second is whether the assemblages from above and below the Fall-Line are seasonally distinct.

Because many plant foods can be stored, using plant remains to detect seasonal patterns of food consumption is difficult. Faunal data would be of considerable help here, but bone preservation is very poor at most of the West Jefferson sites. The West Jefferson features all contain plant resources harvested in late summer or fall--nuts, maize, and in 16 out of 20 persimmon. Since these foods can be stored, their presence in the samples tells us little about when they were consumed. Four summer-ripening fruits--cherry/plum, elderberry, maypop, and grape--are present in the assemblage. These fruits can be dried and stored, but their distribution in relation to the fall-harvested resources might provide clues to seasonal differences in deposition.

Besides fruit, fresh greens and early garden products would have been available in the summer, while supplies harvested the previous fall were probably dwindling. Though they are never abundant, seeds from one or more summer fruits occur in 10 of the 20 features. If seeds from summer fruits were deposited in the summer, we might expect them to occur in features with low quantities of fall resources. Since most of the plant food remains are fall harvested, we can use

total plant food count as a measure of the abundance of fall resources. Seeds from summer fruits occur in six features with lower than the median food count and in four features with higher than the median food count. In other words, summer fruits do not appear to be associated with low densities of fall resources. I also compared the distribution of summer fruit with high and low quantities of hickory nuts, acorns, and maize and found a similar lack of patterning. Moreover, in 8 of the 10 samples with seeds from summer-ripening fruit seeds from the fall-ripening persimmon were also present. In sum, there are no clear grounds for separating the features into seasonal categories.

It has been suggested that there are seasonal differences in the occupations in the upper and lower portions of the Black Warrior Valley (Welch 1981b:82). Our ability to address this question with plant data is again limited by the problem of storable resources. If there were seasonal differences, however, we might be able to detect them by examining both the relative quantities of fall-harvested resources and the distribution of summer fruits in the two spatial divisions. Boxplots comparing plant food counts above and below the Fall-Line are shown in Figure 8:1. (Note that the boxplots in this chapter compare logged values of standardized counts or ratios, and the scale of the boxplots is determined by the extreme values of the variable being plotted.) These plots suggest that quantities of fall resources are similar in the batches from the two areas. Summer fruits occur at all sites except 1Ha11, which has only nuts in its single small sample. Half of the features with summer fruits are from

Figure 8:1. Distribution of plant food remains by location, West Jefferson batch.

Boxplots of logged standardized counts grouped by location above or below the Fall-Line (Above Fall-Line N = 12; Below Fall-Line N = 8). See Chapter VI for an explanation of the symbols used in the boxplots.

above the Fall-Line and half from below. The evidence is by no means conclusive, but there are no indications in the plant data that the occupations above and below the Fall-Line represent different parts of a seasonal round.

Subsistence strategies can vary in either the sets of resources exploited or in the relative proportions in which resources are procured. Before investigating the relative proportions of resources used in the West Jefferson phase, let us briefly examine whether the array of resources varied across space or over time. Hickory and acorn occurred in all features and maize in 95% of them. Clearly these resources were used above and below and early and late. But what about the less frequent taxa?

To get a rough indication of whether the sets of resources varied in either space or time, we can use ubiquity values (See Table 8:1). Twenty-one taxa have ubiquity ratings of 25% or less. The distributions of these infrequent taxa could easily be the results of stochastic variability. It is worth noting, however, that as a group they seem evenly distributed. There are 16 occurrences of these taxa above the Fall-Line and 13 occurrences below. Similarly, there are 12 occurrences in early West Jefferson features and 15 in late West Jefferson features. (The total occurrences for above/below and early/late are different because three features could not be assigned chronological positions within the West Jefferson phase.) Besides hickory, acorn, and maize, there are nine taxa that have ubiquity values of 25% or more. Eight of the nine taxa occur both above and below the Fall-Line. All nine occur in both early and late West

Jefferson features. The taxa distributions suggest that the sets of resources exploited did not vary significantly either spatially or temporally within the West Jefferson phase.

While the same resources seem to have been used throughout the West Jefferson phase, it is possible that the proportions of those resources varied in time and/or space. The relative proportions of hickory shell, acorn shell, and maize cupules can be quantitatively analyzed, but for most other taxa both the abundance and frequency of occurrence are too low to analyze individually. It is necessary to group the taxa to search for variability in the use of resources other than nuts and maize. For these purposes, I use the categories described in Chapter VI (see Table 6:7). Where relevant, I discuss specific seed taxa within the context of the food groups.

The seed taxa are divided into four categories: small grain and oil seeds, fleshy fruits, greens, and "others" (See Table 8:1). Even when grouped, seeds from the greens and "others" categories occur in so few features and in such small numbers that is futile to search for pattern in their distributions. The lack of seeds from plants used for greens is not necessarily an indication that these plants were not used. Greens are usually gathered when the leaves are young and tender, before the seeds ripen. Moreover, several taxa classified as small grains (e.g., chenopod, amaranth, purslane) can also be used as potherbs. The miscellaneous seeds in the "others" category are from taxa that were probably not food plants. The single Ilex seed could not be identified to species, but it may derive from medicinal/ceremonial use of the yaupon plant (Hudson 1979). The

remaining seeds in this class are from plants that colonize open ground and are probably incidental inclusions from the natural seed rain.

Like most fruits, the fruit taxa identified in the West Jefferson batch are from plants that favor open or edge habitats. Differences in the abundance of seeds from fruits might provide clues to the extent of habitat disturbance or land clearance. Seven fruit taxa were identified, but only two occur in quantity, and only one has a median greater than zero.

Most of the sumac seeds (309 of 317 in the entire batch) are from a single late West Jefferson feature from above the Fall-Line. This sample appears as an extreme outlier on the graphs presented below. Various Indian groups brewed sumac berries to extract a tea, which they used both as a beverage and as a medicine (Fernald and Kinsey 1958:262; Yanovsky 1936:40-41). The seeds in the West Jefferson feature might well be brewing residue tossed in with other refuse after the tea had been prepared.

Persimmon is the only fruit with a median count greater than zero. Its relative abundance is partially an artifact of preservation and identification biases. Each persimmon contains several large inedible seeds that are more apt to be discarded and preserved than the small ingestible seeds of berries. Moreover, the counts for persimmon seeds are inflated because both seed fragments and whole seeds were counted (see Chapter VI). It must be emphasized, therefore, that the quantity of persimmon relative to other fruits is not necessarily a measure of its greater importance. Moreover, because

persimmon contributes disproportionately to the fleshy fruit seed count, what we are monitoring when we use boxplots to look at the distribution of fruit seeds is largely the distribution of persimmon.

Boxplots comparing the distribution of fruit seeds in the West Jefferson batch by spatial location and chronological position are shown in Figure 8:2. The widths of the boxes in the plots indicate more variability below the Fall-Line and late in the West Jefferson phase, but the overlapping parentheses indicate that the medians are not significantly different in either set of plots. There is no indication of patterned variability in the distribution of fruit; by extension, the use of fruit seems to have been consistent above and below the Fall-Line and early and late in the West Jefferson phase.

The small grain and oil seeds category contains plants that are early colonizers of disturbed habitats, but several are also known or suspected cultigens. Thus, some taxa in this group were probably deliberately planted or cultivated, while others may have been tolerated volunteers. Before considering the distribution of the group, let us look briefly at those that are most likely to have been crops.

The wild form of the common sunflower is not native to the Eastern Woodlands, and the West Jefferson specimen is almost certainly from a domesticated plant (Yarnell 1978:290). There is good ethnographic and archaeological evidence for the cultivation of sunflowers by the indigenous populations of the Southeast (Yarnell 1978). The single sunflower seed in the West Jefferson assemblage is incomplete and missing its pericarp. The seed is not measurable, but

Figure 8:2. Distribution of fleshy fruit seeds by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts, grouped by location above or below the Fall-Line and by chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

it is small and probably falls at the low end of the range for sunflower seeds from the eastern United States (Yarnell 1978:Table 1).

Recent studies of Chenopodium spp. seeds from archaeological contexts have produced evidence that one or more varieties of Chenopodium berlandieri were cultivated in the prehistoric Eastern Woodlands (Asch and Asch 1985:171-183; Smith 1984a, 1985a, 1985b). Increases in seed sizes and morphological changes in seed coats indicate that some members of the taxon were domesticated. The chenopod seeds in the West Jefferson assemblage are in poor condition; some are popped, while others have damaged or missing seed coats. The condition of the seeds makes it difficult to determine whether they are from domesticated or wild varieties. Nevertheless, the chenopod seeds were submitted to Bruce Smith for examination. Based on a preliminary inspection of 15 seeds, Smith reports that the West Jefferson assemblage contains specimens of both wild and cultivated forms of the taxon (B. Smith, personal communication 1986).

The status of maygrass as a possibly domesticated plant rests on two lines of evidence (Cowan 1978, 1985:212-214). First, maygrass seeds are found in archaeological sites outside of the taxon's natural range (Cowan 1978:282). Second, maygrass normally ripens in the early summer, but maygrass seeds are consistently found in association with other small-seeded grains (e.g., chenopod) that are harvested in late summer or early fall. This latter circumstance suggests that maygrass's natural cycle was altered, and that under cultivation its seeds were ripening later in the growing season (Cowan 1985:213).

Maygrass is the only taxon in the small grain and oil seed category that has a median count greater than zero. Maygrass is native to the Black Belt prairies of Alabama, and it has been found in disturbed areas elsewhere in the state (Harper 1944:67). Though the sites included in my study lie north of the Black Belt, they are not sufficiently distant from this natural habitat of maygrass to support an argument for cultivation based solely on range extension. The West Jefferson maygrass seeds are, however, found in association with fall-ripening chenopod seeds, some of which are cultivated forms. Seven of eight features that have chenopod seeds also have maygrass. This association, and the stronger evidence for the cultivation of maygrass from elsewhere in the Eastern Woodlands, suggest that maygrass was a crop.

As a group, the small grain and oil seed taxa might best be considered garden or field plants. Those that were not actually sown may have been cultivated or at least permitted to grow after they sprouted among the domesticated crops. In examining the boxplots showing the distributions of small grain and oil seed taxa, it should be noted that maygrass and chenopod are the most frequent and most abundant members of the group. Thus, the plotted distributions are primarily the distributions of these probable domesticates.

Boxplots comparing the distributions of small grain and oil seeds above and below the Fall-Line and early and late in the West Jefferson phase are shown in Figure 8:3. The differences in spatial distribution are not significant at the 95% confidence level. There is greater variability above the Fall-Line, however, and there is some suggestion

Figure 8:3. Distribution of small grain and oil seeds by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts, grouped by location above or below the Fall-Line and by chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

that the taxa in this category are more abundant in the features from the upper drainage. The boxplots comparing the distribution of the group in early and late West Jefferson contexts indicate there is greater variability in the early samples but no apparent change in abundance through time. The outlier on both sets Figure 8:3. of graphs is for a feature from 1Ha8; the high value for this feature is a product of the standardization procedures I used (see Chapter VI). Because the weight of plant remains from the feature is very low, a single seed is given an unduly high standardized count.

The greater variability in the distributions of small grain and oil seeds above the Fall-Line and early in the West Jefferson phase requires closer examination. In Figure 8:4, the natural logs of the standardized counts for small grain and oil seed group are plotted against the natural logs of the standardized counts for all plant foods in a sample. Though it is difficult to demonstrate because the batches are small, it appears that there are differences between early samples from above the Fall-Line and most other samples. That is, taxa in the small grain and oil seed group tend to be more abundant in the early features from above the Fall-Line. The evidence is by no means conclusive, but the distribution suggests that small grain and oil seeds were used more intensively in early West Jefferson communities located in the upper Black Warrior drainage.

Nuts would have been the most abundant plant foods in mature forests of the region (see Chapter IV). Thus, it is hardly surprising that nutshells are the dominant plant food remains in the West Jefferson assemblage. Hickory nuts and acorns are the only nut taxa

Figure 8:4. Relationships of small grain and oil seeds to total food count by location and chronological position, West Jefferson batch.

Scatter plot of logged standardized counts grouped by location above or below the Fall-Line and chronological position within the West Jefferson phase (Early West Jefferson sites above the Fall-Line ▲, Early West Jefferson sites below the Fall-Line ▼, Late West Jefferson sites above the Fall-Line △, Late West Jefferson sites below the Fall-Line ▽).

of importance in the assemblage; other nut taxa occur rarely in trace quantities (see Table 8:1). This suggests that the available nut resources were not exploited equally.

Some of the differences in nut use can be explained ecologically, but cultural selection also seems to have been a factor. Pecan, walnut, and hazel nut were not common in the forests of the area (see Chapter IV, Tables 4:4-4:12). The scarcity in the samples of nutshells from these taxa can thus be explained on ecological grounds. On the other hand, chestnut and beech were respectively among the dominants in the uplands and bottomlands. The scarcity of nutshells from these trees is not so readily explained. Small fragments of either chestnut or beech nut shell might be mistaken for acorn shell, but the nutshells of these three taxa can be distinguished and it is unlikely that any quantity of either chestnut or beech nut shells escaped detection. (To make sure I was not overlooking chestnut or beech nut shells in my samples, I carbonized modern specimens of both taxa and cross-checked the identification of any acorn shells that seemed unusual.) Moreover, both these nuts have distinctive outer husks that should be present if the nuts were being collected routinely. In sum, the lack of chestnuts and beech nuts in the samples is probably a result of cultural selection, rather than a product of availability or sampling problems.

Though all nut taxa are included when the distribution of nuts as a group is examined, the quantitative analysis of nut use focuses on hickory nuts and acorns. Only nutshells are used to search for patterned variability in nut use. Nutmeats are excluded because as

consumable foods their chances of preservation differ from nutshells, which are by-products of food preparation.

Boxplots showing the distribution of all nutshells in the West Jefferson batch are presented in Figure 8:5. The plots comparing the distribution by spatial location suggest quantities of nutshell are more variable in features above the Fall-Line. Other than this difference, which is not statistically significant, the use of nuts as a group does not seem to vary in either space or time.

Figures 8:6 and 8:7 present boxplots of the distributions across space and through time of hickory and acorn shell. In both figures, the plots indicate more variability in distributions below the Fall-Line and late in the West Jefferson phase. In neither case are the median counts significantly different along either dimension. It should be noted, however, that the patterns for hickory and acorn are complementary. Hickory counts are marginally higher above the Fall-Line and early in the phase; acorn counts are marginally higher below the Fall-Line and late in the phase. This suggests that there may be shifts in the proportionate use of the two nut types that cannot be detected when the taxa are viewed separately. I will return to this point shortly when I use ratios to investigate changes in the relative use of different taxa.

As we understand it, the transition from horticulture to field agriculture in the Eastern Woodlands centered on changes in the production of maize, beans, and squash. Thus, changes in the distribution of these cultigens are of particular interest for understanding the emergence of the Mississippian subsistence system.

Figure 8:5. Distribution of nutshell by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts grouped by location above or below the Fall-Line and chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:6. Distribution of hickory shell by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts, grouped by location above or below the Fall-Line and chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:7. Distribution of acorn shell by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts, grouped by location above or below the Fall-Line and chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line n = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Maize remains are ubiquitous in the West Jefferson features but bean and squash remains are rare. The absence of beans is probably because the samples predate the introduction of beans to the region. There is no solid evidence for beans being present in the Eastern Woodlands prior to A.D. 1000 (Ford 1985:353; Yarnell and Black 1985:103). Squash, on the other hand, has a long history of cultivation in the region (Ford 1985:344-347). Its scarcity is probably a result of preservation biases. Squash seeds are both edible and fragile, their chances of being preserved by carbonization are slim. The two squash seed fragments in the West Jefferson assemblage come from a single feature and may well be from a single seed.

Boxplots showing the distribution of maize cupules and kernels in the West Jefferson batch are shown in Figures 8:8 and 8:9. For both cupules and kernels the median counts are higher above the Fall-Line and late in the West Jefferson phase. For cupules the differences between the median counts above and below the Fall-Line are significant at the 95% confidence level. That is, there is more maize in the features above the Fall-Line than in those from below the Fall-Line. The differences between medians on the temporal dimension are not significant at the 95% confidence interval but the data do suggest there is more maize in the later features.

Cupules and kernels show similar spatial and chronological distributions. At first glance this is surprising, because in mature maize kernels are edible and cupules are not. The kernels in the samples, however, are mostly fragments; few are complete enough to

```
                                  0.00                                        2.81
Grouped by location
                                  +-----------------------------------------------+
                                  |          --------------                       |
Above Fall-Line      M = 0.97     |----------!(     +     )---                    *
                                  |          --------------                       |
                                  |   ------------                               |
Below Fall-Line      M = 0.31     |(---!+      )  !---------          *           |
                                  |   ------------                               |
                                  +-----------------------------------------------+
                                  0.00                                        2.81

                                  0.00                                        2.81
Grouped by subphase               +-----------------------------------------------+
                                  |         ----------------                     |
Late West Jefferson  M = 1.13     |----------!  (        +  !----)-----          |
                                  |         ----------------                     |
                                  |    ----------                                |
Early West Jefferson M = 0.61     |----! (    + !-)----------                    0
                                  |    ----------                                |
                                  +-----------------------------------------------+
                                  0.00                                        2.81
```

Figure 8:8. Distribution of maize cupules by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts, grouped by location above or below the Fall-Line and chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:9. Distribution of maize kernels by location and chronological position, West Jefferson batch.

Boxplots of logged standardized counts grouped by location above or below the Fall-Line and by chronological position within the West Jefferson phase (Above Fall-Line N = 12; Below Fall-Line N = 8; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

measure. It seems likely that many of the fragments are simply the remnants of kernels that were not fully detached from the cobs when the grain was shelled. Nevertheless, only cupules are used for comparisons between taxa to avoid noise due to differential preservation opportunities. Since cupules and kernels have such similar distributions this should have little affect on the results.

We have examined the distributions of various food resources within the West Jefferson plant assemblage. Only maize shows a pattern in which the median counts are significantly different. Nevertheless, the comparisons suggest that there may also have been differences in the use of other plant foods above and below the Fall-Line and early and late in the West Jefferson phase. These differences by themselves are informative. The within group comparisons have another use, however. They are essential for interpreting changes in the relative proportions between the groups.

Taxon-to-taxon ratios are used to examine variability within the West Jefferson batch in the relative proportions of plant foods. Not all taxa are compared using ratios. Clearly, it is futile to attempt to detect changes in relative proportions of greens and "others", since seeds from taxa in these categories occur so infrequently. Because the boxplots of the fruit group (Figure 8:2) show little variability in either time or space, fruits are also excluded from this portion of the analysis. Ratios are used to compare relative quantities of hickory shell, acorn shell and maize cupules to one another. Ratios are also used to compare quantities of maize cupules to all nutshell, and to compare quantities of small grain and oil

seeds to both nutshell and maize cupules. When ratios are observed to differ, it is possible to determine how taxa changed relative to one another by referring to the plots of taxon distributions (Figures 8:3 through 8:9).

In the preceding pages, I discussed the distributions of a taxon in both time and space before considering the next taxon. For the ratios, however, it makes a more coherent presentation to use a different approach. In the following section, I first examine and discuss spatial variability in the proportionate representation of the taxa, and then consider chronological variability.

Boxplots comparing the spatial distributions of ratios of hickory shell, acorn shell, and maize cupules are shown in Figure 8:10. The acorn/hickory ratios parallel the patterns observed for the individual nut types (see Figures 8:6 and 8:7). That is, the widths of the boxes indicate that the proportions of acorn to hickory are much more variable in samples from below the Fall-Line, but the median ratios for the two batches are quite similar. The cupule/hickory and cupule/acorn ratios are not significantly different in samples from the two areas. The median ratios, especially the cupule/acorn ratio, are higher above the Fall-Line, however.

Boxplots comparing the spatial distributions of ratios of nutshell, maize cupules, and small grain and oil seeds are shown in Figure 8:11. Relative to all nutshell, there are more maize cupules above the Fall-Line than below. The data also suggest that small grain and oil seeds are more abundant relative to both cupules and nutshells above the Fall-Line. Since nutshell quantities are quite

Acorn shell to hickory shell ratio

```
                          0.09                                          2.05
                          ------------
Above Fall-Line  M = 0.28 (   +     ) !-----------
                          ------------
                            ---------------------------------
Below Fall-Line  M = 0.34 --!   +                 )        !-----------------------
                            ---------------------------------
                          0.09                                          2.05
```

Maize cupule to hickory shell ratio

```
                          0.004                                         0.47
                          ------
Above Fall-Line  M = 0.04 !( + !)-------                  0
                          ------
                          ------
Below Fall-Line  M = 0.01 +  ) !----                                    0
                          ------
                          0.004                                         0.47
```

Maize cupule to acorn shell ratio

```
                          0.004                                         1.26
                          ------------
Above Fall-Line  M = 0.15 (     +    )!---                              0
                          ------------
                          --
Below Fall-Line  M = 0.04 +)--
                          --
                          0.004                                         1.26
```

Figure 8:10. Distribution of ratios of major taxa by location and chronological position, West Jefferson batch.

Boxplots of logged ratios grouped by location above or below the Fall-Line (Above Fall-Line N = 12; Below Fall-Line N = 7). See Chapter VI for an explanation of the symbols used in the boxplots.

Maize cupule to nutshell ratio

```
                                 0.002                                                  0.27
                                 ---------
Above Fall-Line  M = 0.04        ! (   +!-)-------                                      0
                                 ---------
                                 -----
Below Fall-Line  M = 0.006       + ) !----      *
                                 -----
                                 0.002                                                  0.27
```

Small grain and oil seeds to nutshell ratio

```
                                 0.001                                                  0.12
                                     ------------
Above Fall-Line  M = 0.02        ---(-!  +    )  !-----                      *         0
                                     ------------
                                 ----------
Below Fall-Line  M = 0.005       +     )  !                            0
                                 ----------
                                 0.001                                                  0.12
```

Small grain and oil seeds to maize cupule ratio

```
                                 0.02                                                   3.11
                                   --------------------------
Above Fall-Line  M = 0.86        --!(          +          )!-------------------------------
                                   --------------------------
                                    ----------
Below Fall-Line  M = 0.32        (--!+     )!                                0
                                    ----------
                                 0.02                                                   3.11
```

Figure 8:11. Distribution of taxa ratios by location, West Jefferson batch.

Boxplots of logged ratios grouped by location above or below the Fall-Line (Above Fall-Line N = 12; Below Fall-Line N = 8). See Chapter VI for an explanation of the symbols used in the boxplots.

similar in both areas (see Figure 8:5), these comparisons support the indications in the plots of the taxa groups that both cupules and small grain and oil seeds were more prevalent in features above the Fall-Line.

The spatial variability in plant use has interesting implications for current models of West Jefferson systems. There are two alternative models of West Jefferson settlement/subsistence systems. One model proposes that the West Jefferson communities were seasonally mobile and that the sites above and below the Fall-Line are different parts of the annual settlement cycle. In this model sites above the Fall-Line are primarily small fall/winter hunting camps, while those below the Fall-Line are horticultural villages occupied for the greater portion of the year (Jenkins 1978:23; Welch 1980:4, 1981b:82). Recently, Welch (1987) has re-examined the data and constructed a different model. This second model proposes that there are spring/summer settlements and fall/winter camps both above and below the Fall-Line. Indeed, Welch (1987) has speculated that during the Late Woodland period there may have been more than one tribal group occupying the Black Warrior Valley.

The results of my analysis of spatial variability in the plant remains from West Jefferson features do not seem to indicate the seasonal and settlement differences proposed by the first model. The plant evidence about seasonality is limited. What there is, however, does not support the suggestion that the occupations above and below the Fall-Line are seasonally distinct. Neither do the data support the suggestions that the sites above the Fall-Line were primarily

hunting camps, while those below the Fall-Line were more involved in horticulture. To the extent that it is possible to measure given the scarcity of most taxa, the same array of plants is used in both regions. There are differences in the proportions of the dominant taxa but these do not indicate a greater use of domesticated plants in the lower portion of the valley. In fact, just the opposite is suggested. Maize remains, and perhaps small grain and oil seeds, are more abundant in features from above the Fall-Line. In contrast, the occupants of settlements below the Fall-Line appear to have used more acorns.

The spatial differences in plant use can be accommodated within the second model that views the upper and lower drainages as the loci of similar, but possibly distinct, West Jefferson communities. The differences in the plant assemblages from the two areas could result from pursuing foraging/gardening subsistence strategies in environments that differed in the distribution and abundance of naturally occurring plant foods. The generally greater variability in plant use below the Fall-Line could be, at least in part, a result of the greater environmental diversity and the dispersion of sites in that area. The differences in the relative proportions of domesticated plants and acorns are more interesting. Maize, small grains, and acorns are all primarily sources of starch. It is possible that what we are detecting is a greater reliance on naturally available carbohydrates (i.e., acorns) below the Fall-Line, and a heavier use of cultivated carbohydrates above the Fall-Line. The

ramifications of this possibility will be considered after I discuss temporal variability in plant use.

Boxplots comparing the temporal distributions of ratios of hickory shell, acorn shell, and maize cupules are shown in Figure 8:12. The medians for the acorn/hickory ratios in the two batches are not significantly different. Nevertheless, the acorn/hickory ratios suggest there were changes in the proportions in which the two nuts were used, with acorns increasing relative to hickory nuts through time. There is also far more variability in the proportions of acorn to hickory in late West Jefferson features than in early West Jefferson features. The proportions of cupules to hickory shells are significantly higher in the late West Jefferson batch. Cupules are also more abundant relative to acorn shells in late features but the differences between the medians are not as marked as those for cupule/hickory ratios.

Boxplots comparing the temporal distributions of ratios of nutshell, maize cupules, and small grain and oil seeds are shown in Figure 8:13. The increase of cupules relative to both nut types through time is summarized in the plot of cupule/nutshell ratios. Since the quantity of nutshells as a group did not vary in time (see Figure 8:5), what we are observing with this ratio seems to be an increase in maize consumption not a decline in nut use. The ratio of small grain and oil seeds to nutshells does not change through time, but the ratio of small grain and oil seeds to cupules appears to decrease. This latter change is more a result of an increase in

Acorn shell to hickory shell ratio

```
                                0.09                                          2.05
                                 ---------------------------------
Late West Jefferson  M = 0.36   --!   +              )        !----------------------
                                 ---------------------------------
                                -------
Early West Jefferson M = 0.20   ( + )!        *     *
                                -------
                                0.09                                          2.05
```

Maize cupule to hickory shell ratio

```
                                0.004                                         0.47
                                 ----
Late West Jefferson  M = 0.05   --( +!)                                        0
                                 ----
                                ----
Early West Jefferson M = 0.008  +) !        *                   0
                                ----
                                0.004                                         0.47
```

Maize cupule to acorn shell ratio

```
                                0.004                                         1.26
                                 ----------
Late West Jefferson  M = 0.12   (!  +    )!-----
                                 ----------
                                --------
Early West Jefferson M = 0.04   +   )  !----                                   0
                                --------
                                0.004                                         1.26
```

Figure 8:12. Distribution of ratios of major taxa by chronological position, West Jefferson batch.

Boxplots of logged ratios grouped by chronological position within the West Jefferson phase (Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Maize cupule to nutshell ratio

```
                                0.002                                                    0.27
                                  -----
Late West Jefferson  M = 0.04   ---(  +!-)     *
                                  -----
                                ------
Early West Jefferson M = 0.007  +  ) !         *                                          0
                                ------
                                0.002                                                    0.27
```

Small grain and oil seeds to nutshell ratio

```
                                0.001                                                    0.12
                                  --------
Late West Jefferson  M = 0.015  --(   +  !)                                              0
                                  --------
                                  ----------------
Early West Jefferson M = 0.02   (!      +       !)----                        *
                                  ----------------
                                0.001                                                    0.12
```

Small grain and oil seeds to maize cupule ratio

```
                                0.02                                                     3.11
                                  --------------
Late West Jefferson  M = 0.29   ---!+      )    !-------------
                                  --------------
                                  ------------------------
Early West Jefferson M = 1.04   ---! (            +        !---)---------------------------
                                  ------------------------
                                0.02                                                     3.11
```

Figure 8:13. Distribution of taxa ratios by chronological position, West Jefferson batch.

Boxplots of logged ratios grouped by chronological position within the West Jefferson phase (Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

cupules, than a change in the quantities of the small grain and oil seeds (see Figures 8:3 and 8:7).

The comparisons between the plant assemblages in early and late West Jefferson features indicate that changes in the use of plant foods occurred within the phase. Both maize and acorn show significant increases relative to hickory. Maize also appears to increase relative to acorn, though the change is not significant at the 95% confidence level. This suggests that the increased reliance on maize was greater than than the increased use of acorns.

The changes in the use of plant foods through time may indicate that the West Jefferson peoples were undergoing subsistence stress. Human skeletal, faunal, and floral data from the nearby Tombigbee River Valley suggest that the terminal Late Woodland peoples in that area experienced dietary stress (Caddell 1981, 1983; Cole et al. 1982; Scott 1983; Woodrick 1981, 1983). The Black Warrior floodplain is narrower than the Tombigbee's, and, particularly above the Fall-Line, the Black Warrior Valley may have been have been poorer in natural food resources. Thus, it is possible that the West Jefferson communities faced subsistence problems similar to those of their contemporaries in the adjacent valley.

Earle (1980) has proposed an economic model of subsistence change based on procurement costs. He argues that if subsistence demands increase, a system can either diversify and adopt new procurement strategies, or intensify existing strategies. The West Jefferson data show no evidence of diversification. To the extent that we can determine, no new plant resources are added nor do any resources that

are scarce in early features become more common in late ones. The increases in maize and acorn use could be evidence of intensification of existing strategies. It must be noted, however, that arguing that an increase in reliance on maize is an indication of dietary stress and that the response to this stress was to intensify maize production is circular. The data are not at odds with the proposition that subsistence stress was instrumental in the economic changes that occurred, but they by no means prove the point. Indeed, it is unlikely that plant data alone will ever be sufficient evidence. We need complementary faunal and human skeletal data to satisfactorily address this issue.

The spatial and temporal differences in the use of plant remains show some interesting parallels. That is, there appears to be a greater use of maize above the Fall-Line and late in the West Jefferson phase. Similarly the use of maize relative to acorns seems higher above the Fall-Line and late in the West Jefferson phase. It is tempting to speculate that what we are detecting is actually simultaneous patterning in two dimensions. I suspect but cannot document that we are observing similar changes taking place at different tempos in the two regions. That is, the move to increase dependence on maize occurs earlier above the Fall-Line, whereas below the Fall-Line it is delayed by first intensifying dependence on acorns. It certainly seems possible given the relative abundance of natural plant foods, that if dietary stress occurred it would be felt first in the upper drainage.

Analysis of Moundville I Plant Food Remains

In Chapter V, I suggested that there were temporal, functional, and, perhaps, status differences within the Moundville I phase deposits for which we have plant data. The occupation south of the Conference Building seems to date earlier in the Moundville I phase than most of the occupation north of Mound R, though the lowest NR strata may be contemporary with the SCB occupation. The two deposits combined probably span the transition from a simple to a complex chiefdom, or at the least a move toward greater complexity. If so, then the deposits may also encompass a change in production strategies. In simple chiefdoms, both commoner and elite households are usually responsible for fulfilling their own subsistence needs. In contrast, in complex chiefdoms food for the chief and his retinue is often supplied as tribute (Steponaitis 1978:420).

The strength of the Moundville I data lies in our ability to use them to make fine-grained temporal observations. Since the possible functional and status differences in the deposits fall within divisions that are also chronological, we can use the temporal dimension to structure our search for variability in the Moundville I plant assemblage. The placement of the SCB strata at the bottom of the temporal sequence is based on arguments presented in Chapter V. While these strata may actually overlap in time with some NR strata, there is not sufficient evidence to precisely insert them in the NR sequence.

To examine patterns of plant use, I use stratigraphic contexts to place the samples from both SCB and NR in chronological order. For

some purposes, I use the stratigraphic group variable (see Chapter VI, Table 6:2) to divide the samples into temporal units. In other instances, I rank the samples with the sequence variable (see Chapter VI, Table 6:3), thereby treating each stratum as an observation in a time-series. This latter approach provides a refined means of searching for fluctuations and trends in the use of plant foods. It is also useful for examining the stability of observed patterns.

Data from 32 pits, 17 lenses, 28 floors, and 26 midden deposits are used in this analysis. Plant remains from pits and lenses were recovered by flotation. Most floor and midden contexts are represented by both small samples recovered by flotation and larger samples recovered by fine-screening. Tables 8:2-8:7 present descriptive statistics, by generalized context and recovery method, for the Moundville I plant remains other than wood (see Appendices B and C for lists of taxa identified in each flotation and fine-screen sample).

Besides the 32 pits included in Table 8:2, samples from 5 other Moundville I pits were processed. Three contained no plant food remains and were simply excluded from the analysis. The other two were cob-filled pits (i.e., smudge pits) that clearly represented different depositional processes than the majority of the features excavated. EDA methods could accommodate the inclusion of these pits in the general analysis. They would appear as extreme outliers on graphs in which maize cupules are variables. The problem is that if the scale of a graph is expanded to include the high values from the

Table 8:2. Descriptive statistics for Moundville I subsistence remains recovered from flotation samples from pits (N = 32).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Hickory	28	0.88	577	2.03	2.07	0.00	5.55
Acorn Shell	28	0.88	2266	3.06	6.80	0.00	66.93
Acorn Meat	8	0.25	30	0.00	0.18	0.00	2.31
Hazel Nut	2	0.06	2	0.00	0.01	0.00	0.10
Walnut	1	0.03	1	0.00	0.003	0.00	0.09
Chestnut	1	0.03	1	0.00	0.003	0.00	0.09
CULTIGENS							
Maize Cupule	27	0.84	1218	2.39	3.18	0.00	17.51
Maize Kernel	27	0.84	1847	3.75	4.04	0.00	20.00
Bean	2	0.06	37	0.00	0.07	0.00	2.03
Maize Cob	1	0.03	1	0.00	0.01	0.00	0.32
Squash Seed	1	0.03	1	0.00	0.00	0.00	0.01
SMALL GRAIN AND OIL SEEDS							
Chenopod	17	0.53	120	0.07	0.17	0.00	0.87
Maygrass	16	0.50	49	0.03	0.19	0.00	1.45
Grass	16	0.50	69	0.01	0.18	0.00	1.23
Cane	10	0.31	21	0.00	0.07	0.00	0.87
Amaranth	8	0.25	21	0.00	0.09	0.00	1.86
Knotweed	5	0.16	7	0.00	0.01	0.00	0.12
Legume	5	0.16	13	0.00	0.02	0.00	0.27
Sedge	2	0.06	3	0.00	0.02	0.00	0.72
Purslane	2	0.06	3	0.00	0.004	0.00	0.08
Wild Bean	2	0.06	2	0.00	0.01	0.00	0.32
Sunflower	1	0.03	2	0.00	0.01	0.00	0.16
FLESHY FRUITS							
Persimmon	25	0.78	351	0.83	1.48	0.00	6.48
Maypop	8	0.25	14	0.00	0.03	0.00	0.31
Blueberry	5	0.16	14	0.00	0.02	0.00	0.36
Bramble	4	0.13	5	0.00	0.01	0.00	0.11
Grape	4	0.13	5	0.00	0.01	0.00	0.12
Elderberry	3	0.09	14	0.00	0.03	0.00	0.72
Cherry/Plum	1	0.03	2	0.00	0.01	0.00	0.24
Sumac	1	0.03	1	0.00	0.00	0.00	0.01
GREENS							
Spurge	5	0.16	6	0.00	0.01	0.00	0.09
Carpetweed	3	0.09	6	0.00	0.02	0.00	0.64
Pokeweed	1	0.03	76	0.00	0.06	0.00	2.11
OTHERS							
Morning Glory	10	0.31	16	0.00	0.04	0.00	0.32
Composite	4	0.13	4	0.00	0.03	0.00	0.72
Mallow	3	0.09	5	0.00	0.01	0.00	0.16
Bedstraw	3	0.09	4	0.00	0.01	0.00	0.07
Yaupon	2	0.06	3	0.00	0.01	0.00	0.21

Table 8:3. Descriptive statistics for Moundville I subsistence remains recovered from flotation samples from lenses (N = 17).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Hickory	15	0.88	49	1.48	2.60	0.00	12.90
Acorn Shell	15	0.88	123	1.54	3.77	0.00	23.43
Acorn Meat	1	0.06	1	0.00	0.03	0.00	0.54
CULTIGENS							
Maize Cupule	15	0.88	80	2.12	3.38	0.00	11.33
Maize Kernel	14	0.82	130	3.84	4.45	0.00	13.56
SMALL GRAIN AND OIL SEEDS							
Chenopod	5	0.29	111	0.00	1.43	0.00	17.92
Maygrass	4	0.24	106	0.00	1.26	0.00	19.85
Grass	3	0.18	3	0.00	0.10	0.00	1.18
Sedge	2	0.12	2	0.00	0.04	0.00	0.30
Knotweed	2	0.12	12	0.00	0.17	0.00	2.12
Amaranth	1	0.06	1	0.00	0.01	0.00	0.19
Purslane	1	0.06	1	0.00	0.01	0.00	0.19
Sunflower	1	0.06	1	0.00	0.07	0.00	1.18
FLESHY FRUITS							
Persimmon	10	0.59	127	0.67	2.40	0.00	12.57
Grape	1	0.06	2	0.00	0.02	0.00	0.39
Elderberry	1	0.06	1	0.00	0.07	0.00	1.18
GREENS							
Pokeweed	1	0.06	1	0.00	0.06	0.00	1.04
Carpetweed	1	0.06	1	0.00	0.01	0.00	0.19
Spurge	1	0.06	1	0.00	0.01	0.00	0.19
OTHERS							
Composite	1	0.06	1	0.00	0.01	0.00	0.19
Morning Glory	1	0.06	1	0.00	0.01	0.00	0.19

Table 8:4. Descriptive statistics for Moundville I subsistence remains recovered from flotation samples from floors (N = 28).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Acorn Shell	20	0.71	115	3.82	4.66	0.00	38.89
Hickory	17	0.61	34	1.48	2.85	0.00	19.35
CULTIGENS							
Maize Cupule	20	0.71	96	3.17	6.21	0.00	67.74
Maize Kernel	20	0.71	120	2.93	5.18	0.00	24.00
SMALL GRAIN AND OIL SEEDS							
Maygrass	4	0.14	11	0.00	0.57	0.00	8.00
Cane	3	0.11	4	0.00	0.10	0.00	1.98
Chenopod	3	0.11	5	0.00	0.21	0.00	4.00
Legume	2	0.07	4	0.00	0.07	0.00	1.44
Grass	1	0.04	1	0.00	0.02	0.00	0.48
Knotweed	1	0.04	1	0.00	0.03	0.00	0.93
Purslane	1	0.04	1	0.00	0.14	0.00	4.00
FLESHY FRUITS							
Persimmon	11	0.39	90	0.00	3.51	0.00	42.86
Blueberry	1	0.04	1	0.00	0.02	0.00	0.48
GREENS							
Carpetweed	1	0.04	1	0.00	0.01	0.00	0.29
OTHERS							
Composite	2	0.07	2	0.00	0.18	0.00	4.00
Mallow	1	0.04	1	0.00	0.03	0.00	0.92
Evening Primrose	1	0.04	1	0.00	0.10	0.00	2.75

Table 8:5. Descriptive statistics for Moundville I subsistence remains recovered from flotation samples from midden deposits (N = 26).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Acorn Shell	19	0.73	60	1.63	2.45	0.00	8.33
Hickory	17	0.65	44	1.25	1.59	0.00	5.56
Acorn Meat	1	0.04	5	0.00	0.21	0.00	5.56
Beech	1	0.04		0.00	0.17	0.00	4.44
CULTIGENS							
Maize Kernel	21	0.81	155	2.89	4.68	0.00	19.57
Maize Cupule	17	0.65	281	2.18	3.71	0.00	32.43
SMALL GRAIN AND OIL SEEDS							
Chenopod	6	0.23	23	0.00	0.35	0.00	2.61
Grass	3	0.12	5	0.00	0.11	0.00	1.67
Cane	3	0.12	4	0.00	0.09	0.00	1.35
Maygrass	2	0.08	2	0.00	0.07	0.00	1.57
Sedge	2	0.08	4	0.00	0.14	0.00	2.70
Legume	2	0.08	3	0.00	0.02	0.00	0.35
Knotweed	1	0.04	1	0.00	0.01	0.00	0.35
FLESHY FRUITS							
Persimmon	12	0.46	30	0.00	1.28	0.00	7.69
Blueberry	2	0.08	2	0.00	0.07	0.00	1.56
Bramble	1	0.04	1	0.00	0.003	0.00	0.09
Sumac	1	0.04	1	0.00	0.01	0.00	0.34
GREENS							
Pokeweed	1	0.04	3	0.00	0.13	0.00	3.33
Carpetweed	1	0.04	1	0.00	0.10	0.00	2.70
OTHERS							
Morning Glory	2	0.08	4	0.00	0.15	0.00	3.13

Table 8:6. Descriptive statistics for Moundville I subsistence remains recovered from fine-screen samples from floors (N = 28).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Hickory	27	0.96	904	4.47	5.18	0.00	13.71
Acorn Shell	27	0.96	1072	6.23	7.86	0.00	22.92
Acorn Meat	1	0.04	3	0.00	0.01	0.00	0.29
Walnut	1	0.04	4	0.00	0.01	0.00	0.31
Pecan	1	0.04	1	0.00	0.07	0.00	2.08
Chestnut	1	0.04	7	0.00	0.05	0.00	1.48
CULTIGENS							
Maize Kernel	28	1.00	979	6.59	7.34	2.08	16.98
Maize Cupule	27	0.96	1496	6.12	9.40	0.00	46.26
Squash Rind	3	0.11	5	0.00	0.02	0.00	0.21
Bean	2	0.07	4	0.00	0.03	0.00	0.85
SMALL GRAIN AND OIL SEEDS							
Cane	13	0.46	59	0.00	0.39	0.00	5.49
Legume	4	0.14	22	0.00	0.12	0.00	2.60
Chenopod	3	0.11	6	0.00	0.03	0.00	0.69
Knotweed	2	0.07	2	0.00	0.02	0.00	0.45
Maygrass	1	0.04	1	0.00	0.01	0.00	0.21
Wild Bean	1	0.04	2	0.00	0.01	0.00	0.20
FLESHY FRUITS							
Persimmon	19	0.68	191	0.50	0.86	0.00	4.11
Maypop	5	0.18	9	0.00	0.05	0.00	0.35
Grape	2	0.07	4	0.00	0.02	0.00	0.28
Cherry/Plum	1	0.04	1	0.00	0.003	0.00	0.10
GREENS							
Spurge	1	0.04	1	0.00	0.01	0.00	0.16
OTHERS							
Morning Glory	3	0.11	5	0.00	0.04	0.00	0.52

Table 8:7. Descriptive statistics for Moundville I subsistence remains recovered from fine-screen samples from midden (N = 24).

TAXA	UBIQUITY COUNT	UBIQUITY PCT	RAW COUNT	STANDARDIZED COUNTS MEDIAN	MEAN	MINIMUM	MAXIMUM
NUTS							
Acorn Shell	24	1.00	948	4.25	5.95	0.22	17.77
Hickory	23	0.96	933	4.29	4.44	0.00	11.73
Acorn Meat	2	0.08	3	0.00	0.01	0.00	0.16
Beech Nut	2	0.08	3	0.00	0.01	0.00	0.21
Walnut	1	0.04	1	0.00	0.004	0.00	0.10
Pecan	1	0.04	8	0.00	0.01	0.00	0.30
Chestnut	1	0.04	8	0.00	0.03	0.00	0.70
CULTIGENS							
Maize Cupule	23	0.96	1135	4.00	6.28	0.00	15.15
Maize Kernel	23	0.96	1839	6.78	7.92	0.00	23.00
Bean	4	0.17	46	0.00	0.21	0.00	2.64
SMALL GRAIN AND OIL SEEDS							
Cane	8	0.33	22	0.00	0.12	0.00	0.91
Legume	6	0.25	43	0.00	0.18	0.00	2.47
Knotweed	5	0.21	7	0.00	0.04	0.00	0.30
Chenopod	4	0.17	5	0.00	0.03	0.00	0.56
Maygrass	2	0.08	2	0.00	0.01	0.00	0.16
Grass	2	0.08	3	0.00	0.01	0.00	0.16
Wild Bean	2	0.08	5	0.00	0.06	0.00	1.11
Sedge	1	0.04	1	0.00	0.01	0.00	0.25
Sumpweed	1	0.04	1	0.00	0.01	0.00	0.24
FLESHY FRUITS							
Persimmon	22	0.92	333	1.52	1.77	0.00	6.67
Maypop	9	0.37	19	0.00	0.06	0.00	0.26
Grape	3	0.12	10	0.00	0.02	0.00	0.30
Cherry/Plum	1	0.04	1	0.00	0.01	0.00	0.20
GREENS							
Spurge	3	0.12	4	0.00	0.02	0.00	0.30
Pokeweed	1	0.04	2	0.00	0.08	0.00	1.93
OTHERS							
Morning Glory	7	0.29	13	0.00	0.08	0.00	0.56
Composite	1	0.04	1	0.00	0.004	0.00	0.09

cob pits, then the values for the rest of the batch are compressed at the low end of the graph. This makes it difficult to distinguish patterns in the batch. For this reason, the cob pits are not included in this portion of my analysis.

Before we can investigate variability in plant use in other dimensions, it is necessary to determine whether either the taxa present or the relative proportions of taxa differ by depositional context. We can use information presented in Tables 8:2-8:7 to assess whether there are qualitative differences by context in taxon presence. The taxa lists and ubiquity values in these tables indicate that pits contain more varied plant assemblages than do other contexts. Hickory shell, acorn shell, and maize remains are ubiquitous in all contexts. For other plant remains, however, pits have both more taxa and generally higher ubiquity values for those taxa than the general deposits.

While pits may have received more varied or more concentrated refuse than living surfaces, it is possible that the richer assemblages are products of differences in recovery methods. All feature fill was floated, while only 3 liters of soil were floated from general levels. The 3 liter samples may have been too small to recover scarce taxa. The fine-screen samples from general deposits were larger, but they were subjected to harsher treatment and also have inherent size biases. Whatever the case, to avoid problems resulting from differential distribution by context and recovery methods, only pits are used for the quantitative analysis of taxa other than nuts and maize.

To determine whether nutshells and maize remains are differentially distributed by context, we must look at the quantitative distribution of these taxa. Boxplots comparing logged standardized counts of hickory shell, acorn shell, and maize cupules by recovery method and context are shown in Figures 8:14-8:16. (Note that the boxplot scales for flotation and fine-screen samples are different.) None of the taxa are differentially distributed by context. Moreover, the flotation and fine-screen samples have parallel patterns, though the median counts for all taxa are higher in the fine-screen samples. This means that to examine variability in the distribution of nutshells and maize, samples from different contexts can be combined. Moreover, analysis of flotation or fine-screen data should produce comparable results for these taxa.

It seems likely that Moundville was occupied year-round. Nevertheless, before examining taxa distributions, we must briefly consider whether there are detectable differences in the seasons materials were deposited. Seeds from summer-ripening fruit--grape, maypop, bramble, elderberry, plum, and blueberry--are never abundant, but they are present in 12 of the 32 pits. Though summer fruit seeds tend to co-occur (9 of the 12 pits in which they are found have more than one summer taxa), they are always mixed with late summer/fall harvested plants. If we use total plant food count as a measure of fall resources, summer fruit exhibit no pattern of association with these resources. Half of the features with summer resources have food counts higher than the median, the other half have food counts lower than the median. Summer fruit show a similar lack of patterning when

Flotation samples

Fine-screen samples

Figure 8:14. Distribution of hickory shell by context, Moundville I batch.

Boxplots of logged standardized counts grouped by context for flotation and fine-screen samples (Midden Flotation N = 26; Floor Flotation N = 28; Pit Flotation N = 32; Lense Flotation N = 17; Midden Fine-screen N = 24; Floor Fine-screen N = 28). See Chapter VI for an explanation of the symbols used in the boxplots.

Flotation samples

Fine-screen samples

Figure 8:15. Distribution of acorn shell by context, Moundville I batch.

Boxplots of logged standardized counts grouped by context for flotation and fine-screen samples (Midden Flotation N = 26; Floor Flotation N = 28; Pit Flotation N = 32; Lense Flotation N = 17; Midden Fine-screen N = 24; Floor Fine-screen N = 28). See Chapter VI for an explanation of the symbols used in the boxplots.

Flotation samples

Fine-screen samples

Figure 8:16. Distribution of maize cupules by context, Moundville I batch.

Boxplots of logged standardized counts grouped by context for flotation and fine-screen samples (Midden Flotation N = 26; Floor Flotation N = 28; Pit Flotation N = 32; Lense Flotation N = 17; Midden Fine-screen N = 24; Floor Fine-screen N = 28). See Chapter VI for an explanation of the symbols used in the boxplots.

compared to the distributions of hickory shell, acorn shell, and maize cupules. In sum, there is no clear evidence that season of deposition accounts for differences in feature contents.

Having examined the effects of depositional context and seasonality on taxa distributions, we can now search for variability in plant use over time. For these purposes, both stratigraphic groups and stratigraphic sequence (see Tables 6:2 and 6:2) are used. Because the quantities of many taxa are low, I employ the same food groups (see Table 6:7) I used to search for variability in the distributions of plant taxa in the West Jefferson assemblage.

Neither the greens nor the "others" category contains enough seeds for a distribution analysis. There are, however, a few points that must be mentioned before we move on to the remaining categories.

The 76 pokeweed seeds listed in Table 8:2 are all from a single SCB feature. While pokeweed is listed among the greens, pokeweed berries can be used for medicinal purposes and to make dyes (Fernald and Kinsey 1958:187; Yanovsky 1936:23). The seeds in this feature probably derive from use of the fruit rather than being a by-product of collecting the leaves for greens.

Three *Ilex* ssp. seeds were recovered from pit fill. Two, found together, appear to be *Ilex vomitoria*, a species from which the ceremonial tea, Black Drink, was made (Fairbanks 1979; Merrill 1979). Harper (1944:148-149) noted that *I. vomitoria* is native to the coast, but that he sometimes found it growing inland on or near prehistoric sites. He specifically mentions finding the plant growing at Moundville (Harper in Jones n.d.; Harper 1944:148). While an argument

based solely on distribution is far from conclusive, it is conceivable that yaupon was intentionally planted and cultivated. The third Ilex sp. seed was found in a separate pit. This specimen cannot be identified to species but appears to be different from the other two.

The presence of morning glory seeds in the samples is also interesting. Morning glory vines are common field nuisances with little economic importance, though some species have edible tubers (Yanovsky 1936:53). Chapman and Shea (1981:76) note that both morning glory and maypop seeds appear to be associated with increased maize production in the archaeological record. They suggest the vines of these plants were using maize stalks for props. It is possible that morning glory vines were tolerated for their tubers, and that the vines and seeds were accidentally harvested when maize was brought in from the fields.

Seeds from the fleshy fruit and the small grain and oil seed categories are sufficiently abundant that boxplots can be used to analyze their distributions. Because there seem to be either depositional or recovery biases in the distribution by context of seeds from these taxa groups (see above), only samples from pits are used to examine variability in fruits and grains. The distribution of these taxa groups are examined with boxplots in which stratigraphic units have been used to group the samples. It should be noted, that these comparisons are at best rough indicators, because the number of samples in most divisions is small. The batches range from one to seven samples.

Seeds from eight fruit taxa are present in the Moundville I assemblage. Only persimmon has a median count greater than zero, however. Thus, when we look at the distribution of the fruit group, we are largely measuring variability in the presence of persimmon seeds.

Boxplots comparing the distributions of fruit seeds in pits grouped by stratigraphic unit are shown in Figure 8:17 (note that group 10 is the SCB deposit [see Table 6:2]). The plots indicate greater variability in the distribution of fruit seeds in the earlier strata but no change in the median counts through time. This suggests that fruit use remains constant within the occupations for which we have data.

The taxa in the small grain and oil seeds group range from plants that were clearly domesticated (e.g., sunflower) to plants that simply may have been weeds (e.g., the unspecified grasses). Whatever the status of these taxa along the continuum from wild to domesticated, most probably grew in gardens, fields, and other disturbed habitats around Moundville. The exception is cane, which might have grown along field edges and in old fields, but which would also have grown on recent alluvium and elsewhere in the bottomlands.

Sunflower and sumpweed, two members of the composite family that have seeds rich in oil, were domesticated prehistorically (Yarnell 1978). Both taxa are present, though rare, in the Moundville I samples. Sumpweed is represented by a single fragmentary seed from a midden level. The seed is too damaged to measure; thus, it is impossible to determine whether the specimen is from a domesticated or

Grouped by stratigraphic unit

Figure 8:17. Distribution of fleshy fruit seeds by stratigraphic unit, Moundville I batch.

Boxplots of logged standardized counts grouped by stratigraphic unit for flotation samples from Moundville I pits (Group 2 N = 3; Group 3 N = 2; Group 4 N = 7; Group 6 N = 5; Group 8 N = 2; Group 9 N = 7; Group 10 N = 6). See Chapter VI for an explanation of the symbols used in the boxplots.

wild sumpweed plant. The three sunflower seeds are almost certainly from domesticated plants.

Only one sunflower seed was in measurable condition, and it lacked the pericarp. The seed minus its pericarp, was 4.8 mm long and 2.6 mm wide. Yarnell (1978:296) has suggested that to estimate achene size, measurements on carbonized seeds should be increased by 30% for length and 45% for width. The corrected measurements for the Moundville I specimen are 6.25 mm and 3.8 mm for an index of 23.7. This is larger than the wild ancestral form but small compared to most sunflower seeds recovered from Mississippian contexts (see Yarnell 1978:Table 1). The size is similar, however, to that of the few sunflower seeds recovered from Mississippian contexts at the Lubbub site in the Tombigbee valley (Caddell 1983: 224).

Chenopod and maygrass are the only taxa in the small grain and oil seed group that have median counts greater than zero. These taxa are found individually or together in 22 of the 32 Moundville I pits. Eleven of the 22 contain both taxa; 6 contain only chenopod; and 5 contain only maygrass. Besides the pits, there is another particularly interesting sample that contains both chenopod and maygrass seeds. A burn lense, encountered on a floor in stratigraphic group 7 NR, yielded a roughly even mix of chenopod (93) and maygrass (103) seeds. The standardized count for small grain and oil seeds for this lense is 40.28, whereas the median count for small grain and oil seeds in pits is only 0.78. The lense probably resulted from a cooking accident; the sample composition suggests a gruel or porridge like preparation was spilled. Bruce Smith examined six chenopod seeds

from this lense. Three specimens were too fragmentary for varietal identification, the other three were domesticated forms. Two of these are similar to the testaless variety recently identified by Gayle Fritz, but C. berlandieri ssp. jonesianum may be present as well (B. Smith, personal communication 1986). The recovery of maygrass clearly associated with domesticated forms of chenopod suggests that both grains were being produced as crops. It is worth noting that Smith has also identified a specimen of wild C. berlandieri from another context in the NR deposit. Thus, both wild and domesticated forms of chenopod are present in the Moundville I samples.

Boxplots showing the distributions of small grain and oil seeds in flotation samples from Moundville I pits are shown in Figure 8:18. Since only pits are included in the plots the extremely high value for this category for the lense discussed above does not appear on the graphs. The median counts for SCB pits (group 10) and for pits associated with the NR "pit house" strata (group 9) seem to be lower than those for later NR strata. This might be an indication that less land was cleared or that dependence on cultivated plants was lower in these occupations. Alternatively, it might be a result of differences in food preparation activities.

Possible sampling and recovery biases for the seed taxa led me to use only flotation samples from pits to examine variability in the distributions of these taxa. These biases do not seem to affect the distributions of either nutshells or maize remains, however. Thus, we can use fine-screen data from midden and floor strata, as well as

Grouped by stratigraphic unit

Figure 8:18. Distribution of small grain and oil seeds by stratigraphic unit, Moundville I batch.

Boxplots of logged standardized counts grouped by stratigraphic unit for flotation samples from Moundville I pits (Group 2 N = 3; Group 3 N = 2; Group 4 N = 7; Group 6 N = 5; Group 8 N = 2; Group 9 N = 7; Group 10 N = 6). See Chapter VI for an explanation of the symbols used in the boxplots.

flotation data, to investigate variability in the distribution of the dominant taxa.

Where it is possible to place individual samples in a sequence, time-series plots provide a more refined picture of variability than do boxplots, for which samples must be collapsed into groups. For the Moundville I assemblage, we have the stratigraphic control necessary to rank the fine-screen samples from general level contexts. Since the distributions of hickory, acorn, and maize remains do not vary by context or recovery method, there is no need to try to fit the Moundville I pits into the sequence. Though I present some boxplots in the following section, smoothed time-series plots are the primary tools I use to examine temporal variability in the abundance of the dominant taxa.

Nutshells are the dominant wild plant food remains in the Moundville I assemblage. Hickory and acorn occur regularly in moderate quantities, but remains from other nut taxa are rare. The scarcity of hazel nut, walnut, and pecan is easily explained; these taxa were uncommon in Black Warrior Valley forest communities. Chestnuts and beech nuts were readily available in the region, so their virtual absence in the samples is probably a result of cultural factors affecting procurement strategies.

Boxplots comparing the distribution of nutshells by stratigraphic unit are presented in Figures 8:19 (pits) and 8:20 (levels). In both figures a similar pattern can be seen; nutshell counts are generally lower in the earlier stratigraphic units. The quantities of nutshells SCB (group 10) and in the NR "pit house" strata (group 9 and perhaps

Grouped by stratigraphic unit

Figure 8:19. Distribution of nutshell by stratigraphic unit, Moundville I batch.

Boxplots of logged standardized counts grouped by stratigraphic unit for flotation samples from Moundville I pits (Group 2 N = 3; Group 3 N = 2; Group 4 N = 7; Group 6 N = 5; Group 8 N = 2; Group 9 N = 7; Group 10 N = 6). See Chapter VI for an explanation of the symbols used in the boxplots.

Grouped by stratigraphic unit

Figure 8:20. Distribution of nutshell by stratigraphic unit, Moundville I batch.

Boxplots of logged standardized counts grouped by stratigraphic unit for fine-screen samples from midden and floor (Group 1 N = 4; Group 2 N = 2; Group 3 N = 11; Group 4 N = 4; Group 5 N = 5; Group 6 N = 2; Group 7 N = 8; Group 8 N = 6; Group 9 N = 2; Group 10 N = 8). See Chapter VI for an explanation of the symbols used in the boxplots.

group 8) are lower, though not significantly so, than the quantities of nutshells in strata comprising the sand floors interspersed with midden deposits. Before we attempt to explain the apparent increase in nut use, however, it is necessary to determine whether the distributions of both hickory and acorn vary or whether the differences in nutshell abundance are confined to one taxon.

To examine variability in the distributions of the two nut taxa, I use smoothed time-series plots. These plots are constructed using the "4253H,twice" algorithm to smooth logged standardized counts for the taxa (see Chapter VI or Velleman and Hoaglin [1981:171-173] for a discussion of smoothing). Each plot shows the logged standardized values (A), the smoothed values (B), the residuals (C), the smoothed residuals (D), and the reroughed values (E). The vertical sections define a natural log scale from 0 to 5; the horizontal lines mark the boundaries between stratigraphic groups. The reroughed (E) and residual (C) plots are of primary interest to us.

The time-series plots for hickory and acorn shell are presented in Figures 8:21 and 8:22. The reroughed plot for hickory (Figure 8:21E) shows minor fluctuations in the quantities of this taxon in the lower half of the graph but, overall, the plot suggests a fairly constant level of hickory use. The reroughed plot for acorn (Figure 8:22E) shows more variability than that of hickory. Acorn quantities are generally lower and fluctuate more in the earlier deposits. If we examine the residuals for both taxa (Figures 8:21C and 8:22C), we find that the amplitude of the oscillations is higher in the lower halves of the graphs. This is more obvious for acorn but, with the exception

Figure 8:21. Time-series plots of hickory shell by stratigraphic sequence, Moundville I batch.

Time-series plots of "4253H,twice" smoothed logged standardized counts from fine-screen samples ranked by stratigraphic sequence (A - logged standardized values, B - smoothed values, C - residuals, D - smoothed residuals, E - reroughed values).

Figure 8:22. Time-series plots of acorn shell by stratigraphic sequence, Moundville I batch.

Time-series plots of "4253H,twice" smoothed logged standardized counts from fine-screen samples ranked by stratigraphic sequence (A - logged standardized values, B - smoothed values, C - residuals, D - smoothed residuals, E - reroughed values).

of a large dip at the bottom of stratigraphic group 3, hickory also seems to follow the pattern. The dampened fluctuations in the residual and reroughed values suggest that use of hickory nuts and acorns stabilizes in the later portions of the deposit. (There is a dip for all taxa at the daub layer. This is not surprising since the stratum appears to be structural debris and would not be expected to contain many food remains.) Taken together, the hickory and acorn plots indicate that the increase in nutshells observed in Figures 8:19 and 8:20 is more an increase in the abundance of acorn than an increase in nuts as a group. Consideration of possible reasons for an increase in acorn abundance is deferred until after we have explored variability in maize remains and examined the ratios of hickory, acorn, and maize to one another.

Three Mesoamerican domesticates--maize, squash, and beans--formed the basis of Mississippian agricultural systems. All are present in the Moundville I assemblage, though only maize remains occur in quantity. Squash remains are rare; only two seeds and five rind fragments were recovered (note that one squash seed was recovered from a cob pit and does not appear in the tables in this chapter). The lack of squash remains is most likely due to preservation biases.

As with squash, the general scarcity of beans in the Moundville I assemblage may be partially due to preservation biases. There is, however, another factor that seems to affect the distribution of beans. All samples containing beans come from the upper levels of the NR deposit; the taxon was not recovered below the top-most floor sequence (group 3). Interestingly, in the strata in which they occur,

beans are not uncommon: 3 of 6 pits (including a cob pit) and 6 of 16 fine-screen samples from groups 1 through 3 contain beans. It seems likely that what we are observing is the addition of beans to the Moundville crop repertoire.

While beans seem to appear late in the Moundville I phase, their presence in deposits that predate A.D. 1250 is comparatively early for this cultigen. Beans were not introduced to the Eastern Woodlands until sometime after A.D. 800; the earliest known examples are from the Midwest and Northeast and date circa A.D. 1000 (Ford 1985:353). The only beans noted by Yarnell and Black (1985:103) in their recent synthesis of plant remains from the lower Southeast are the Moundville I specimens. It should be noted, however, that the foci of the Yarnell and Black's survey were pre-Mississippian contexts and that beans were mentioned only in passing.

Fragments of maize are the most abundant plant food remains in the Moundville I assemblage. Both cupules and kernels have higher median counts than those of other taxa. Boxplots comparing the distributions of cupules and kernels by context and recovery method are presented in Figures 8:23 (flotation) and 8:24 (fine-screen). The patterns shown by cupules and kernels are similar. Since they have the same distributions, either kernels or cupules could be used to examine temporal variability in the distribution of maize. I use cupules because as food by-products their preservation opportunities are more consistent than those of kernels. Thus, some noise due to site formation processes is filtered when cupules are used.

Maize Cupule

Maize Kernel

Figure 8:23. Distribution of maize cupules and kernels in flotation samples by context, Moundville I batch.

Boxplots of logged cupule and kernel counts standardized by plant weight, grouped by context for flotation samples from Moundville I proveniences (Midden N = 26; Floor N = 28; Pit N = 32; Lense N = 17). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:24. Distribution of maize cupules and kernels in fine-screen samples by context, Moundville I batch.

Boxplots of logged counts standardized by plant weight, grouped by context, for fine-screen samples from Moundville I proveniences (Midden N = 24; Floor N = 28). See Chapter VI for an explanation of the symbols used in the boxplots.

A time-series plot of maize cupule counts is presented in Figure 8:25. The figure was constructed using the procedures described above for Figures 8:21 and 8:22. As with hickory and acorn shell, the values used to construct this graph are logged standardized counts from fine-screen samples. The reroughed plot for cupules (Figure 8:25E) indicates that maize quantities are lower in the earlier strata than they are in later deposits. Cupule counts show an increase in the lowest floor series (group 7) and increase slightly thereafter. If we examine the residuals (Figure8:25C), we find that the amplitude of the oscillations seems fairly constant. Throughout the occupation represented by the sand floor structures (i.e., between the daub and midden group 8) maize use is very stable, especially if we consider the noise that site formation processes cause in archaeological data. The plots suggest that maize use may have increased slightly within the Moundville I phase. The observed change, however, does not seem large enough to represent a major shift in production strategies. In other words, it is likely that by the time of the earliest Moundville I occupations for which we have plant data the switch from horticulture to agriculture had already occurred.

We have now examined the distribution of all plant food groups in the Moundville I batch. Both acorn and maize use seem to be higher in the strata associated with the sand floor occupation. In contrast, taxa distributions seem to be more variable in the lower portions of the deposit. While there is variability within the Moundville I batch, the dominant impression gained from investigating individual taxon distributions is that patterns of food use were stable.

Figure 8:25. Time-series plots of maize cupules by stratigraphic sequence, Moundville I batch.

Time-series plots of "4253H,twice" smoothed logged standardized counts from fine-screen samples ranked by stratigraphic sequence (A - logged standardized values, B - smoothed values, C - residuals, D - smoothed residuals, E - reroughed values).

To gain further insights about variability and stability in Moundville I plant procurement and production strategies, we can use taxon-to-taxon ratios. Using ratios, we can examine the relative proportions of hickory shell, acorn shell, and maize cupules. Ratios are also useful for comparing quantities of cupules with quantities of all nutshell, and for comparing quantities of small grain and oil seeds with quantities of cupules and nutshells. The individual taxon plots presented in Figures 8:18 through 8:25 provide a baseline for interpreting the ratio plots.

Reroughed time-series plots for ratios of acorn shell to hickory shell (A), cupules to hickory shell (B), and cupules to acorn shell (C) are shown in Figure 8:26. Through time, both acorn shells and cupules increase slightly relative to hickory shells. The individual taxon plots (Figures 8:21, 8:22, and 8:25) indicate that hickory quantities are quite stable while acorn and maize increase. The ratios confirm this pattern. The plot for cupules to acorn shell indicates no trend in the relative proportions of these taxa. For all three ratios, there is more oscillation in the lower strata. Relative proportions vary less through time; from midden group 4 to the top of the Moundville I deposit proportions of the three taxa are remarkably stable. It should be emphasized, however, that while proportions in the upper strata are more stable than in the lower strata, there is little variability anywhere in the sequence. That is, the individual taxon plots and the ratio plots fluctuate within a narrow range. This would seem to indicate that the procurement and production strategies,

Figure 8:26. Time-series plots of major taxa ratios by stratigraphic sequence, Moundville I batch.

Time-series plots of "4253H,twice" smoothed logged ratios of acorn shell to hickory shell (A), maize cupules to hickory shell (B), and maize cupules to acorn shell (C) from fine-screen samples ranked by stratigraphic sequence in the Moundville I batch.

as well as the food preparation activities responsible for entry of food remains into the deposits, were highly consistent over time.

Boxplots comparing ratios for nutshells, cupules, and small grain and oil seeds by stratigraphic group are shown in Figures 8:27-8:29. The cupule/nutshell ratios plotted in Figure 8:27 are based on fine-screen data. The plot shows some variability in ratios but no clear pattern. If we compare these boxplots to the time-series plots (Figure 8:21, 8:22, and 8:25), we can see that the stratigraphic groups with lower cupule/nutshell ratios are those in which acorn shell increases while cupules stay constant. The small grain and oil seed/nutshell (Figure 8:28) and small grain and oil seed/cupule ratios (Figure 8:29) are based on flotation data from pits. The ratios of small grain and oil seeds to nutshells shows some variability between groups 8-10 and the other groups, but, given the small size of the batches compared, the pattern suggests a relatively stable use of small grain and oil seeds compared to nuts. The ratios of small grain and oil seeds to cupules are again more variable for groups 8-10, but the proportions of garden/field associates to major crops are fairly constant.

Overall, the investigation of variability in the Moundville I plant assemblage has produced a picture of stable patterns of plant food use. Within this general pattern, the results suggest there was some increase in the use of both wild and cultivated starches from the earlier SCB and "pit house" occupations to the later occupation represented by the sand floor structure(s). There also seems to be generally more variability in plant use in the earlier strata than in

Figure 8:27. Distribution of ratio of maize cupules to nutshells by stratigraphic unit, Moundville I batch.

Boxplots of logged ratios grouped by stratigraphic unit for fine-screen samples (Group 1 N = 4; Group 2 N = 1; Group 3 N = 11; Group 4 N = 4; Group 5 N = 5; Group 6 N = 2; Group 7 N = 7; Group 8 N = 6; Group 9 N = 2; Group 10 N = 8). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:28. Distribution of ratio of small grain and oil seeds to nutshells by stratigraphic unit, Moundville I batch.

Boxplots of ratios, grouped by stratigraphic unit, for flotation samples from Moundville I pits (Group 2 N = 3; Group 3 N = 2; Group 4 N = 7; Group 6 N = 5; Group 8 N = 2; Group 9 N = 7; Group 10 N = 6). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:29. Distribution of ratio of small grain and oil seeds to cupules by stratigraphic unit, Moundville I batch.

Boxplots of ratios, grouped by stratigraphic unit, for flotation samples from Moundville I pits (Group 2 N = 3; Group 3 N = 2; Group 4 N = 7; Group 6 N = 5; Group 8 N = 2; Group 9 N = 7; Group 10 N = 6). See Chapter VI for an explanation of the symbols used in the boxplots.

the later ones. The upper stratigraphic units NR show remarkable stability in the relative proportions of the dominant taxa. The task now is to place the results of the plant analysis in their cultural context to see if we can interpret these observations.

In my analysis of the Moundville I plant data, I used the temporal dimension to structure my examination of variability in taxa distributions. Within this chronological framework, however, differences exist in the nature of occupations, and presumably activities, between the SCB area, the "pit house", and the remainder of the NR deposit (see Chapter V). Also, though we cannot be sure, it is possible that the deposits span the transition from a simple to a complex chiefdom. At the very least, by the time the upper Moundville I strata NR were being deposited, Moundville was probably primus inter pares if it had not yet become the paramount center.

Taking into account the cultural changes that were occurring, it is possible to suggest several interpretations for the results of my analysis. Unfortunately, we have too small a window on plant use to select which of the alternatives is most likely. We need comparable data from other Moundville I sites, and from other levels of the social hierarchy, before we can go beyond the speculative explanations I offer here.

The apparent increase in the consumption of starchy foods represented by the increase in acorn and maize remains is difficult to interpret without other lines of evidence. It may be simply that the proportions of carbohydrates in the diet increased. On the other hand, it is possible that the apparent increase in starch use is a

result of differences between the several occupations in food preparation and consumption activities. There is evidence that the NR area was an elite precinct (see Chapter V). Perhaps, the remains in the later NR strata are a result of preparing starchy foods for feasting or for distribution as tokens of the chief's bounty.

The question of why acorns should increase in concert with maize is equally problematical. The lysine in acorn protein (McCarthy and Matthews 1984:21-23) complements the low amount of that amino acid in maize in much the same way bean protein does. It is possible that the increase in acorn use occurred to balance the increase in maize consumption. If this were the case, however, it is somewhat puzzling that similar patterns have not been observed for other Mississippian systems. For example, in the Tombigbee Valley acorn use seems to have declined drastically when maize production increased (Caddell 1983;233-236). Unfortunately, explaining such apparently contradictory patterns and exploring the possible nutritional connections between acorn and maize consumption will have to be deferred until more data are available.

Besides suggesting an increased use of starchy foods, the results also indicated that patterns of plant use stabilized over time. It is possible that the greater variability in the early deposits and the stability in the later ones are the progressively dampened oscillations of a subsistence system reaching a new equilibrium. Within the Moundville I batch, there are no changes in plant use of the magnitude we would expect if we were witnessing a change from garden to field production. Rather, the patterns we are seeing might

be an "after-shock". That is the transition to field agriculture occurred prior to the earliest Moundville I occupation for which we have data and what we are observing are minor adjustments in the proportionate use of plants as the subsistence economy approaches a new homeostasis.

There is another, admittedly speculative, explanation for the greater stability in the later deposits. In simple chiefdoms, the chief's household is generally responsible for fulfilling its own subsistence needs and must also generate a surplus for the chief's largess. In complex chiefdoms, the dietary needs of the chief and his retinue are met at least in part with provisions supplied as tribute. It seems likely that the NR deposit derives from an elite occupation, and that the deposits span the transition to a more complex organization. Perhaps, the fluctuations in proportions of plant foods in the earlier strata are the normal stochastic variability we would expect to find in production for household consumption, while the almost startling stability in the later NR strata is an effect of provisioning.

Comparison of West Jefferson and Moundville I Plant Assemblages

The goal of my research is to improve our understanding of the transition in the Black Warrior Valley from a subsistence economy based on foraging/gardening to one based on field agriculture. In the preceding sections, I have examined variability within the plant assemblages from the West Jefferson and Moundville I phases. In the final section of this chapter, I complete my investigation of changes

in procurement and production strategies by comparing the plant assemblages from the two phases.

The questions that structure this portion of my analysis are enumerated in the introduction to this chapter. The comparisons are designed to provide evidence about when subsistence strategies shifted from an emphasis on wild plant procurement to an emphasis on crop production. At the same time, information is sought about adjustments in wild plant procurement strategies that accompanied the transition to field agriculture.

The focus of my analysis is on changes in plant use through time. There are significant differences between early and late West Jefferson contexts in the proportions of plant resources. Therefore, in the boxplots presented here the West Jefferson samples are separated by chronological position. In contrast, the Moundville I samples are treated as a unit, because the relative proportions of resources varied little within the phase.

To compare the West Jefferson and Moundville I plant assemblages, only flotation data from pits are used. This minimizes biases due to differential preservation or recovery. All West Jefferson samples included in my study are flotation samples from pits. Data from all 20 appear in the tables, but only the 17 that can be assigned to subphase are used in the boxplots. The Moundville samples come from more varied contexts and were recovered by both flotation and fine-screening. Only the 32 flotation samples from pits are included in this portion of my analysis.

Before we investigate quantitative differences in the proportions of plant resources used in the two phases, let us consider whether there are qualitative differences in the resources procured. We already know that beans are added to the set of cultivated plants, but this occurs within the Moundville I period. To search for other qualitative differences between the phases in the resources procured or produced we can use ubiquity values. Table 8:8 presents ubiquity values for taxa identified in the West Jefferson and Moundville I batches.

Viewed from this perspective the assemblages are quite similar. There are 41 taxa listed in Table 8:8; 32 are present in both West Jefferson and Moundville I contexts, while 9 taxa occur only in one batch. Most of the latter have low ubiquity values for the batch in which they occur. Thus, their presence in one assemblage but not the other could be a result of random variation. The only taxa that show marked differences in ubiquity values are morning glory, grass, and cane. All are more frequent in the Moundville I assemblage. For morning glory and grass this is probably a result of land clearance rather than a product of new resources being added to the diet. The situation for cane is less certain; the seeds are edible, but their presence may be due to differences in the depositional context. That is, the cane seeds were found in pits associated with the sand floor structure(s). They may represent debris from thatching, flooring, or some other non-food use of cane. Whatever the case, the bulk of the evidence suggests that the same resource sets were used in both phases.

Table 8:8. Ubiquity values for taxa identified in flotation samples from West Jefferson and Moundville I pits.

TAXON	WEST JEFFERSON (N = 20) COUNT	FREQUENCY	MOUNDVILLE I (N = 32) COUNT	FREQUENCY
NUTS				
Hickory	20	1.00	28	0.88
Acorn Shell	20	1.00	28	0.88
Acorn Meat	10	0.50	8	0.25
Hazel Nut	2	0.10	2	0.06
Walnut	1	0.05	1	0.03
Pecan	1	0.05	0	0
Chestnut	0	0	1	0.03
CULTIGENS				
Maize Cupule	19	0.95	27	0.84
Maize Kernel	18	0.90	27	0.84
Maize Cob	0	0	1	0.03
Bean	0	0	2	0.06
Squash Seed	1	0.05	1	0.03
SMALL GRAIN AND OIL SEEDS				
Maygrass	14	0.70	16	0.50
Sunflower	1	0.05	1	0.03
Grass	5	0.25	16	0.50
Cane	1	0.05	10	0.31
Sedge	1	0.05	2	0.06
Chenopod	8	0.40	17	0.53
Amaranth	6	0.30	8	0.25
Knotweed	3	0.15	5	0.16
Legume	6	0.30	5	0.16
Wild Bean	1	0.05	2	0.06
Purslane	6	0.30	2	0.06
FLESHY FRUITS				
Persimmon	16	0.80	25	0.78
Maypop	2	0.10	8	0.25
Grape	4	0.20	4	0.13
Cherry/Plum	6	0.30	1	0.03
Sumac	6	0.30	1	0.03
Honey Locust	1	0.05	0	0
Blueberry	0	0	5	0.16
Bramble	0	0	4	0.13
Elderberry	1	0.05	3	0.09
GREENS				
Pokeweed	1	0.05	1	0.03
Spurge	2	0.10	5	0.16
Carpetweed	1	0.05	3	0.09
OTHERS				
Morning Glory	0	0	10	0.31
Composite	2	0.10	4	0.13
Mallow	1	0.05	3	0.09
Bedstraw	1	0.05	3	0.09
Yaupon	1	0.05	2	0.06
Clammyweed	1	0.05	0	0

To investigate possible quantitative differences in procurement and production strategies, I again use groups of taxa and boxplots. Before I analyze variability in the relative proportions of taxa, however, it is necessary to consider differences between the phases in the general abundance of plant food remains.

Figure 8:30 presents stem-and-leaf plots and boxplots comparing standardized counts of plant food remains for the West Jefferson and Moundville I batches. It is evident from these plots that West Jefferson samples have significantly more plant food remains than do Moundville I samples. It is, of course, possible that the apparent differences in the quantities of food remains result from greater use of resources that routinely generate preservable by-products. For example, a change in the intensity of nut use might produce such an effect.

There is another possibility that must be considered, however. In Chapter VI, I argued that for the Black Warrior data, plant weight is the most effective of the standardizing variables that are commonly employed to control differences in the abundance of plant remains per unit of soil. The plots in Figure 8:30 may indicate that, where discrepancies in the abundance of plant remains are large, even standardizing by plant weight and using a log scale does not fully filter noise due to differences in plant abundance. For this reason, we must treat variability in the distributions of individual taxa or groups of taxa cautiously. Boxplots comparing distributions of each taxa group are presented to provide a basis for understanding changes in relative proportions, but no interpretations of the plots are

```
West Jefferson          Moundville I

                            1   1
                            1   3
                            1
                            1
                            1   89
                            2   001
                            2 H 233
                            2   45
     2   6                  2   666
***OUTSIDE VALUES***        2 M 89999
     3                      3 H 00011
     3   2                  3   33
     3                      3   445
     3   66                 3
     3 H 899                3   8
     4 M 0111               4
     4 H 2233           ***OUTSIDE VALUES***
     4   45                 4   5
     4   77
     4   9
```

```
                          1.14                                        4.92
                            ---------------
Moundville I        M = 2.90 ----------------!    ( + )-----------        *
                            ---------------
                                                          ---------
Late West Jefferson M = 4.28                        *       --(  +  !)---
                                                          ---------
                                                          ------
Early West Jefferson M = 4.18                         ------(  + !)------  *
                                                          ------
                          1.14                                        4.92
```

Figure 8:30. Distribution of plant food counts by chronological position, West Jefferson and Moundville I batches.

Stem-and-leaf plots and boxplots comparing logged standardized plant food counts for West Jefferson and Moundville I pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9; West Jefferson N = 20). See Chapter VI for an explanation of stem-and-leaf plots and the symbols used in the boxplots.

offered. Taxon-to-taxon ratios are not affected by the potential problems of differential abundance. Therefore, the emphasis in this portion of the analysis is on ratios. My interpretations and explanations rely heavily on changes observed in relative proportions of resources.

Seeds from greens and "others" are neither frequent nor abundant in the West Jefferson and Moundville I assemblages. For these categories, the presence of morning glory seeds in 31% of the Moundville I samples is the only apparent difference between the batches. The association of this taxon with field crops was noted earlier. Beyond this, little can be said about these two groups.

Fleshy fruit seeds, other than persimmon seed fragments, are infrequent and few in number in both assemblages. The ubiquity values for taxa in this category hint that there may be a slight shift in fruit procurement over time. In the West Jefferson batch, fruit taxa that favor woods and thickets (e.g., grape, cherry/plum, sumac) tend to have higher ubiquity values. In the Moundville I batch, taxa found in thickets are present, but taxa found on recently disturbed ground and in old fields (maypop, bramble, elderberry, blueberry) are slightly more common. This difference is tenuous at best, but be noted.

Boxplots comparing the distributions of fleshy fruit seeds in the West Jefferson and Moundville I batches are presented in Figure 8:31. When inspecting this figure, it should be remembered that the plots primarily measure differences in the quantities of persimmon seeds, although the high outlier on the late West Jefferson plot is sumac.

Figure 8:31. Distribution of fleshy fruit seeds by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged standardized counts grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

The boxplots show no differences between the phases in the median counts for fruit seeds.

In both the West Jefferson and Moundville I batches, maygrass and chenopod comprise the majority of the seeds classified as small grain and oil seeds. Because these plants appear to be crops, variability in their distribution is of particular interest to understanding the changes in plant production strategies. That is, it would be useful to know whether the switch to field agriculture entailed a change in the relative proportions of the crops that were raised, or whether the production of all crops increased.

Boxplots comparing the distributions of small grain and oil seeds by temporal context are presented in Figure 8:32. There is more variability in the distribution of small grain and oil seeds in the early West Jefferson phase (see above for a discussion of this pattern). Otherwise, the plots indicate that quantities of seeds in this category vary little over time.

Since nuts would have been the most abundant plant foods in mature forests of the region, it is hardly surprising that nutshells are common in samples from both phases. Interestingly, throughout the period for which we have evidence nut procurement seems to have been selective. Hickory nuts and acorns were used regularly, whereas chestnuts and beech nuts were not. Though procurement efforts remained selective, there were changes in nut utilization over time.

Boxplots comparing by chronological position distributions of all nutshells, hickory shells, and acorn shells are shown in Figure 8:33. The plots for nutshells as a group indicate a dramatic difference in

Figure 8:32. Distribution of small grain and oil seeds by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged standardized counts grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Figure 8:33. Distribution of nutshell, hickory shell, and acorn shell by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged standardized counts grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

nutshell quantities. Within the West Jefferson phase, nutshell quantities are stable, but between the phases nutshell quantities drop significantly. The plots for hickory shell and acorn shell show similar patterns; both decrease significantly between late West Jefferson and Moundville I contexts. The decline in hickory shell quantities is more extreme, however. Not only are the median counts for hickory shell significantly lower in Moundville I samples, there is no overlap at all in the standardized values for the batches. It is likely that it is the marked decline in the abundance of nutshells that produces the significant differences observed for total food counts (see Figure 8:30).

Evidence about the timing and nature of changes in crop production strategies is, of course, the key to understanding the development of the Moundville subsistence economy. Because maize cupules have better preservation chances than other crop remains, variability in the relative abundance of maize remains provides the best monitor for examining changes in the intensity of crop production. The related issue of whether production of all crops increased has already been mentioned and will be examined later using ratios.

Boxplots comparing the distributions of maize kernels and cupules between the phases are presented in Figure 8:34. The plots for both types of maize remains show similar patterns. There is a significant increase in maize quantities from early to late West Jefferson. In contrast, cupule and kernel quantities do not show significant differences between late West Jefferson and Moundville I contexts.

Maize cupule

Maize Kernel

Figure 8:34. Distribution of maize cupules and kernels by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged standardized counts grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

The distribution of each food group for which quantitative comparisons can be made has been examined. Standardized counts for fruit seeds and small grain and oil seeds do not vary much over time. Nutshell quantities change significantly between the phases, with nuts being far less abundant in Moundville I contexts. Maize remains increase significantly from early to late West Jefferson contexts, but the standardized counts do not show comparable increases from late West Jefferson to Moundville I contexts. These distributions provide some clues to variability in plant use. Because of possible problems with differences in the abundance of plant remains in the deposits from the two phases, however, the individual taxa distributions are difficult to evaluate. Taxon-to-taxon ratios are, thus, invaluable to this investigation of changes in plant procurement and production strategies.

Boxplots comparing by temporal context the relative proportions of hickory shell, acorn shell, and maize cupules are shown in Figure 8:35. The plots comparing acorn/hickory ratios indicate that through time acorn shell increases relative to hickory shell. Within the West Jefferson phase, not only does acorn use seem to increase relative to hickory, but there is also an increase in variability in the proportionate use of the two nut taxa. Between the late West Jefferson and Moundville I batches, there appears to be a further increase in acorn shell relative to hickory shell. The differences between adjacent phases in the median acorn/hickory ratios are not statistically significant. The differences between the median ratios for early West Jefferson and for Moundville I, however, are

Figure 8:35. Distribution of ratios of major taxa by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged ratios of acorn shell to hickory shell, maize cupules to hickory shell, and maize cupules to acorn shell in the West Jefferson and Moundville I batches grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

significant at a 95% confidence level. Finally, it is worth noting that throughout the West Jefferson phase acorn is generally less abundant than hickory, while in most Moundville I samples acorn shell is more abundant than hickory shell.

While there are changes in the ratios of the two major nut taxa, the changes in the relative proportions of cupules to hickory are far more dramatic. When the ratios of cupules to hickory within the West Jefferson batch were compared, the results indicated that late West Jefferson contexts had significantly more cupules than did early West Jefferson contexts (see Figure 8:12). The differences between the ratios for the two West Jefferson subphases and for the Moundville I phase are so great, however, that the change within West Jefferson does not even appear when the values are plotted on a scale expanded to include the values for Moundville I ratios. In other words, cupules increased relative to hickory within the West Jefferson phase, but the change was minute compared to the change between late West Jefferson and Moundville I contexts.

The changes in the proportions of cupules to acorn shell are not as extreme as those for cupules to hickory shell. There is an increase in the ratio of cupules to acorn within the West Jefferson phase, but the difference between the median ratios is not significant. The change in the ratio of cupules to acorn shell is, however, significant between late West Jefferson contexts and Moundville I contexts.

The boxplots for all three ratios show significant changes over time in the relative proportions of nuts and maize. In each case, the

proportions change between early and late West Jefferson contexts and again between late West Jefferson and Moundville I contexts. These changes are graphically summarized in Figure 8:36, in which median percentages define the end points of the bars.

While in all cases there is more difference between late West Jefferson and Moundville I than within the West Jefferson phase, the magnitude and rate of change for each ratio is different. We can see this most easily by examining unlogged values for the ratios. The median acorn/hickory ratio changes from about 1:4 in early West Jefferson, to 1:2 in late West Jefferson, to 4:1 in Moundville I. Roughly 11% of this sixteen-fold change occurs within the West Jefferson phase. The median cupule/hickory ratio changes from 1:125 in early West Jefferson, to 1:22 in late West Jefferson, to 2:1 in Moundville I. Only 2% of this change occurs within the West Jefferson phase. The median cupule/acorn ratio changes from 1:22 in early West Jefferson, to 1:8 in late West Jefferson, to about 1:1 in Moundville I, with 11% of this change occurring within the West Jefferson phase.

Boxplots comparing relative proportions of fruit seeds and small grain and oil seeds to nutshells and maize cupules are shown in Figures 8:37 and 8:38. The plots comparing the ratios of these groups to nutshell show stable patterns of use within West Jefferson, but dramatic differences between West Jefferson and Moundville I contexts. That is, both fruit seeds and small grain and oil seeds increase relative to nutshells. In contrast, the plots comparing ratios of fruit seeds and small grain and oil seeds to maize cupules indicate

Figure 8:36. Relative proportions of maize cupules, acorn shell, and hickory shell, Moundville I and West Jefferson batches.

Bar graphs of median percentages of total plant food count for flotation samples from pits.

Fleshy fruit seeds to nutshell ratio

Small grain and oil seeds to nutshell ratio

Figure 8:37. Distribution of ratios of fleshy fruit seeds to nutshell and small grain and oil seeds to nutshell by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged ratios grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson N = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

Fleshy fruit seed to maize cupule ratio

Small grain and oil seeds to maize cupule ratio

Figure 8:38. Distribution of ratios of fleshy fruit seeds to maize cupules and small grain and oil seeds to maize cupules by chronological position, West Jefferson and Moundville I batches.

Boxplots of logged ratios grouped by chronological position for flotation samples from pits (Moundville I N = 32; Late West Jefferson N = 8; Early West Jefferson n = 9). See Chapter VI for an explanation of the symbols used in the boxplots.

significant decreases in the ratios over time. Both taxa decrease relative to maize within West Jefferson and they decrease further between West Jefferson and Moundville I contexts. We know from the individual taxa plots that standardized quantities of both fruit and grain seeds did not vary by temporal context. On the other hand, we know that nutshell decreased and cupules increased. The patterns in these two figures suggest that collection of fruit and small grains was not influenced by the factors that led to changes in nut procurement and maize production.

In this chapter, I have examined variability in plant use in some detail. By combining the results of my investigations of within- and between-phase variability, it is possible to describe some changes in plant use that preceded and accompanied the development of the Moundville subsistence economy. Within the West Jefferson phase, hickory nut use was stable, while acorn and especially maize use increased through time. Between late West Jefferson and Moundville I, maize use increased dramatically relative to both hickory nuts and acorns. At the same time, there appears to have been a further increase in the use of acorns relative to hickory nuts. In contrast to these changes, during the Moundville I phase, patterns of food use seem to have been quite stable. On the whole, the use of fruit and small grain and oil seeds was affected little by the changes in nut procurement and maize production.

Besides providing a sketch of changing patterns of plant food use, the results of my analysis also can be used to provide some answers to the questions I posed at the beginning of this chapter.

There are gaps in the available plant data. For example, we lack plant remains from the earliest portion of the Moundville I phase, and we have data only from the upper stratum(a) of Moundville society. Because of such gaps, the answers I propose must be regarded as provisional. Nevertheless, the data do provide new insights about changes in procurement and production strategies, and suggest several intriguing avenues for future research.

Changes in the amount of time and energy devoted to crop production may have been the catalyst that led to changes in other procurement strategies. Thus, it seems logical to begin this discussion by considering the evidence about the timing of the move to increased maize production. In other words, can we determine when subsistence strategies shifted from an emphasis on wild plant procurement to an emphasis on crop production?

Entire communities or larger social units do not decide from one growing season to the next to become farmers rather than foragers. Economic changes of this sort are the composite effect of decisions made by individual households or production units about how to allocate labor. Because our chronological measures are imprecise, changes in subsistence strategies often appear abrupt. Nevertheless, transitions that are ephemeral in the archaeological record may take a generation or more to occur.

The results of my analysis show that the shift toward an economic strategy based on crop production began in the West Jefferson phase. The changes within the West Jefferson phase, and between the late West Jefferson phase and the Moundville I phase, suggest a system in

transition. Unfortunately, we lack data from contexts that are indisputably early Moundville I. Thus, we cannot say whether the subsistence change was completed before simple chiefdoms developed in the Black Warrior Valley. Clearly, by the time of the Moundville I occupations for which we have plant data a new balance of procurement and production strategies had been attained. The Moundville I assemblage presents a picture of a stable, successful subsistence system.

Besides indicating that the move toward increased maize production began in the West Jefferson phase, the results of the analysis shed some light on two other aspects of the shift to crop production. First, though the evidence is by no means conclusive, the examination of spatial variability in plant use within the West Jefferson phase suggests that the move toward increased crop production occurred earlier above the Fall-Line than below. Second, the decrease of small grain and oil seeds relative to maize cupules suggests that the switch to crop production focused on increased production of maize. While other cultigens were not abandoned, there does not seem to have been an across-the-board increase in crop production.

Intensification of one procurement/production strategy often requires adjustments to other elements in a subsistence strategy. Particularly when seasonal resources are used, scheduling conflicts may arise requiring that labor be reallocated. Moreover, where the intensified strategy is crop production, the availability of other resources may be altered. Adjustments to subsistence strategies can

be made by modifying the set of resources that are exploited or by changing the relative proportions in which resources are procured. In the following paragraphs, I will first review the evidence concerning the sets of resources exploited and then discuss changes in the proportionate use of the main resources.

There were no significant changes in the sets of non-domesticated resources used during the West Jefferson and Moundville I phases. For both assemblages, taxa lists and ubiquity values are quite similar. While morning glory seeds occur only in Moundville I contexts and grass seeds are more frequent in samples from this phase, these were probably not important food plants.

One major domesticated plant was added to the set of resources used. Sometime late in the Moundville I phase, beans were introduced to the region. They make their first appearance, however, well after the shift to crop production occurred. In other words, the addition of beans to the crop repertoire was not a factor in the shift in plant procurement/production strategies.

The evidence clearly indicates that increased maize production was not simply grafted on to existing subsistence strategies, however. Patterns of fruit collection seem to have been stable, but nut procurement changed. Not only did nut use decline, but the proportions in which hickory and acorns were used changed. The overall decrease in nut use can be explained by labor and scheduling constraints. The changes in relative proportions of acorns and hickory nuts are somewhat puzzling. While several possible

explanations for the observed changes are offered here, no one explanation is completely satisfactory.

It has been suggested that hickory shell was collected and used for fuel (e.g., Munson et al. 1971:427). If so, the changes in nutshell proportions might result from changes in fuel use rather than in collection and consumption of nutmeats. Lopinot (1984:154-157), however, has presented cogent arguments that collection of nutshell for use as fuel is a very inefficient allocation of labor. Hickory shell might well be used for fuel, but only as a secondary use of a food by-product. This brings us back to the problem of why there should be more hickory shell available for fuel in early contexts than in late ones.

Scheduling conflicts between the maize harvest and fall nut gathering activities might also result in changes in nut procurement. In the Black Warrior Valley, maize would have been ready to harvest in late August or September. Acorns and hickory nuts ripen in the fall and might be ready for harvest when the labor demands of maize were at their height. This could well result in a decreased use of nuts, but would probably not result in an increase of acorns over hickory nuts. Acorns are not only a favorite browse for animals, such as deer and turkey, they also are prone to germinate, rot, or become infested with insects if left on the ground or in the shell (Schopmeyer 1974:698-699). Therefore, acorns must be harvested and processed when they ripen. The thicker shelled hickory nuts can remain undamaged on the ground for longer periods of time and can be stored in the shell (Schopmeyer 1974:271). Their harvest and processing can be delayed if

necessary. Given the harvesting requirements of the two nut taxa, scheduling conflicts are more apt to be a problem with acorns than with hickory nuts.

In a preliminary report on some of the data used in this research, I suggested that the changes in nut use might be a result of differential reduction of nut resources due to land clearance (Scarry 1981a:95). There is a major flaw in this explanation. The best agricultural land is found in the bottomlands and on the terraces. Hickories and oaks grow in these zones, but both taxa were most abundant in the uplands and hills (see Chapter IV). In other words, clearing land for fields would not have reduced the availability of hickory nuts more than acorns. Indeed it would not have much effect on the majority of the nut groves. For a site like Moundville, which sits at the edge of the floodplain, both hickory nuts and acorns would have been available within a reasonable collection territory.

In times when resources are plentiful, several characteristics might cause acorns to be classified as second line resources. Acorns are primarily a source of starch; they lack the fat and protein content that make hickory nuts a high energy food. Acorns also require more work and are less flexible about when it can be performed than hickory nuts. Acorns must be gathered and processed immediately upon ripening, and many species must have their tannin leached before they can be consumed. If the increase in acorns relative to hickory occurred only within West Jefferson contexts, we might explain the change as a response to subsistence stress. The problem is, that if acorns are a second line food, then once maize production is in full

swing we would expect their use to drop relative to hickory. But the reverse occurs, thus this explanation would account for only the changes observed within the West Jefferson phase.

If we look at the problem from a different perspective, two admittedly highly speculative explanations for some of the changes in nut ratios can be offered. Hickory shell quantities are stable within West Jefferson and then decrease abruptly. Ethnohistoric accounts suggest that the primary use of hickory nuts was as a source of oil (Larson 1980:187). Perhaps, the elite residents of the Moundville I areas for which we have data obtained protein and fat from animal foods rather than plants. Alternatively, hickory oil may have been extracted elsewhere on the site, or in other settlements of the Moundville system, and provisioned to the elite. Such practices would not account for the changes in nut proportions within the West Jefferson phase, however.

It is, of course, possible that the factors that caused the changes in nut ratios within the West Jefferson phase differed from the factors that caused the dramatic changes in nut ratios between the West Jefferson and Moundville I phases. By this logic, an increased use of second-line resources (i.e., acorns) could have produced the differences in nutshell ratios observed within the West Jefferson phase. Thereafter, a greater reliance by the elite on animal sources of fat or provisioning of hickory oil could have produced the marked changes in nut ratios observed between the phases. Unfortunately, evaluating such a compound explanation requires data we simply do not possess. Nut ratios from Moundville I farmsteads or from non-elite

occupations at Moundville are critical. Such ratios would permit us to determine whether there were changes in nut use throughout the society or whether the nut ratios in my data are a result of status related dietary practices.

In sum, my analysis has demonstrated that in the Black Warrior Valley the shift from a foraging/gardening economy to an agricultural one began within the Late Woodland West Jefferson phase and that a new balance of subsistence strategies was achieved either before or early in the Moundville I phase. The spatial and temporal variability in the Late Woodland assemblage strongly suggest a subsistence system undergoing change. On the other hand, the Mississippian assemblage indicates a stable subsistence system. The changes in crop production strategies were accompanied by changes in the procurement or consumption of some but not all wild plant foods. I have suggested that subsistence stress, scheduling conflicts, and status-related food distribution or consumption practices are all factors that may have contributed singly or in concert to the patterns we have observed. Clearly the next step is to fill in the gaps in the data so that we can convert plausible explanations to probable ones.

CHAPTER IX

MAIZE COB ANALYSIS

Maize production was a vital component of the Moundville subsistence economy. In preceding chapters, I reviewed studies of the Moundville settlement system and the possible relationships between site locations and maize production and distribution; I described propositions about agricultural risk and strategies for coping with that risk; and I investigated questions about the timing of the move toward increased maize production. In this chapter, I analyze morphological characteristics of maize cobs recovered from the Black Warrior River and Tombigbee River Valleys. The results of my analysis yield an additional perspective on production strategies by providing information about the maintenance of maize varieties in west-central Alabama in the late prehistoric period.

Early ethnohistoric accounts from the southeastern United States indicate that the Native American populations recognized several distinct types of maize. They maintained separate cultivars through seed selection and by planting in different fields or at different times. Among other things, the various kinds of maize differed in the length of time between planting and ripening, in vegetation characteristics, in ear size, and in kernel shape and hardness (Cutler and Blake 1976:2; Swanton 1946:268,274,290).

The maize remains used in this study are all carbonized. Clearly, ripening dates, vegetation morphology, and other characteristics of the ethnohistorically described maize cultivars cannot be determined from the archaeological specimens. Similarly, the criteria by which the Native Americans selected and maintained different types of maize cannot be ascertained.

Maize cultivars are, however, distinguished by several morphological cob and kernel characteristics that are often retained in carbonized materials. In particular, the number of rows of grain per ear seems to be a diagnostic trait (Cutler and Blake 1976:2). Row number and other characteristics can be used to investigate variability in archaeological maize remains and, where samples are sufficiently large, to determine whether more than one type is present. While it is difficult to relate such information directly to ethnographically described cultivars, evidence about diversity in maize populations is by itself useful for understanding cropping strategies.

Several races of maize have been identified in archaeological collections from the eastern United States. These races have been described by Cutler and Blake (1976:5-6), who have studied maize remains from more than 400 sites (Blake 1986:3). North American Pop, also called Tropical Flint (Anderson and Cutler 1942), seems to have been the first maize grown in the East. This maize was characterized by small cupules and small cobs having 12 to 14 rows of grain. Midwestern Twelve Row appears to be a later, modified form of this race; it is the dominant maize found in collections from Cahokia, the

central Mississippi Valley and the Caddoan region. Cob collections with mean row numbers greater than ten are probably dominated or at least strongly influenced by these high-row races. Eastern Eight Row, originally called Northern Flint by Brown and Anderson (1947), was the dominant race grown over much of the eastern United States in the latest prehistoric and early historic periods. This race can be considered dominant in cob collections with mean row numbers less than ten (Blake 1986:3-4; Cutler and Blake 1976:6).

Most maize remains in the West Jefferson and Moundville I plant assemblages were fragments of kernels or cupules too incomplete to measure. The samples did contain, however, 98 kernels, 834 cupules, and from the Moundville I deposits 24 cobs that were sufficiently intact to measure. A detailed analysis of the cobs is presented below. Before discussing this analysis, however, a few words are necessary about the kernels and cupules.

To search for evidence of differences in grain size or shape, I measured kernel and cupule height and width. For the kernels I also measured thickness and recorded information about the grain surface. I then used scatter plots and stem-and-leaf plots of the dimensional measurements to look for clusters and multi-modal distributions. Unfortunately, no patterns could be discerned. For the kernels this may be partially a problem of small sample size. For both kernels and cupules, however, there is another factor that may affect our ability to detect patterns that relate to cultivar differences. Besides varying between different types of maize, grain size often varies by location (i.e., tip, midsection, butt) on a cob. There is no way to

determine the portion of a cob from which an isolated kernel or cupule is derived. Thus, noise due to differences in the portion of the cob represented by fragmentary remains may obscure patterns resulting from differences in grain size between cultivars.

Because of the problems with detecting pattern in fragmentary maize remains, this analysis focuses on variability in maize cobs. Diversity indices are used as general measures of variety in the cob assemblage. A K-means cluster analysis is used to attempt to identify distinct maize cultivars, by sorting cobs into groups with similar characteristics. The results of the cluster analysis are evaluated with temporal and spatial variables.

The Cob Population

Observations on 13 morphological attributes for 438 cobs comprise the data base for this analysis. A small, well preserved collection of cobs was recovered from the Moundville I deposits north of Mound R. Unfortunately, no intact cobs were recovered from West Jefferson contexts, although kernel and cupule fragments were found in virtually every sample. To improve the chances of understanding some of the variability in the prehistoric maize population, a larger data base than that available from Moundville I contexts is required. Therefore, cobs recovered from later Moundville and Alabama River phase contexts in the Black Warrior Valley, and from Late Woodland (Miller III) through protohistoric (Summerville IV) contexts from the Lubbub Creek Archaeological Locality in the nearby Tombigbee Valley are included in the analysis.

A total of 235 cobs from sites in the Black Warrior Valley is used in this analysis. Slightly less than half of the cobs (101) come from Moundville itself. The UMMA excavations north of Mound R resulted in the recovery of cobs from both Moundville I and Moundville II/III contexts. Besides these materials, the analysis includes cobs recovered during Depression-era excavations at Moundville.

Cobs from two other sites located below the Fall-Line in the Black Warrior Valley are also used in the analysis. Paul Welch (1986) directed excavations of Moundville II/III midden deposits at the White site (1Ha8), a subsidiary center in the Moundville system. This work produced a superb collection of 93 well-preserved cobs. Caleb Curren (1984:143-193) directed excavations at the Moody Slough site (1Tu4), an Alabama River phase farmstead. (Note the Alabama River phase in the protohistoric phase that immediately follows the collapse of the Moundville chiefdom.) David Lentz analyzed a collection of 41 cobs recovered from Moody Slough, and published measurements for each cob (Lentz 1980:100-102). The variables he measured were comparable to those I measured on the cobs from Moundville and the White site (see below). Therefore, it is possible to include the Moody Slough cobs in the analysis.

In the Tombigbee Valley, extensive excavations were conducted at the Lubbub Creek Archaeological Locality (Peebles 1983b). The late prehistoric components at the site have been divided into five phases: late Miller III and Summerville I through IV (Peebles and Mann 1983:70). These are roughly equivalent to the West Jefferson, Moundville I through III, and Alabama River phase divisions used in

the Black Warrior Valley. In the Mississippian period, the Lubbub site was the ceremonial center for a small chiefdom (Peebles 1983a:405-407). While the site is not part of Moundville system, its geographic proximity makes it a reasonable source of comparative and supplemental data for studies focused on the Black Warrior Valley.

A total of 203 cobs was recovered from Late Woodland and Mississippian contexts at Lubbub. Gloria Caddell analyzed these cobs and presented detailed measurements for each cob in her report on the Lubbub plant remains (Caddell 1983:252-258). The collection includes cobs from contexts assigned to the Late Miller III component and to each of the Summerville components. Most cobs (130), however, are from presumably Mississippian cob pits that were not associated with artifacts which would permit assignment to phase.

Characteristics for all cobs, regardless of analyst, were measured according to the general procedures described by Ford (1973:188-189). Observations were made on 13 attributes. Five of these are qualitative characteristics. Cob fragment type was coded as whole (W), midsection (M), tip (T), or butt (B). Combinations, such as M-T for midsection-tip, were used to indicate segments present on larger fragments. Cob shape was recorded as tapered (T) when a fragment decreased in diameter toward the tip, straight (S), or cigar-shaped (C) when a fragment tapered toward both ends or towards the butt. Strength of row pairing was coded as weak (W) when cupule wings overlapped, moderate (M) when a narrow groove separated adjacent cupules, and strong (S) when the groove between cupules was wide. Cross section shape was coded as circular (C), quadrilateral (Q), or

elliptical (E). Presence or absence of irregular rows was also noted. These attributes are subjective observations; the way in which any particular cob would be coded may vary between analysts.

Besides the qualitative characteristics, eight quantitative attributes were recorded. Row number was counted as close to the midsection as possible to avoid distortions caused by irregular rows at either end of a cob. Maximum and minimum diameter were also measured at midsection. Cob fragment length was recorded in millimeters; this measurement is the length of the actual archaeological specimen not an estimate of original or complete cob length. The width and height (internode length) of the largest cupule near the midpoint of the cob were measured in millimeters. If glumes were present, glume width was also measured for this cupule. Finally, a condensation index was computed by dividing the row number by cupule height (Smith 1980:123,138).

While these measurement procedures are adapted from Ford (1973:188-189), there are a few differences in how observations were made. Ford measured the number of cupules in a 10 mm section of cob to determine cupule height. For the Alabama cobs, cupule height was measured as the distance between the base of one set of lower glumes and the base of the next set in the same row. Ford recorded whether a cob was a nubbin or a fully developed cob. Systematic observations were not made for this attribute in the studies of the Alabama cobs. It should be noted, however, that I did not find any nubbins in the cob collections from either Moundville or the White site.

For the analysis, I created a computerized data base in which each cob was treated as a case. Provenience data and observations on the cob attributes comprise the variables for each case. For some cobs, not all attributes were recorded. Many cobs lacked measurable glumes, and determination of cob fragment type and shape was difficult to impossible for small fragments. Also, fragment type and presence/absence of irregular rows were not recorded for the Alabama River phase cobs. Cobs missing observations on these attributes were included in the data base. Cobs that lacked complete cross sections from which row number could be determined were excluded, however. Appendix D presents data on the cobs from Moundville and the White site. Cob data for Moody Slough and Lubbub may be found in Lentz (1980) and Caddell (1983:252-258) respectively.

Before describing the quantitative analysis, it is useful to present brief descriptions of the cob collections from the Black Warrior Valley. Summary statistics for the cobs from the Black Warrior Valley are presented in Tables 9:1 through 9:3. Comparable descriptive statistics for the cobs from Lubbub, as well as a discussion of variability over time in the Lubbub cob population, can be found in Caddell's report (1983:250-262). The reader is referred to her excellent report for this information.

Measurable cobs were recovered from three Moundville I contexts north of Mound R. The majority came from two cob-filled pits. Feature 43 was encountered at the level of the daub (Stratigraphic group 2), while Feature 161 was encountered in the first midden stratum below the daub (Stratigraphic group 4). The third context

Table 9:1. Summary statistics for the Moundville I cob population.

		Black Warrior Valley Population	MOVL I Sample	Mdvl-NR Feat 43	Mdvl-NR 6N2W Level 9	Mdvl-NR Feat 161
N =		235	24	5	3	16
Row Number						
Mean		9.68	11.00	14.80	12.67	9.50
8	#	87	5	0	0	5
	%	37.02	20.83	0	0	31.25
10	#	105	10	0	0	10
	%	44.68	41.67	0	0	62.50
12	#	35	3	0	2	1
	%	14.89	12.50	0	66.67	6.25
14	#	5	4	3	1	0
	%	2.13	16.67	60.00	33.33	0
16	#	2	2	2	0	0
	%	0.85	8.33	40.00	0	0
Cupule Width $\bar{x}$		6.47	5.23	6.18	5.83	4.82
Cupule Height $\bar{x}$		2.86	2.89	3.46	3.30	2.64
Glume Width $\bar{x}$		3.87	3.04	3.38	3.30	2.84
Maximum Diameter $\bar{x}$		10.49	9.17	13.52	10.97	7.36
Condensation Index $\bar{x}$		3.59	3.91	4.29	3.84	3.81

Table 9:1. Summary statistics for Moundville I cob population (continued).

		Black Warrior Valley Population	MDVL I Sample	Mdvl-NR Feat 43	Mdvl-NR 6N2W Level 9	Mdvl-NR Feat 161
N =		235	24	5	3	16
Row Pairing						
Weak	#	84	17	3	2	12
	%	35.74	70.83	60.00	66.67	75.00
Moderate	#	114	7	2	1	4
	%	48.51	29.17	40.00	33.33	25.00
Strong	#	36	0	0	0	0
	%	15.32	0	0	0	0
Cob Shape						
Tapered	#	45	7	2	0	5
	%	19.15	29.17	40.00	0	31.25
Straight	#	175	15	3	3	9
	%	74.47	62.50	60.00	100.00	56.25
Cigar	#	0	0	0	0	0
	%	0	0	0	0	0
Cross Section Shape						
Circular	#	133	17	3	2	12
	%	56.60	70.83	60.00	66.67	75.00
Quadrilateral	#	44	0	0	0	0
	%	18.72	0	0	0	0
Elliptical	#	58	7	2	1	4
	%	24.68	29.17	40.00	33.33	25.00

Table 9:2. Summary statistics for Moundville II/III cob populations.

		Black Warrior Valley Population	MDVL II/III sample	MDVL III Mdvl-NR Feat 3	MDVL II/III White Feat 56	MDVL II/III White Feat 22
N =		235	120	25	3	89
Row Number						
Mean		9.68	9.83	9.68	10.00	9.89
8	#	87	34	5	1	27
	%	37.02	28.33	20.00	33.33	30.34
10	#	105	60	17	1	40
	%	44.68	50.00	68.00	33.33	44.94
12	#	35	24	1	1	22
	%	14.89	20.00	4.00	33.33	24.72
14	#	5	1	1	0	0
	%	2.13	0.80	4.00	0	0
16	#	2	0	0	0	0
	%	0.85	0	0	0	0
Cupule Width $\bar{x}$		6.47	6.34	6.34	5.60	6.39
Cupule Height $\bar{x}$		2.86	3.03	3.15	3.03	2.99
Glume Width $\bar{x}$		3.87	3.80	3.88	3.70	3.70
Maximum Diameter $\bar{x}$		10.49	10.51	10.33	8.23	10.66
Condensation Index $\bar{x}$		3.59	3.28	3.11	3.34	3.34

Table 9:2. Summary statistics for Moundville II/III cob populations (continued).

		Black Warrior Valley Population	MDVL II/III sample	MDVL III Mdvl-NR Feat 3	MDVL II/III White Feat 56	MDVL II/III White Feat 22
N =		235	120	25	3	89
Row Pairing						
Weak	#	84	47	4	2	40
	%	35.74	39.17	16.00	66.67	44.94
Moderate	#	114	66	17	1	46
	%	48.51	55.00	68.00	33.33	51.69
Strong	#	36	7	4	0	3
	%	15.32	5.83	16.00	0	3.37
Cob Shape						
Tapered	#	45	13	6	0	6
	%	19.15	10.83	24.00	0	6.74
Straight	#	175	94	18	3	71
	%	74.47	78.33	72.00	100.00	79.78
Cigar	#	0	0	0	0	0
	%	0	0	0	0	0
Cross Section Shape						
Circular	#	133	67	13	2	50
	%	56.60	56.83	52.00	66.67	56.18
Quadrilateral						
	#	44	23	3	1	18
	%	18.72	19.17	12.00	33.33	20.22
Elliptical						
	#	58	30	9	0	21
	%	24.68	25.00	36.00	0	23.60

Table 9:3. Summary statistics for miscellaneous cob populations from the Black Warrior Valley.

		Black Warrior Valley Population	Moody Slough	MDVL Mound W Area	MDVL General
N =		235	41	45	5
Row Number					
Mean		9.68	9.12	8.98	10.40
8	#	87	22	25	1
	%	37.02	53.66	55.56	20.00
10	#	105	15	18	2
	%	44.68	36.59	40.00	40.00
12	#	35	4	2	2
	%	14.89	9.76	4.44	40.00
14	#	5	0	0	0
	%	2.13	0	0	0
16	#	2	0	0	0
	%	0.85	0	0	0
Cupule Width $\bar{x}$		6.47	7.07	6.97	5.90
Cupule Height $\bar{x}$		2.86	1.82	3.32	3.14
Glume Width $\bar{x}$		3.87	4.03	4.07	3.60
Maximum Diameter $\bar{x}$		10.49	11.04	10.67	10.10
Condensation Index $\bar{x}$		3.59	5.22	2.74	3.34

Table 9:3. Summary statistics for miscellaneous cob populations from the Black Warrior Valley (continued).

		Black Warrior Valley Population	Moody Slough	MDVL Mound W Area	MDVL General
N =		235	41	45	5
Row Pairing					
Weak	#	84	13	5	2
	%	35.74	31.71	11.11	40.00
Moderate	#	114	14	24	3
	%	48.51	34.15	53.33	60.00
Strong	#	36	14	15	0
	%	15.32	34.15	33.33	0
Cob Shape					
Tapered	#	45	14	10	1
	%	19.15	34.15	22.22	20.00
Straight	#	175	27	35	4
	%	74.47	65.85	77.78	80.00
Cigar	#	0	0	0	0
	%	0	0	0	0
Cross Section Shape					
Circular	#	133	28	19	2
	%	56.60	68.29	42.22	40.00
Quadrilateral					
	#	44	6	14	1
	%	18.72	14.63	31.11	20.00
Elliptical					
	#	58	7	12	2
	%	24.68	17.07	26.67	40.00

from which cobs were recovered was the daub layer itself. Since Feature 43 originated in this level, it is entirely possible that the cobs belong with the feature.

The number of Moundville I cobs is not large (24), but within this small batch there are some intriguing differences between the attributes for the cobs from the two pits (see Table 9:1). Comparison of the statistics for the two features suggests that there may be more than one type of maize present. The cobs in Feature 43 have both larger cupules and more rows than the cobs in Feature 161. It is tempting to speculate that the cobs in the former are specimens of Midwestern Twelve Row, while the cobs in the latter are specimens of Eastern Eight Row.

The Moundville II/III cob population includes cobs from Moundville and from the White site (Table 9:2). Twenty-five cobs from a Moundville III cob pit and two isolated cobs from Moundville II/III fill deposits were recovered from the upper levels of the NR deposit. The excavations at the White site produced cobs from two pits (89 from one pit and 3 from the other) as well as a single cob from a general midden level. The statistics for the three stray Moundville II/III cobs do not appear in the break-down by feature, but these cobs are included in the summary statistics for the phase. The attributes of the Moundville II/III cobs from Moundville and from the White site are quite similar (Table 9:2). Based on mean row number, these cobs would be considered Eastern Eight Row maize.

Summary statistics for the Alabama River phase cobs from Moody Slough are given in Table 9:3. These cobs have lower row numbers and

wider cupules than most other cobs from the Black Warrior Valley. The average cupule height is, however, smaller than for the other cob samples. Again based on row number, this collection seems to be dominated by Eastern Eight Row maize.

Besides the cobs that can be assigned to temporal contexts, there are 50 cobs recovered during the Depression-era excavations at Moundville. Most of these were found Northwest of Mound W (39) or in Mound W (6). The Mound W area is known to have a Moundville I/II component. A uncorrected radiocarbon determination circa A.D. 1260 on material from Mound W (Walthall and Wimberly 1978:121) places the deposit at the boundary between the two phases, but late burials have also been recovered from the area (Steponaitis 1983a:157). There is no way to determine whether the cobs from the area are associated with the earlier or later Moundville component. Five other cobs were recovered from scattered locations at Moundville.

Statistics for the cobs from the Depression-era excavations are also presented in Table 9:3. As a group these cobs have generally low row numbers and large cupules. In this respect they are similar to the Alabama River phase cobs. Cupule height is, however, different for the two samples.

The quantitative analysis is designed to provide information about production strategies by investigating variability in the maize population. For these purposes, I use two approaches. Following the work of Caddell (1983:262) on the Lubbub cobs, I use diversity indices to measure variation over time in the cob population from the Black Warrior Valley. I use a K-means cluster analysis to investigate

whether cobs pattern in ways that are not obvious when summary statistics for individual attributes are examined. This latter approach, I use as a tool to search for the presence of multiple maize cultivars.

Diversity Indices

The diversity index, H, is a measure of variability or lack of predictability in a frequency distribution (Pielou 1966; Shannon and Weaver 1949:14). The index is calculated as follows:

$$H = - \mathrm{Sum}(p_i \ln p_i)$$

where p is the frequency, expressed as a decimal, of observations in each cell. If all observations fall in a single cell, then there is no unpredictability and H = 0. The maximum value for H occurs when observations are equally distributed among the cells.

Caddell (1983:262) calculated diversity indices for the cob collections from different temporal contexts at the Lubbub Creek Archaeological Locality. She used the indices to monitor variation over time in the frequency of cobs with differing row numbers. To do this she divided her cob sample by phase, and used the frequency of cobs having 8, 10, 12, 14 and 16 rows to calculate H. Her results, reproduced in Table 9:4, indicate a steady decrease through time in the diversity of the cob population. Overall, there was a 50% reduction in diversity, as measured by row numbers, between Late Woodland and Protohistoric contexts.

I use the same procedures here to measure temporal variety in the cob population from the Black Warrior Valley. Diversity indices for

Table 9:4. Comparison of diversity indices for Lubbub and Black Warrior Valley cob populations.

Locality	Phase	Diversity Index (H)
Maximum Possible Diversity		1.609
Lubbub Creek Archaeological Locality *		
	Miller III	1.359
	Summerville I-II	1.104
	Summerville II-III	1.062
	Summerville IV	0.673
Black Warrior Valley		
	Moundville I	1.457
	Moundville II-III	1.072
	Alabama River	0.929

* Diversity indices for cobs from Lubbub Creek Archaeological Locality were calculated by Caddell 1983:362.

the cobs from Moundville I, Moundville II/III, and Alabama River phase contexts are presented in Table 9:4. As with the Lubbub data, these indices are calculated using frequencies of cobs having different row numbers.

The indices for the Black Warrior Valley show a pattern similar to the indices for the cobs from the Tombigbee Valley. There is a decrease in variety through time, although the reduction in diversity is not as great as that found in the Lubbub collection. It must be remembered, however, that there are no cobs from the Late Woodland period in the Black Warrior collections.

The reduction through time in the diversity of the maize populations from the Black Warrior and Tombigbee Valleys could be a result of seed selection and field maintenance practices designed to produce high crop yields. Maize raised for high productivity is carefully selected and tended. This results in ears, and by extension cobs, that show little variability in phenotypic expression (Ford 1979a:237). Such decreasing diversity does not necessarily mean that there is selection for a single type of maize. To the contrary, careful cropping strategies applied to two or more types of maize would still reduce the overall variability in the maize population. Diversity could also be reduced by changing the proportions in which several types of maize were planted.

The descriptive statistics and diversity indices measure the behavior of individual cob attributes. These summary measures provide

important information, but they do not tell the whole story. To understand variability in the cob population, it is also necessary to examine relationships between attributes.

K-Means Cluster Analysis

As noted earlier, maize cultivars are distinguished by constellations of traits, which include morphological characteristics. For this analysis, I assume that if several types of maize are present in the archaeological collections, cobs from one type will be more similar to one another than to specimens of another type. In other words, cob shape, row number, row configuration, cupule size, cupule shape, etc. vary less within a cultivar than between cultivars. This being the case, multivariate analysis can be used to detect constellations of attributes that may represent maize cultivars.

I used a K-means cluster analysis to search for evidence of multiple maize cultivars in the cob populations from the Black Warrior and Tombigbee Valleys. To do this, I used the K-means program contained in the Cluster module of the microcomputer statistical package, SYSTAT (version 2.1). This K-means routine follows the algorithm described by Hartigan (1975:84-107); slight modifications derived from Hartigan and Wong (1979) are incorporated to improve speed (Wilkinson 1986:Cluster 15).

K-means analyses are non-hierarchical, iterative, partitioning techniques for identifying clusters of data points (Aldenderfer and Blashfield 1984:45-49). K-means algorithms vary in the procedures by which clusters are created, but they share several salient features.

In most K-means routines, the number of clusters created is specified by the analyst on the basis of a priori or experimental criteria. Making repeated passes through the data, K-means routines attempt to assign data points (e.g., in this case cobs) to clusters so that the variance within clusters is minimized while the variance between clusters is maximized. That is, using Euclidean distances, the sum squared error within clusters is minimized and, by extension, the sum squared error between clusters is maximized (Kintigh and Ammerman 1982:39).

Regardless of the underlying data structure, K-means procedures produce the prescribed number of clusters. Thus, the production of clusters is not evidence that clusters exist in the sample population. Nor are significance tests comparing attribute means for different clusters appropriate tools for validating the cluster solutions. Because by design the cluster routines maximize between cluster variance, significance tests will always be positive (Aldenderfer and Blashfield 1984:64-65).

This does not imply that cluster solutions cannot be evaluated. The internal consistency of the solutions can be evaluated by replication of the solution across a series of data subsets (Aldenderfer and Blashfield 1984:65). The validity of the solution can be assessed using external criteria. That is, if variables not included in the cluster analysis show distributions that pattern along the clusters, and if the cluster results are interpretable then there is a strong possibility that the structure identified is real (Aldenderfer and Blashfield 1984:66).

Four attributes coded for the cob population were included in the cluster analysis. These attributes, row number, cupule height, cupule width, and maximum cob diameter, were selected for two primary reasons. First, observations on the four attributes were made for all cobs in the data base. Second, observations on these numerical variables are less apt to be affected by analyst bias then observations on the categorical shape attributes. Because K-means procedures use Euclidean distances, the measurements for each variable were converted to standard scores to avoid problems caused by differences in measurement scales (Aldenderfer and Blashfield 1984:21).

Replication of results is one way to check the internal consistency of a cluster solution. For this reason, I divided the 438 cobs in the data base into two groups, and ran all cluster analyses for both subsets. To try to insure that the full range of variability in the cob population was represented in both subsets, I split the cob sample by assigning every even numbered case to one subset and every odd numbered case to the other. That is, the first cob in the data base went to the odd file, the second cob to the even file, and so on. Because the Black Warrior Valley is of central interest to my research, I ran a third cluster series on a data base that included all cobs from the Black Warrior Valley and omitted all Lubbub cobs.

There were no a priori reasons to predict the number of clusters, if any, that would produce the optimal solution for the cob population. It seemed likely, however, that the number would be small. Thus, for each subset, solutions were generated for three,

four, and five clusters. Evaluation of the solutions with external criteria suggests that the four-cluster solution is the most satisfactory. The reasons for this will be presented after the four-cluster solution has been discussed.

Attribute descriptions for the four-cluster solutions for the odd, even, and Black Warrior Valley cob samples are presented in Tables 9:5 through 9:8. Table 9:5 presents means and standard deviations by subset and cluster for the four attributes used in the cluster routine. Tables 9:6 through 9:8 present by subset descriptions of the cobs assigned to each cluster. In these latter tables, summary statistics are given for the total cob population, the subset used for the clustering, and for the clusters. The cluster columns are arranged so that Cluster 1 in Table 9:5 is equivalent to Cluster 1 in Tables 9:6-9:8, Cluster 2 is equivalent to Cluster 2, etc. It should be noted that sometimes percentages do not sum to 100, though they should not exceed 100. For example, in Table 9:7 a single 6-row cob tip assigned to Cluster 3 is not tabulated in the break down by row number, thus the percentages sum to 98.95%. Because cases with missing observations are not shown in the tables but were included when frequencies were calculated, percentages listed for the shape attributes do not always equal 100.

Comparison of the attribute descriptions for the clusters from the three subsets indicates a high degree of replication in the solutions. When we compare the attribute means for each cluster in the odd sample to those for the equivalent clusters in the even sample (Table 9:5), we can see that there is a very close correspondence

Table 9:5. Summary statistics by subset and cluster for attributes included in K-means analysis.

Attribute	Subset	Cluster 1	Cluster 2	Cluster 3	Cluster 4
		mean (s.d.)	mean (s.d.)	mean (s.d.)	mean (s.d.)
Row Number	Odd	12.63 (1.06)	9.36 (1.18)	9.12 (1.00)	9.06 (1.24)
	Even	12.41 (1.14)	9.42 (1.30)	9.12 (1.04)	8.74 (0.99)
	BWV	12.51 (1.12)	9.46 (1.27)	9.05 (1.00)	8.97 (1.12)
Maximum Diameter	Odd	11.57 (1.86)	7.60 (1.24)	10.52 (1.49)	12.56 (2.87)
	Even	12.30 (1.85)	7.35 (1.47)	10.61 (1.65)	11.16 (2.13)
	BWV	12.08 (1.84)	8.24 (1.29)	10.97 (1.40)	12.00 (2.43)
Cupule Height	Odd	3.19 (0.42)	2.82 (0.41)	3.22 (0.40)	1.77 (0.49)
	Even	3.30 (0.38)	2.74 (0.39)	3.25 (0.31)	1.94 (0.44)
	BWV	3.13 (0.38)	2.70 (0.47)	3.26 (0.34)	1.85 (0.44)
Cupule Width	Odd	5.84 (0.79)	5.00 (0.86)	6.94 (0.83)	7.56 (1.51)
	Even	5.91 (0.89)	4.78 (0.79)	6.79 (0.81)	7.33 (0.90)
	BWV	6.10 (0.74)	5.30 (0.88)	7.09 (0.73)	7.49 (1.22)

Table 9:6. Summary statistics for cluster analysis of odd numbered cob sample.

		Population	Sample	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	219	35	81	86	17
Row Number							
Mean		9.76	9.76	12.63	9.36	9.12	9.06
8	#	156	78	0	31	38	9
	%	35.62	35.62	0	38.27	44.19	52.94
10	#	194	100	0	45	48	7
	%	44.29	45.66	0	55.56	55.81	41.18
12	#	72	31	25	5	0	1
	%	16.44	14.16	71.43	6.17	0	5.88
14	#	11	9	9	0	0	0
	%	2.51	4.11	25.71	0	0	0
16	#	4	1	1	0	0	0
	%	0.91	0.46	2.86	0	0	0
Cupule Width $\bar{x}$		6.08	6.09	5.84	5.00	6.94	7.56
Cupule Height $\bar{x}$		2.98	2.96	3.19	2.82	3.22	1.77
Glume Width $\bar{x}$		3.66	3.62	3.51	3.18	3.95	4.27
Maximum Diameter $\bar{x}$		9.88	9.77	11.57	7.60	10.52	12.56
Condensation Index $\bar{x}$		3.41	3.44	4.03	3.40	2.86	5.37

Table 9:6. Summary statistics for cluster analysis of odd numbered cob sample (continued).

		Population	Sample	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	219	35	81	86	17
Row Pairing							
Weak	#	151	68	22	26	16	4
	%	34.47	31.05	62.86	32.10	18.60	23.53
Moderate	#	220	117	12	47	52	6
	%	50.23	53.42	34.29	58.02	60.47	35.29
Strong	#	62	29	1	4	17	7
	%	14.16	13.24	2.86	4.94	19.77	41.18
Cob Shape							
Tapered	#	189	90	16	43	24	7
	%	43.15	41.10	45.71	53.09	27.91	41.18
Straight	#	217	116	19	28	59	10
	%	49.54	52.97	54.29	34.57	68.80	58.82
Cigar	#	8	2	0	2	0	0
	%	1.83	0.91	0	2.47	0	0
Cross Section Shape							
Circular	#	245	127	27	48	42	10
	%	55.94	57.99	77.14	59.26	48.84	58.82
Quadrilateral							
	#	96	51	0	20	29	2
	%	21.92	23.29	0	24.69	33.72	11.76
Elliptical							
	#	95	40	8	12	15	5
	%	21.69	18.26	22.86	14.81	17.44	29.41

Table 9:7. Summary statistics for cluster analysis of even numbered cob sample.

		Population	Sample	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	219	39	66	95	19
Row Number							
Mean		9.76	9.76	12.41	9.42	9.12	8.74
8	#	156	78	0	26	40	12
	%	35.62	35.62	0	39.39	42.11	63.16
10	#	194	94	0	33	54	7
	%	44.29	42.92	0	50.00	56.84	36.84
12	#	72	41	34	7	0	0
	%	16.44	18.72	87.18	10.61	0	0
14	#	11	2	2	0	0	0
	%	2.51	0.91	5.13	0	0	0
16	#	4	3	3	0	0	0
	%	0.91	1.37	7.69	0	0	0
Cupule Width $\bar{x}$		6.08	6.07	5.91	4.78	6.79	7.33
Cupule Height $\bar{x}$		2.98	2.99	3.30	2.74	3.25	1.94
Glume Width $\bar{x}$		3.66	3.70	3.43	3.11	4.01	4.25
Maximum Diameter $\bar{x}$		9.88	9.99	12.30	7.35	10.61	11.16
Condensation Index $\bar{x}$		3.41	3.38	3.81	3.53	2.83	4.75

Table 9:7. Summary statistics for cluster analysis of even numbered cob sample (continued).

		Population	Sample	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	219	39	66	95	19
Row Pairing							
Weak	#	151	83	19	35	25	4
	%	34.47	37.90	48.72	53.03	26.32	21.05
Moderate	#	220	103	18	25	51	9
	%	50.23	47.03	46.15	37.88	53.68	47.37
Strong	#	62	33	2	6	19	6
	%	14.16	15.07	5.13	9.09	20.00	31.58
Cob Shape							
Tapered	#	189	99	19	33	41	6
	%	43.15	45.21	48.72	50.00	43.16	31.58
Straight	#	217	101	19	23	47	12
	%	49.54	46.12	48.72	34.85	49.47	63.16
Cigar	#	8	6	1	2	3	0
	%	1.83	2.74	2.56	3.03	3.16	0
Cross Section Shape							
Circular	#	245	118	19	42	47	10
	%	55.94	53.88	48.72	63.64	49.47	52.63
Quadrilateral							
	#	96	45	0	16	25	4
	%	21.92	20.55	0	24.24	26.32	21.05
Elliptical							
	#	95	55	20	7	23	5
	%	21.69	25.11	51.28	10.61	24.21	26.32

Table 9:8. Summary statistics for cluster analysis of Black Warrior Valley cob sample.

		Population	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		235	35	70	95	35
Row Number						
Mean		9.68	12.51	9.46	9.05	8.97
8	#	87	0	23	45	19
	%	37.02	0	32.86	47.37	54.29
10	#	105	0	40	50	15
	%	44.68	0	57.14	52.63	42.86
12	#	35	28	6	0	1
	%	14.89	80.00	8.57	0	2.86
14	#	5	5	0	0	0
	%	2.13	14.29	0	0	0
16	#	2	2	0	0	0
	%	0.85	5.71	0	0	0
Cupule Width $\bar{x}$		6.47	6.10	5.30	7.09	7.49
Cupule Height $\bar{x}$		2.86	3.13	2.70	3.26	1.85
Glume Width $\bar{x}$		3.87	3.41	3.17	4.02	4.27
Maximum Diameter $\bar{x}$		10.49	12.08	8.24	10.97	12.00
Condensation Index $\bar{x}$		3.59	4.10	3.65	2.81	5.11

Table 9:8. Summary statistics for cluster analysis of Black Warrior Valley cob sample (continued).

		Population	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		235	35	70	95	35
Row Pairing						
Weak	#	84	24	35	19	6
	%	35.74	68.57	50.00	20.00	17.14
Moderate	#	114	11	31	56	16
	%	48.51	31.43	44.29	58.95	45.71
Strong	#	36	0	4	19	13
	%	15.32	0	5.71	20.00	37.14
Cob Shape						
Tapered	#	45	6	15	12	12
	%	19.15	17.14	21.43	12.63	34.29
Straight	#	175	29	45	78	23
	%	74.47	82.86	64.29	82.11	65.71
Cigar	#	0	0	0	0	0
	%	0	0	0	0	0
Cross Section Shape						
Circular	#	133	22	46	45	20
	%	56.60	62.86	65.71	47.37	57.14
Quadrilateral						
	#	44	0	9	29	6
	%	18.72	0	12.86	30.53	17.14
Elliptical						
	#	58	13	15	21	9
	%	24.68	37.14	21.43	22.11	25.71

between the clusters generated from the two subsets. The cob population was divided so that these subsets did not overlap (i.e., any given cob occurred in one or the other, but not both samples). Thus, the replication of the clusters indicates an internally consistent solution. The solution for the Black Warrior Valley (Table 9:5) also shows a close correspondence to the other two solutions. This cannot be taken as independent replication, however, because the Black Warrior Valley sample contained cobs used in the other runs.

In each solution, Cluster 1 segregates cobs with high row numbers. The cluster contains all 14- and 16-row cobs, and most 12-row cobs. Probably due to their high row numbers, cobs in this cluster have large diameters. Compared to cobs in the three other clusters, cobs in Cluster 1 have only moderate cupule widths, but large cupule heights. Using Cutler and Blake's (1976:5-6) classification system, Cluster 1 would be considered a collection of Midwestern Twelve Row cobs. It must be emphasized, however, that the description is tentative.

Based on their attribute descriptions, Clusters 2, 3, and 4 are similar in many respects. The clusters are differentiated from one another by decreasing mean row numbers, increasing cupule widths, and increasing cob diameters. Cupule height does not pattern clearly by cluster; height increases from Cluster 2 to Cluster 3 then decreases sharply in Cluster 4. All three clusters have mean row numbers less than ten and fit within descriptions of Eastern Eight Row maize.

Evaluation of the Four-Cluster Solution

I noted earlier that the validity of cluster solutions can be evaluated by patterning of variables not included in the initial analysis and by the interpretability of the results. In the following pages, I evaluate the four-cluster solution for the cob population. First, I examine the distribution of cob attributes not included in the cluster analysis. Next, I use information about the archaeological contexts of the cobs comprising the clusters to determine whether cobs from different temporal or spatial contexts sort by cluster.

Besides the four cob attributes used in the cluster analysis, nine other attributes were coded. Three of these (strength of row pairing, cob shape, and cross section shape) are useful for evaluating the cluster solutions. The other six are either products of preservation rather than morphological cob traits (e.g., cob fragment length), or redundant with attributes used in the cluster analysis (e.g., glume width and cupule width are both measures of kernel width).

The four-cluster solutions for the odd and even subsets replicate one another. Thus, it is possible to recombine the samples and using the total population describe the cob attributes for each cluster (Table 9:9). The composite descriptions simplify the task of evaluating the cluster solution by eliminating the need to refer to several tables to determine whether external attributes pattern with the clusters.

Table 9:9. Summary statistics for cluster attributes of recombined total cob population.

		Population	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	74	147	181	36
Row Number						
Mean		9.76	12.51	9.38	9.12	8.89
8	#	156	0	57	78	21
	%	35.62	0	38.78	43.09	58.33
10	#	194	0	78	102	14
	%	44.29	0	53.06	56.35	38.89
12	#	72	59	12	0	1
	%	16.44	79.73	8.16	0	2.78
14	#	11	11	0	0	0
	%	2.51	14.86	0	0	0
16	#	4	4	0	0	0
	%	0.91	5.41	0	0	0
Cupule Width $\bar{x}$		6.08	5.88	4.90	6.86	7.44
Cupule Height $\bar{x}$		2.98	3.24	2.78	3.23	1.86
Glume Width $\bar{x}$		3.66	3.47	3.15	3.98	4.26
Maximum Diameter $\bar{x}$		9.88	11.95	7.49	11.04	11.82
Condensation Index $\bar{x}$		3.41	3.91	3.46	2.84	5.04

Table 9:9. Summary statistics for cluster attributes of recombined total cob population (continued).

		Population	Cluster 1	Cluster 2	Cluster 3	Cluster 4
N =		438	74	147	181	36
Row Pairing						
Weak	#	151	41	61	41	8
	%	34.47	55.41	41.50	22.65	22.22
Moderate	#	220	30	72	103	15
	%	50.23	40.54	48.98	56.91	41.67
Strong	#	62	3	10	36	13
	%	14.16	4.05	6.80	19.89	36.11
Cob Shape						
Tapered	#	189	35	76	66	13
	%	43.15	47.30	51.70	36.46	36.11
Straight	#	217	38	51	106	22
	%	49.54	51.35	34.69	58.56	61.11
Cigar	#	8	1	4	3	0
	%	1.83	1.35	2.72	1.66	0
Cross Section Shape						
Circular	#	245	46	90	89	20
	%	55.94	62.16	61.22	49.17	55.56
Quadrilateral						
	#	96	0	36	54	6
	%	21.92	0	24.49	29.83	16.67
Elliptical						
	#	95	28	19	38	10
	%	21.69	37.84	12.93	20.99	27.78

Strength of row pairing seems to pattern with the clusters, though the fit is not perfect. The majority of the cobs in Cluster 1 have weakly paired rows. Most other cobs in Cluster 1 have moderate row pairing; strongly paired rows are scarce. Between Clusters 2, 3, and 4, row pairing seems to increase in strength. In all three clusters, the majority of the cobs have moderate row pairing. But a trend can be seen if the frequencies of cobs in each category are examined. Cobs with weak row pairing decrease in frequency from Cluster 2 through 4; the largest change being between Cluster 2 and 3. Cobs with moderate row pairing peak in frequency in Cluster 3 and then decline. Cobs with strong row pairing show a steady increase in frequency from Cluster 2 through Cluster 4.

Cob shape also seems to pattern by cluster, but not as clearly as row pairing. Cigar-shaped cobs are scarce in the collection; the few that were found are scattered among the clusters. Tapered and straight cobs are roughly evenly represented in Cluster 1. Cluster 2 has more tapered cobs than straight. Cluster 3 and 4 have similar frequencies of tapered and straight cobs, with straight cobs predominating.

Cross section shape patterns only partially by cluster. There are no quadrilateral cobs in Cluster 1. Clusters 2 through 4 all have both circular and quadrilateral cobs; in each case circular cobs are more frequent than quadrilateral ones. The proportion of quadrilateral cobs increases between Clusters 2 and 3, but then drops sharply for Cluster 4. Because elliptical cross sections are often

the result of post-depositional distortion rather than actual cob morphology, this category need not be examined.

By themselves, the distributions of the shape attributes provide ambiguous support for the validity of the four-cluster solution. It should be noted, however, that observations on these variables are subjective. In fact, at least some of the muddy distribution of these variables seems to result from observer bias. Explaining the influence of analyst bias must be deferred, however, until after the contextual relationships between the cobs in each cluster have been examined.

To evaluate the four-cluster solution, I use two contextual variables. I examine the distribution by cluster of cobs from each phase to determine whether the clusters separate cobs by chronological position. Similarly, I examine the distribution by cluster of cobs from different sites and features to determine whether the clusters separate cobs from different spatial contexts. If the cobs from different temporal or spatial contexts pattern by cluster, then I would argue that the solution has identified real structure in the cob population.

The cluster distributions of the cobs from each phase are presented for the Black Warrior Valley and Tombigbee Valley cob populations in Tables 9:10 and 9:11. The frequencies presented in these tables are calculated across the rows. In other words, the frequencies are the proportions of a phase's cob population that occur in each cluster.

Table 9:10. Distribution of Black Warrior Valley cobs by phase and cluster.

Phase	Total	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Moundville I	24	8 33.33	15 62.50	1 4.17	0 0
Moundville II/III	120	22 18.33	39 32.50	55 45.83	4 3.33
Alabama River	41	1 2.44	8 19.51	1 2.44	31 75.61
Moundville (misc.)	50	4 8.00	5 10.00	41 82.00	0 0

Table 9:11. Distribution of Lubbub cobs by phase and cluster.

Phase	Total	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Miller III	31	12 38.71	6 19.35	13 41.94	0 0
Summerville I	19	3 15.79	12 63.16	4 21.05	0 0
Summerville II/III	15	4 26.67	3 20.00	8 53.33	0 0
Summerville IV	4	0 0	1 25.00	3 75.00	0 0
Mississippian	130	20 15.38	69 53.08	41 31.54	0 0
Mixed (Lubbub)	4	0 0	3 75.00	1 25.00	0 0

Cobs from different time periods seem to pattern partially by cluster. For each phase, a minority of cobs are assigned to Cluster 1, the high-row cluster. Proportions of cobs assigned to Clusters 2, 3, and 4, however, appear to vary by phase. The majority of Moundville I and Summerville I cobs occur in Cluster 2. The majority of Moundville II/III, Summerville II/III, and Summerville IV cobs are assigned to Cluster 3. Finally, the majority of Alabama River phase cobs occur in Cluster 4. Indeed, Cluster 4 seems to segregate the Alabama River phase cobs, and a few miscellaneous cobs from Moundville II/III contexts, from the rest of the cob population. There are no Lubbub cobs in Cluster 4. The cob population from the Miller III phase, which Caddell (1983:262) has described as highly variable, does not seem to fit the observed patterns. Except for the Miller III cobs, Clusters 2 through 4 seem to sort cobs by chronological position.

The cluster distributions of cobs by feature are presented in Tables 9:12 and 9:13. Only contexts from which two or more cobs were recovered are included in the tables. Again, the frequencies are calculated across the rows. Because there is such a clear association between Cluster 4 and the Alabama River phase, the feature distributions of cobs from this phase are not shown.

The cobs from Moundville I contexts show an amazingly clear distribution pattern (Table 9:12). There is a complete separation by context of cobs assigned to Clusters 1 and 2. In other words, the cobs assigned to Cluster 1 were found in one pit, and in the level at which that pit was encountered. The cobs assigned to Cluster 2 were

Table 9:12. Distribution of cobs by provenience and cluster for Moundville I and Moundville II/III contexts.

Provenience	Total	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Moundville I contexts					
MDVL-NR Feat. 43	5	5	0	0	0
		100.00	0	0	0
MDVL-NR 6N2W L 9	3	3	0	0	0
		100.00	0	0	0
MDVL-NR Feat. 161	16	0	15	1	0
		0	93.75	6.25	0
Moundville II/III contexts					
MDVL-NR Feat. 3	25	2	6	17	0
		8.00	24.00	68.00	0
White Feat. 22	89	20	29	37	3
		22.47	32.58	41.57	3.37
White Feat. 56	3	0	2	1	0
		0	66.67	33.33	0

Table 9:13. Distribution of cobs by provenience, phase, and cluster for the Lubbub Creek Archaeological Locality.

Provenience	Total	Cluster 1	Cluster 2	Cluster 3
Miller III contexts				
8587	5	0 0	2 40.00	3 60.00
8912	25	12 48.00	4 16.00	9 36.00
Summerville I contexts				
3958	15	2 13.33	11 73.33	2 13.33
Summerville II/III contexts				
6189	8	3 37.50	1 12.50	4 50.00
9334	2	0 0	0 0	2 100.00
Summerville IV contexts				
4788	3	0 0	0 0	3 100.00
Undifferentiated Mississippian contexts				
1443	8	2 25.00	6 75.00	0 0
2399	5	0 0	5 100.00	0 0
2714	8	1 12.50	7 87.50	0 0
4118	16	2 12.50	9 56.25	5 31.25
6165	8	0 0	3 37.50	5 62.50
9011	9	5 55.56	1 11.11	3 33.33

found in a separate, stratigraphically earlier, pit. The only cob assigned to Cluster 3 was found in the pit containing the Cluster 2 cobs.

The cobs from Moundville II/III contexts do not sort as cleanly by feature as the Moundville I cobs (Table 9:12). Cobs assigned to Cluster 1, the high-row group, were found mixed with cobs from the other clusters. Feature 3 from Moundville seems to contain a cob collection that sorts primarily to Cluster 3. The features from the White site, however, do not exhibit a clear dominance of Cluster 2 or 3 cobs. This may be a result of differences in the chronological positions of the features from Moundville and the White site. The sample from Feature 3 at Moundville almost certainly dates to the Moundville III phase. A radiocarbon determination of 650±50 (circa A.D. 1335) on materials from Feature 56 at 1Ha8 suggests a temporal placement in late Moundville II or in Moundville III for the feature (Welch 1986). Thus it may be earlier than Feature 3 from Moundville. There is no date for Feature 22, but it is likely that this feature also dates to late Moundville II or Moundville III (P. Welch, personal communication 1986). While the majority of the cobs from the White site features occur in Cluster 3, a fair number of cobs are also assigned to Clusters 1 and 2. If Clusters 2 through 4 represent a temporal cline in a maize cultivar, the distribution of cobs from these features might result from their intermediate chronological position.

Distributions by phase, context, and cluster are tabulated for the Lubbub cob population in Table 9:13. Several Lubbub contexts seem

to have cobs that sort by cluster. All cobs from samples 9334 from the Summerville II/III phase and 4788 from the Summerville IV phase are assigned to Cluster 3. The number of cobs from these contexts (2 and 3 respectively) is too low, however, to make convincing arguments on the basis of these samples alone. Sample 3958 from the Summerville I phase, and samples 1443, 2389, and 2714 from undifferentiated Mississippian contexts, all have more than 70% of their cobs assigned to Cluster 2. These instances may indicate segregation by cluster of cobs from different contexts, but the case is not as clear as for the Moundville I distributions presented above.

I have described the cluster analysis and evaluated the four-cluster solution using both cob attributes that were not included in the cluster program and contextual variables. During the presentation, I deferred two issues for discussion after the solution had been evaluated with contextual variables. Before we consider the implications of the cob analysis for understanding crop production strategies, these issues must be addressed.

Besides the four-cluster solution presented above, I also generated K-means cluster solutions that produced three and five clusters. These solutions were similar to the four-cluster solution in that both segregated a high-row group from the remainder of the population. The three-cluster solution then divided the Eastern Eight Row type into two clusters that did not pattern in either time or space. Compared to the four-cluster solution, the three-cluster solution was "muddy". The five-cluster solution produced groups comparable to Clusters 1 through 3 of the four-cluster solution, but

split the Alabama River phase cobs into two clusters. This did not contribute much to an understanding of structure in the cob population. In sum, the structure revealed by the four-cluster solution could be more easily interpreted using contextual variables, than the structures produced by the three- and five-cluster solutions. Thus, I deemed the four-cluster solution most satisfactory.

When the distribution of cob attributes not included in the K-means analysis was examined, ambiguous patterning by cluster was found. Strength of row pairing increased between Clusters 2 through 4, but the distributions of cob shape and cross section shape were muddy. I suggested that this was at least partially due to observer bias. Now that the I have described the archaeological contexts of the cobs comprising the clusters, it is possible to identify two probable instances of observer bias.

Cluster 4 contains the Alabama River phase cobs measured by Lentz, whereas Clusters 1 through 3 contain cobs measured by Caddell and me. When the frequencies by cluster of tapered and straight cobs in the Black Warrior population (Table 9:8) are compared to cob shape frequencies by cluster in the total population (Table 9:9), it can be seen that the frequencies of tapered cobs in Clusters 1 through 3 are lower for the Black Warrior population than for the population as a whole. It seems likely that this results from differences in how Caddell and I perceived and coded cob shape.

The second instance of observer bias seems to affect the cluster distributions of cross section shape. As the number of 8-row cobs in a population increases (indicated by low mean row number), the

frequency of quadrilateral cobs and the frequency of strongly paired rows can be expected to increase. Between Clusters 2 through 4, strength of row pairing behaves as expected, but cross section shape does not. Instead, the frequency of quadrilateral cobs increases from Cluster 2 to Cluster 3, then drops sharply in Cluster 4. Since the cobs in Cluster 4 were measured by Lentz, the unexpected cross section shape distribution may be because Lentz differed from Caddell and me in his perception of cross section shape.

Discussion

Despite the possible effects of observer bias, the four-cluster solution seems to segregate the cobs into groups that make sense when considered in the light of the archaeological contexts of the samples. The temporal dimension of the clusters is most evident. There appears to be a minority maize type, Cluster 1, that persists throughout the period covered by the samples. It can be suggested that cobs from this cluster are drawn from a maize cultivar similar to the Midwestern Twelve Row race described by Cutler and Blake (1976:5-6). Clusters 2 through 4 seem to contain cobs from a second type of maize that changes through time. This latter cultivar is similar to the Eastern Eight Row race that was common over much of the eastern United States in the late prehistoric period (Cutler and Blake 1976:6). Indeed, the changes that seem to occur within this type (i.e., decreasing mean row number, increasing diameter, and increasing cupule width) parallel changes observed in other populations of Eastern Eight Row maize (e.g., Cutler and Blake 1973:134).

Though the high-row cultivar sorts as one cluster, there is some evidence that this type also changes over time. The only 14- and 16-row cobs from Lubbub occur in Miller III contexts. The remainder of the Lubbub cobs that sort to Cluster 1 have 12 rows. There is a similar pattern in the cob population from the Black Warrior Valley. All Moundville I cobs assigned to Cluster 1 have 14 or 16 rows. In contrast, 27 of the 28 Cluster 1 cobs from later contexts in the valley have 12 rows. This reduction in row number may indicate change due to selection. There is an alternative explanation that must be considered, however. It is possible that the reduction in row number is a result of the high-row cultivar hybridizing with the Eastern Eight Row type. Depending on whether the races were planted in separate fields, this could have two results. If the cultivars were grown where they could cross-pollinate, the high-row type might be gradually absorbed into the other population. If the cultivars were grown in well separated fields, deliberate or occasional unintentional cross pollination might produce new variants.

Except for the Moundville I and Alabama River phase samples, the cluster solution does not cleanly separate cobs by site or feature context. This is not particularly surprising. Most cobs are preserved because they have been used as fuel. Cobs burned at the time grain was processed might be from a single cultivar. But, once the maize was shelled there would be no reason to keep cobs from different cultivars separate. If discarded cobs were set aside to meet later fuel needs, then mixed assemblages might well occur. Moreover, if Clusters 2 through 4 are divisions within a population

that was changing over time, clean separation by cluster of cobs from features in intermediate temporal positions would not be expected.

Combined with the diversity indices, the results of the cluster analysis can be used to make some inferences about crop production strategies in the Black Warrior and Tombigbee River Valleys. It must be emphasized, however, that the suggestions I present here are plausible, but by no means proven.

The diversity indices indicate that through time variability in the cob population decreased, while the cluster analysis suggests maintenance of two types of maize, at least one of which changed through time. At first glance these results might seem contradictory, but both effects could be produced by careful seed selection and diligent field maintenance. Within a cultivar, desirable characteristics can be encouraged and genetic variability can be reduced by saving ears that meet specific standards for seed. Also within a cultivar, phenotypic variability can be reduced by weeding and other field activities that decrease stress on the growing plants. At the same time, separate cultivars can be maintained by planting the seed for each type in well separated fields so that cross pollination is minimized. Such crop strategies are labor intensive and are generally practiced when maize is produced for high yields (Ford 1979a:327). The results of the analysis, therefore, suggest that during the Mississippian period in west central Alabama maize production was directed toward high productivity.

The results also provide some tenuous evidence about the implementation and continuation of these cropping strategies. The

high diversity in the Miller III cob population, and the lack of pattern to the distribution by cluster of the Late Woodland specimens suggest variability typical of maize raised for security (i.e., to supplement other resources) rather than for high yield. In contrast, the clear presence of two types of maize in the Moundville I samples, and the relatively clean sorting by cluster of Summerville I cobs suggest more careful seed selection and field maintenance. It is tempting to speculate that new, labor intensive cropping strategies were adopted as maize production increased during the transition from Late Woodland to Mississippian subsistence economies. That is, not only was more maize planted, but the care and attention given that maize increased.

Planting and maintaining more than one type of maize confers several advantages, though it may entail additional labor to prevent accidental hybridization. Maize cultivars vary in the length of time between sowing and harvesting. By staggering planting schedules of several cultivars, variability in food supplies and labor demands can be smoothed to some extent.

Maize cultivars also differ in their responses to environmental stress. For example, some types of maize are tolerant of temperature extremes, while others are tolerant of moisture extremes. In any given year, one cultivar is apt to yield better than another. It is seldom possible to forecast weather conditions for the entire growing season at the time seed is sown, however. Planting several types of maize with different stress parameters improves the chances of having a good yield, though a bumper crop may be forfeit by such a practice.

Risk of severe crop loss is also reduced by the need to plant cultivars in separate fields to prevent cross pollination. In a floodplain environment, soils in different fields will often vary in water retention capabilities. Moreover, within a region fields may be differently affected by localized weather patterns. Planting several dispersed fields with separate types of maize would improve the chances of getting some yield in poor crop years. In other words, regardless of the cultural reasons for maintaining separate types of maize, the result would be a wise strategy for reducing the chance of major crop losses.

CHAPTER X

CONCLUSIONS

As in much of the Southeast, the Late Woodland-Mississippian transition in the Black Warrior Valley is marked by profound changes in subsistence strategies and sociopolitical organizations. Though our knowledge of the Moundville chiefdom at its peak is extensive, our understanding of the emergence of this polity is based on a little evidence and a lot of conjecture. My research has taken the first steps toward improving our information about the transformation of the subsistence economy from reliance on foraging/gardening to dependence on agriculture. The analyses presented in this volume provide evidence about which plant procurement and production strategies were altered and the sequence in which these changes occurred. Nevertheless, we are still a long way from explaining why these changes occurred.

My goal when I began this study was to provide answers to basic questions about changes in plant procurement and production strategies. Despite the gaps in my data, I exceeded my initial expectations in providing answers to such questions. To a large extent, this is a testimony to the value of exploratory data analysis (EDA), which provides methods for coping with some of the problems encountered in quantitative analyses of archaeobotanical data. Naturally I have not fully answered the questions I posed, but I have

confidence that most changes I have described will be upheld when further data are examined. My interpretations of the observed patterns are often speculative, however. This is unavoidable; I am hampered both by the gaps in the plant data and by the paucity of other excavated data for the transitional period.

Summary: Changes in Plant Procurement and Production Strategies

The analyses presented in this work demonstrate that the move to increase crop production began during the West Jefferson phase. This is not unexpected, but such clear evidence is useful. More surprising are the indications that not only were West Jefferson communities above the Fall-Line as involved in horticulture as their contemporaries below the Fall-Line, but that the move toward greater reliance on maize occurred earlier in the upper drainage than on the floodplain proper.

By the time of the Moundville I occupations for which we have data , the new production strategies were in full swing. Maize remains dominate the Moundville I plant assemblage and the relative proportions of the different food by-products show remarkably little variability. Moreover, the cob analysis indicates that multiple maize cultivars were raised and that cropping strategies, including seed selection and field maintenance, were geared toward dependable yields.

The plant data suggest that crop production increased before the emergence of the Moundville chiefdom(s). The examination of climatic variability and maize requirements strongly suggests, however, that agricultural <u>risk</u> was not a selective pressure that contributed to the

development of hierarchical organization in the Black Warrior Valley. This is not to say that the switch to a subsistence economy based on crop production was unrelated to the changes in social relations. Rather, it simply means that for the Moundville system we must seek other connections between the two transformations.

Increased crop production was accompanied by changes in other plant procurement strategies. Our ability to monitor plant use is affected by differential preservation opportunities. Nevertheless, it does not appear that the West Jefferson and Moundville I populations exploited different sets of plant resources. There is one obvious exception; sometime in Moundville I, beans were added to the crops being raised. This occurred well after the new subsistence strategies were in place, however. While the sets of resources exploited during the West Jefferson and Moundville I phases do not seem to differ, the proportions in which some plants were used do vary through time.

Other than maize, nuts show the greatest temporal variability in use. During the West Jefferson phase, hickory nut procurement did not vary much, but acorn procurement increased. Between late West Jefferson and Moundville I, use of both types of nuts declined. The changes in the proportionate representation of hickory are far more dramatic than those for acorn. It is not certain, however, if the marked decrease in the abundance of hickory shell is because procurement of hickory nuts declined or whether during the Moundville era high-status households were provisioned with hickory oil.

In contrast to nuts, the use of other plant foods does not seem to have been affected much by the increases in maize production. Procurement of fleshy fruits varied little over time, though there are slight indications that use of fruit from taxa found in old fields increased as more land was cleared. Absolute levels of production or procurement of small grain and oil seeds also varied little over time. This suggests that when reliance on crops increased, the strategy employed was not simply to expand the amount of land cultivated. Rather, it appears that the crop mix was altered, with maize given precedence over smaller, less productive grains.

Synthesis: Other Evidence about Subsistence Strategies

Throughout this volume, I have used plant data to examine and discuss the transition from foraging/gardening to agriculture in the Black Warrior Valley. There are, of course, other potential sources of evidence about subsistence strategies. The most direct of these are faunal and human skeletal data. Unfortunately, there are few faunal data and no human skeletal data for the West Jefferson phase. Faunal data are also limited for the Moundville era. Michals (1980, 1981) has done a preliminary analysis of some of the bone recovered from the Moundville I deposits north of Mound R, and Welch (1986) has analyzed faunal remains from a Moundville III deposit. Human skeletal data are available for Moundville, but the studies that produced these data (Peebles and Schoeninger 1981; Powell 1985) of necessity treated the entire Moundville-era skeletal population as synchronic. Nevertheless, the Moundville-era faunal and skeletal data provide

support for some of my interpretations, as well as information that cannot be obtained from plant data.

The only faunal data we have for the West Jefferson phase come from two bell-shaped pits. Both pits are from sites located below the Fall-Line (1Tu44/45 and 1Ha39), and both pits also produced plant remains that are included in my analysis. Susan Scott (Welch 1987) identified the bones from these features, but the samples were too small for analytical purposes. All that can be said is that in both features a diverse set of fauna was present. Taxa identified include: shellfish, white-tailed deer, birds, fish, small and medium-sized mammals, and turtles (Welch 1987). Because of acidic soil conditions, bone was not preserved at the West Jefferson sites above the Fall-Line.

Faunal data are somewhat better for the Moundville I phase, but samples are still too small to support much interpretation. Lauren Michals (1980, 1981) analyzed bones from 19 Moundville I features from the deposit north of Mound R. Identified taxa in the samples included: white-tailed deer, gray squirrel, fox squirrel, swamp rabbit, cottontail, opossum, domestic dog, gray wolf, wild turkey, snake, and turtle. The dominant taxa in the samples were white-tailed deer, gray squirrel, and turkey. Fish were present in every sample, but their proportionate abundance was not quantified. Though she emphasized that her results were preliminary, Michals (1981) presented several tentative interpretations of the faunal data. Based on the taxa present, she suggested that terrestrial animals were being procured from nearby bottomland forests, while fish were obtained

primarily from the main river channel. She also suggested that there was no evidence that hunting was creating pressure on the prey species. Finally, Michals suggested that the residents of the area north of Mound R may have received preferred meat cuts.

We have some additional faunal data from later in the Moundville era. Excavations at the White site (1Ha8), a single mound center, produced a small collection of bones from a Moundville III refuse deposit. The bones were by identified by Scott Blanchard, and the data were analyzed by Paul Welch (1986). Welch compared the fauna from the White site with the fauna from the Moundville I deposit north of Mound R. Though both collections are small, especially the Moundville I sample, he argued that they showed similar faunal procurement patterns. On the basis of the age structure of the deer remains from the White site, he also argued that local fauna was sufficiently abundant that mature individuals were being selectively hunted. Following methods used by Scott (1981), Welch examined distributions of deer elements and provided convincing evidence that the residents at the White site were being provisioned with choice cuts of venison.

Two analyses of human skeletal remains have addressed questions about the diet and health of the Moundville population. Powell (1985) divided a sample of 564 burials by age, sex, and social status (i.e., elite, commoner, residual--status unknown). She then examined a battery of morphological attributes to determine whether there were health or dietary differences that patterned by group. Her results indicated that the Moundville population was generally healthy and

that age was the major determinant affecting differences in health status. She found little evidence for nutritional stress in the population, and no evidence that dietary differences between social groups were responsible for variability in skeletal health. In other words, though there may have been differences between the diet of the elite and the commoners, the commoners' diet was sufficient for health maintenance. Analysis of dental health indicated that the carbohydrate consumption of both elite and non-elite individuals was similar.

The second study measured the amount of strontium in samples of human bone to search for differences in protein consumption (Peebles and Schoeninger 1981). As in Powell's study, the population was divided into groups determined by age, sex, and social status. Both neutron activation and atomic absorption were used to measure strontium levels. While not statistically significant, preliminary results from a sample of 136 bones (114 neutron activation and, with some duplication, 54 atomic absorption) suggest there were differences in protein intake. Males and elite individuals seem to have consumed more meat than females and commoners. The differences between sexes is probably a result of males' participation in hunting. The differences between status groups suggest that membership in the elite entitled individuals to more meat. Note, however, that Powell's study suggests that this varied access to animal protein did not affect health status.

The faunal and human skeletal data provide a perspective on Moundville-era subsistence strategies complementing that presented by

the plant data. The faunal and skeletal data indicate that hunting was selective and that the health and nutrition of the Moundville population was good. These patterns provide some support for my contention that the new subsistence strategies based on crop production reached an equilibrium early in the Moundville era and that these strategies were successful. The faunal and skeletal data also suggest that the diet of the elite differed from that of commoners in the amount of animal protein consumed, but that despite the elites' greater access to meat (possibly through provisioning) commoners had nutritionally adequate diets.

To supplement the data from the Black Warrior Valley, we can gain some additional information by considering evidence from the adjacent Tombigbee Valley. Botanical, faunal, and human skeletal remains from the Tombigbee Valley indicate that during the Late Woodland-Mississippian transition in that region both the subsistence strategies and the health and nutritional status of the human population changed. Before I review this evidence, it is necessary to emphasize that the environments of the Black Warrior and Tombigbee Valleys are similar but not identical, and that the Mississippian trajectories in the two valleys are different. While the geographic proximity of the Tombigbee Valley makes it an obvious source of comparative data for the Black Warrior Valley, evidence from the Tombigbee cannot be directly substituted for evidence from the Black Warrior.

Analyses of plant remains from the Tombigbee Valley suggest that the plant procurement and production strategies of Late Woodland and

Mississippian communities differed (Caddell 1981, 1983). Maize was used by the Late Woodland population, but wild resources, particularly nuts, were the primary plant foods. When count data are used to compare the relative abundance of nut taxa in Late Woodland contexts, quantities of hickory shell and acorn shell are found to be about equal (Caddell 1983:202 Table 4). In contrast, maize remains are overwhelmingly the dominant plant food remains found in all Mississippian contexts. Nutshells are not abundant, but where nuts are present hickory nuts are more abundant than acorns. Seed taxa are scarce in both Late Woodland and Mississippian contexts, thus it is not presently possible to discern any pattern in the use of small grains or fruits. Because of differences in the methods used to process and quantify the archaeobotanical materials, the Tombigbee and Black Warrior plant data cannot be directly compared. Despite this problem, it appears that the general patterns in the two regions are similar, though not identical.

Analyses of faunal remains provide evidence that the hunting strategies employed by Late Woodland and Mississippian communities in the Tombigbee Valley also differed (Scott 1983; Woodrick 1981, 1983). During the Late Woodland, procurement of deer decreased, while procurement of smaller prey of all kinds increased. Remains from Late Woodland and Mississippian contexts indicate changes in hunting strategies. Deer use increased markedly, whereas turtle and fish use declined. The size of fish procured, however, increased. In a discussion of these changes, Scott (1983:363-365) makes several suggestions of interest here. She argues that Late Woodland hunters

had to travel progressively greater distances and use smaller prey to procure adequate animal resources. Based on changes in proportions of taxa that are sensitive indicators of land clearance, Scott suggests that crop production began to increase in the terminal Late Woodland. Finally, she contends that increased dependence on domesticated plants permitted more selective procurement of animal resources. That is, hunters were able to concentrate their efforts on larger prey, especially deer. Such animals were more energetically expensive to pursue, but provided larger quantities of meat when the hunt was successful.

Analyses of human skeletal remains from several sites in the Tombigbee Valley indicate that the population experienced subsistence stress and that such stress was greatly reduced during the Mississippian period (Hill 1981; Cole et al. 1982; Powell 1983). Indications of nutritional stress, systemic infection, and degenerative pathology were observed on skeletal remains from Late Woodland contexts. In contrast, skeletal remains from Mississippian contexts show a marked decline in both the incidence and severity of these pathologies.

In sum, for the Tombigbee Valley botanical and faunal data indicate changes in subsistence strategies during the Late Woodland-Mississippian transition, and faunal and human skeletal data suggest that subsistence stress was a stimulus for the observed changes. The data also suggest that the changes in procurement and production strategies were successful in alleviating the populations' subsistence problems.

Given the evidence for subsistence stress in the adjacent Tombigbee Valley, the possibility that the Black Warrior Valley populations experienced similar difficulties must be given serious consideration. Unfortunately, the lack of analyses of faunal and human skeletal remains from West Jefferson contexts precludes evaluation of this proposition. Without faunal data, we cannot determine whether West Jefferson and Moundville I hunting strategies were similar or whether procurement of animal resources changed in concert with the changes in procurement and production of plant resources. Likewise, without skeletal data we cannot determine whether the health and nutritional status of the West Jefferson population was similar to that of the Moundville-era population or whether the West Jefferson population experienced nutritional stress.

I am well aware that it is circular to argue from my data alone that subsistence stress was a factor selecting for increased crop production. Nevertheless, I feel there is a distinct possibility that stress was a catalyst, though not necessarily the only one, that stimulated the move toward increased crop production in the Black Warrior Valley. In the final section of this work, I present some further thoughts about stress, and speculate about the connection between the changes in subsistence strategies and sociopolitical organizations during the Late Woodland-Mississippian transition.

Speculations: Causes of Change in Plant Procurement and Production

Subsistence stress can result from decreases in resource availability, increases in population size, or changes in population distribution. For the late prehistoric period in west-central Alabama, there is no reason to believe that resource availability was altered by natural environmental changes. If subsistence stress occurred, it is far more likely that it was due to changes in the size or distribution of the human population. While population growth may have been a factor, I would argue that changing settlement patterns may have played an equal or greater role in altering access to food resources.

Throughout the Southeast, the Late Woodland-Mississippian transition seems to have been a period of changing social relations. It is possible that intersociety competition or hostility compelled communities to restrict the territories in which they hunted and foraged. In such circumstances, local population/resource imbalances could produce subsistence stress, even if regional population size and resource availability did not change.

Earle (1980:20) has argued that populations have two options when faced with population/resource imbalances. Subsistence strategies can be diversified by adding new resources to those routinely used, or increased demands can be met by intensifying procurement or production of resources already utilized. Wild resources have definite and restricted yields, however. Procurement costs (i.e., labor and time invested in search, travel, and preparation) for such resources are initially low, but rise rapidly when efforts are made to extract more

food from the natural environment. In contrast, crop production has high "start-up" costs because land must be cleared, but once the initial investment is made crop yields can often be expanded at lower costs than are required to intensify wild resource procurement.

For the sake of argument, let us assume that subsistence stress due to population/resource imbalance was a catalyst for the changes in plant procurement and production strategies that occurred during the Late Woodland-Mississippian transition in the Black Warrior Valley. From this perspective, Earle's (1980) model provides a framework for describing the observed changes. That is, the initial response to increased subsistence demands seems to have been to intensify acorn procurement and maize production. Surprisingly, while it would have been possible to diversify nut procurement by gathering either chestnuts or beech nuts, there is no evidence that the population attempted to do so. Once the move toward increased crop production was begun, there was a rapid reallocation of labor from foraging to field activities. An agriculturally based subsistence economy was probably in place by the beginning of the Moundville I phase.

I have suggested that changing social relations might have led to population/resource imbalances that in turn led to changes in subsistence strategies. The relationship between changing social relations and changing subsistence strategies, however, may be a "chicken or egg" question. Uneasy intersocietal relations may have placed a premium on strategies that could extract more food per unit of land. Conversely, implementation of such strategies may also have provided the basis for changes in intra- or intersocietal relations.

Steponaitis (1987) has proposed recently that the adoption of maize agriculture may have provided greater opportunities for amassing surpluses that could be manipulated for social and political purposes. He notes that it is difficult to generate surpluses of wild resources and suggests that reliance on foraging may have placed a limit on the use of feasting, gift giving, and so on for political purposes. Thus, economies based on crop production may have permitted social deployment of food on a grander scale than was previously possible.

These ideas are clearly speculative, and finding ways to evaluate Steponaitis's proposition will be difficult. Nevertheless, I find his suggestion extremely thought-provoking. His ideas provide an alternative to our recent preoccupation with the search for a functional link between increased crop production and the emergence of chiefdoms in the Southeast. Steponaitis's proposition can also be modified to suggest ways in which increased subsistence demands might lead to increased crop production without having to invoke subsistence stress.

I have cast my speculations about change in plant procurement and production in a framework based on subsistence stress as a catalyst. Steponaitis (1987) used similar arguments to explain the adoption of agriculture and then suggested that the new economy provided opportunities for disbursing foods to manipulate personal or community obligations. The use of subsistence stress as a catalyst is in line with much current thought. But it is possible to turn the relationship around. That is, it is not inconceivable that changing social relations in and of themselves increased subsistence demands.

If so, communities, or perhaps households of powerful individuals, might have increased crop production to generate surpluses that could be deployed for their self-aggrandizement.

Clearly to evaluate these propositions we need more data than are presently available. Of crucial importance is evidence that would enable us to resolve the issue of subsistence stress. In addition to subsistence information, however, for both the West Jefferson and Moundville I phases we need data from cemeteries and more excavated data from settlements. Evidence about changes in mortuary programs and community organizations would allow us to examine intra- and inter-community changes in social relations during the transitional period. Without information that would permit us to juxtapose the sequences of changes in subsistence strategies and social organizations our explanations of the emergence of the Moundville chiefdom will remain, as they are now, speculations.

APPENDICES

APPENDIX A

WOOD TAXA IDENTIFIED IN SAMPLES

This appendix presents the wood charcoal identifications for each West Jefferson and Moundville I sample for which there were sufficient wood remains for identification purposes (see Chapter IV).

Tables A:1-A:3 list provenience data for the samples. For each sample a FSN (field specimen number) is listed. For the West Jefferson samples the FSN's listed in the tables are designations I used to avoid problems with overlapping field specimens numbers for samples from different sites and excavations. For the Moundville I samples a "+" after the FSN indicates that there was more than one sample from a provenience. Multiple samples from a single provenience were combined for analysis and the tables present data for the composite samples. The feature type abbreviations are:

bell pit = bell-shaped pit
bas pit = basin-shaped pit
cyl pit = cylindrical pit
irr pit = irregular pit
con pit = conical pit

Table A:4 lists the wood taxa identified in the samples and the codes used for those taxa in the data tables.

Tables A:5-A:7 list counts of identified wood fragments for each sample. The abbreviations across the top of each table are the wood taxa codes listed in Table A:4. The FSN column is the key that identifies the provenience of each sample.

Table A:1. Provenience data for West Jefferson wood identifications from flotation samples.

FSN	Site/area	Unit	Level	Feature Number	Feature Type	Sample Type	Phase
A	1HA39			1	Bell Pit	Flot.	WJEFF
B	1HA39			3	Bas. Pit	Flot.	WJEFF
C	1HA39			24	Bas. Pit	Flot.	WJEFF
E	1TU44/45			1	Bell Pit	Flot.	WJEFF
G	1JE31			4	Bell Pit	Flot.	WJEFF
H	1JE31			8	Bell Pit	Flot.	WJEFF
I	1JE31			10	Bell Pit	Flot.	WJEFF
J	1JE31			11	Bell Pit	Flot.	WJEFF
K	1JE31			12	Bell Pit	Flot.	WJEFF
L	1JE32			2	Bell Pit	Flot.	WJEFF
M	1JE32			20	Cyl. Pit	Flot.	WJEFF
N	1JE33			3	Bell Pit	Flot.	WJEFF
O	1JE33			16	Irr. Pit	Flot.	WJEFF
P	1JE33			18	Bas. Pit	Flot.	WJEFF
Q	1JE33			28	Bas. Pit	Flot.	WJEFF
R	1JE33			36	Bell Pit	Flot.	WJEFF
S	1HA11			77	Bell Pit	Flot.	WJEFF
U	1HA8			2	Bas. Pit	Flot.	WJEFF
V	1HA8			8	Cyl. Pit	Flot.	WJEFF

Table A:2. Provenience data for Moundville wood identifications from fine-screened samples.

FSN	Site/area	Unit	Level	Feature Number	Feature Type	Sample Type	Phase
101	Moundville-NR	6N2W	8		Floor	FnScr	MI
118+	Moundville-NR	6N2W	9		Daub	FnScr	MI
154	Moundville-NR	8N2E	7		Floor	FnScr	MI
169	Moundville-NR	6N2W	10		Midden	FnScr	MI
170+	Moundville-NR	8N2E	7		Midden	FnScr	MI
196+	Moundville-NR	6N2W	11		Floor	FnScr	MI
219	Moundville-NR	6N2W	12		Floor	FnScr	MI
244	Moundville-NR	6N2W	13		Floor	FnScr	MI
258	Moundville-NR	8N2E	8		Midden	FnScr	MI
261+	Moundville-NR	6N2W	14		Floor	FnScr	MI
263	Moundville-NR	8N2E	8		Daub	FnScr	MI
295	Moundville-NR	8N2E	9		Ash Lense	FnScr	MI
305	Moundville-NR	8N2E	9A		Floor	FnScr	MI
321+	Moundville-NR	8N2E	10		Floor	FnScr	MI
326	Moundville-NR	6N2W	15		Midden	FnScr	MI
378	Moundville-NR	6N2W	16		Floor	FnScr	MI
380	Moundville-NR	6N2W	17		Midden	FnScr	MI
382	Moundville-NR	6N2W	18		Floor	FnScr	MI
385	Moundville-NR	6N2W	19		Midden	FnScr	MI
415	Moundville-NR	6N2W	21		Floor	FnScr	MI
423	Moundville-NR	6N2W	22		Midden	FnScr	MI
425	Moundville-NR	8N2E	11		Floor	FnScr	MI
459	Moundville-NR	6N2W	23		Floor	FnScr	MI
492	Moundville-NR	8N2E	12		Floor	FnScr	MI
501	Moundville-NR	6N2W	24		Midden	FnScr	MI
535+	Moundville-NR	6N2W	25		Midden	FnScr	MI
547	Moundville-NR	8N2E	13		Floor	FnScr	MI
554	Moundville-NR	8N2E	14		Midden	FnScr	MI
591+	Moundville-NR	6N2W	26		Midden	FnScr	MI
617	Moundville-NR	8N2E	15		Floor	FnScr	MI
620	Moundville-NR	6N2W	27		Midden	FnScr	MI
621	Moundville-NR	8N2E	16		Floor	FnScr	MI
640+	Moundville-NR	8N2E	17		Midden	FnScr	MI
725	Moundville-NR	8N2E	18		Floor	FnScr	MI
729	Moundville-NR	8N2E	19		Floor	FnScr	MI
738	Moundville-NR	8N2E	20		Floor	FnScr	MI
740	Moundville-NR	8N2E	21		Floor	FnScr	MI
775	Moundville-NR	8N2E	22		Floor	FnScr	MI
779	Moundville-NR	8N2E	23		Floor	FnScr	MI
788	Moundville-NR	8N2E	24		Floor	FnScr	MI
790	Moundville-NR	8N2E	25		Midden	FnScr	MI
801+	Moundville-NR	6N2W	28		Midden	FnScr	MI
816	Moundville-NR	8N2E	26		Midden	FnScr	MI
846	Moundville-NR	8N2E	27		Midden	FnScr	MI

Table A:2. Provenience data for Moundville wood identifications from fine-screened samples (continued).

FSN	Site/area	Unit	Level	Feature Number	Feature Type	Sample Type	Phase
820	Moundville-SCB	TUA	2		Midden	FnScr	MI
884	Moundville-SCB	TUA	3		Midden	FnScr	MI
886	Moundville-SCB	TUA	4		Midden	FnScr	MI
926	Moundville-SCB	TUA	5		Floor	FnScr	MI
972	Moundville-SCB	TUD	2		Midden	FnScr	MI
990	Moundville-SCB	TUD	5		Midden	FnScr	MI
1005	Moundville-SCB	TUD	3		Midden	FnScr	MI
1007	Moundville-SCB	TUD	4		Floor	FnScr	MI

Table A;3. Provenience data for Moundville wood identifications from flotation samples.

FSN	Site/area	Unit	Level	Feature Number	Feature Type	Sample Type	Phase
291+	Moundville-NR	6N2W	10	95	Cyl. Pit	Flot.	MI
293+	Moundville-NR	6N2W	10	108	Cyl. Pit	Flot.	MI
330+	Moundville-NR	8N2E	9	135	Cyl. Pit	Flot.	MI
359+	Moundville-NR	6N2W	15	156	Cyl. Pit	Flot.	MI
370	Moundville-NR	6N2W	14	155	Bas. Pit	Flot.	MI
391+	Moundville-NR	6N2W	A	150	Cyl. Pit	Flot.	MI
394+	Moundville-NR	6N2W	18	195	Cyl. Pit	Flot.	MI
445+	Moundville-NR	6N2W	21	198	Cyl. Pit	Flot.	MI
476+	Moundville-NR	6N2W		230	Cyl. Pit	Flot.	MI
484+	Moundville-NR	6N2W	23	226	Bas. Pit	Flot.	MI
548+	Moundville-NR	6N2W	25	258	Cyl. Pit	Flot.	MI
560+	Moundville-NR	6N2W	B	150	Cyl. Pit	Flot.	MI
584	Moundville-NR	8N2E	13	252	Bas. Pit	Flot.	MI
666+	Moundville-NR	8N2E	15	275	Cyl. Pit	Flot.	MI
667+	Moundville-NR	8N2E	15	274	Cyl. Pit	Flot.	MI
672	Moundville-NR	6N2W	27	302	Bas. Pit	Flot.	MI
714+	Moundville-NR	6N2W	27	313	Cyl. Pit	Flot.	MI
724+	Moundville-NR	6N2W	27	315	Bas. Pit	Flot.	MI
769+	Moundville-NR	8N2E	18	318	Cyl. Pit	Flot.	MI
782+	Moundville-NR	6N2W	28	345	Bas. Pit	Flot.	MI
807+	Moundville-NR	8N2E	22	342	Cyl. Pit	Flot.	MI
883+	Moundville-NR	8N2E	26	394	Cyl. Pit	Flot.	MI
899+	Moundville-NR	8N2E		368	Cyl. Pit	Flot.	MI
916+	Moundville-NR	8N2E	26	401	Con. Pit	Flot.	MI
888	Moundville-SCB	TUA	4	2	Ash Lense	Flot.	MI
943+	Moundville-SCB	TUA&D	3	5	Bas. Pit	Flot.	MI
982	Moundville-SCB	TUA	9	16	Con. Pit	Flot.	MI
1048+	Moundville-SCB	TUD	4	4	Bas. Pit	Flot.	MI

Table A:4. Wood taxa identified in the Moundville and West Jefferson samples.

Code	Taxon	
Ma	Maple	*Acer* sp.
Ca	Cane	*Arundinaria* sp.
Hi	Hickory	*Carya* sp.
Ch	Chestnut	*Castanea dentata*
Pe	Persimmon	*Diospyros virginiana*
Be	Beech	*Fagus grandifolia*
As	Ash	*Fraxinus* sp.
Lo	Locust	*Gleditsia* sp.
Wa	Walnut	*Juglans* sp.
Ce	Cedar	*Juniperus* sp.
Gu	Gum	*Liquidambar/Nyssa* spp.
Mg	Magnolia	*Magnolia* sp.
Pi	Pine	*Pinus* sp.
Sy	Sycamore	*Platanus occidentalis*
WO	White Oak	*Quercus* sp. (*Lepidobalanus*)
RO	Red Oak	*Quercus* sp. (*Erythrobalanus*)
Oa	Oak	*Quercus* sp.
Sa	Sassafras	*Sassafras albidum*
Cy	Cypress	*Taxodium distichum*
El	Elm	*Ulmus* sp.
Mz	Maize	*Zea mays*
Ba	Bark	
Ho	Hornbeam	*Ostrya virginiana*
Ha	Hackberry	*Celtis* sp.
Pl	Plum/cherry	*Prunus* sp.
Mo	Monocot	
Co	Conifer	
Di	Dicot	
Un	Unidentified	
Ot	Other	

Table A:5. Counts of wood taxa from West Jefferson flotation samples.

FSN	Ma	Ca	Hi	Ch	Pe	Be	As	Lo	Wa	Ce	Gu	Mg	Pi	Sy	WO	RO	Oa	Sa	Cy	El	Mz	Ba	Ho	Ha	Pl	Mo	Co	Di	Un	Ot	Total
A	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
B	0	0	0	0	0	0	0	0	0	0	0	0	19	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
C	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
E	0	0	6	2	0	0	1	1	0	0	0	0	2	0	9	7	0	1	0	0	0	1	0	0	0	0	0	1	2	0	33
G	0	1	0	0	0	0	0	0	0	1	0	0	12	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	20
H	0	0	0	1	0	0	0	0	0	0	1	0	15	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	20
I	0	0	1	0	0	0	0	0	0	0	2	0	14	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	20
J	0	0	1	1	0	0	1	2	0	0	2	0	11	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	22
K	0	0	1	0	0	0	0	0	0	0	0	0	16	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	20
L	0	0	0	0	0	0	0	0	0	0	0	0	18	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	20
M	0	0	0	5	0	0	0	0	0	2	0	0	7	0	3	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	20
N	0	0	0	8	1	0	0	0	0	0	0	0	8	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	20
O	0	0	2	0	0	0	1	0	0	0	0	0	11	0	1	3	0	0	0	1	0	0	0	0	0	0	0	1	0	0	20
P	0	3	2	0	0	0	0	0	0	0	0	0	13	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Q	0	0	0	0	0	2	0	0	0	0	0	0	16	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
R	0	0	2	0	0	0	1	0	0	0	1	0	14	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	20
S	0	0	0	0	0	0	13	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	0	0	20
U	0	0	1	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	20
V	0	0	4	1	0	0	2	0	0	0	0	0	10	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	20

Table A:6. Counts of wood taxa from Moundville I fine-screened samples.

FSN	Ma	Ca	Hi	Ch	Pe	Be	As	Lo	Wa	Ce	Gu	Mg	Pi	Sy	WO	RO	Oa	Sa	Cy	El	Mz	Ba	Ho	Ha	Pl	Mo	Co	Di	Un	Ot	Total
101	1	0	1	0	2	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	22
118+	2	12	3	1	5	0	2	8	0	0	2	0	33	0	11	8	1	2	6	1	0	0	5	0	0	4	0	0	2	12	120
154	0	1	3	0	1	0	0	0	0	0	2	0	8	0	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	20
169	0	5	0	0	0	0	1	0	0	0	0	0	6	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	2	0	20
170+	0	2	4	0	0	0	0	0	0	0	8	0	17	0	10	3	0	0	15	0	0	0	0	0	0	0	0	0	1	0	60
196+	0	0	0	0	1	0	0	0	0	0	1	0	14	0	5	7	0	0	2	0	0	0	0	0	0	4	2	2	2	0	40
219	0	0	1	0	0	0	0	0	0	0	5	0	8	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	20
244	0	0	3	0	1	0	0	0	0	0	0	0	3	0	6	2	0	0	0	0	0	0	0	0	0	5	0	0	0	0	20
258	0	1	4	0	2	0	0	0	0	0	2	0	3	0	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	20
261+	1	0	6	0	0	0	1	0	0	0	4	1	12	0	7	1	2	0	0	0	0	0	0	0	0	5	0	2	1	0	43
263	0	0	0	0	0	0	0	1	0	0	4	0	5	0	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
295	0	3	1	0	0	0	0	0	0	0	0	0	12	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
305	0	3	1	0	0	0	0	0	0	0	2	0	7	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	20
321+	0	1	1	0	1	0	0	1	0	0	1	0	8	0	19	3	0	0	3	0	0	0	0	0	0	2	0	0	0	0	40
326	0	0	3	0	0	0	1	0	0	0	2	0	5	0	3	4	0	0	0	1	0	0	0	0	0	1	0	0	3	0	23
378	0	0	0	0	0	0	0	0	0	0	1	0	10	0	4	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	21
380	0	0	3	0	1	0	0	0	0	0	0	0	7	0	3	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	20
382	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	2	0	0	8	0	0	0	0	0	0	5	0	0	0	0	20
385	0	0	0	0	0	0	0	0	0	2	0	0	5	0	4	1	0	0	8	0	0	0	0	0	0	0	0	0	0	0	20
415	1	0	4	0	0	0	2	0	0	0	3	0	6	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	20
423	0	0	0	0	1	0	2	0	0	0	3	0	11	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	20
425	0	1	0	0	0	0	1	0	0	0	1	0	12	0	3	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	20
459	0	0	0	0	0	0	0	0	0	0	6	0	8	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
492	1	0	1	0	0	0	0	0	0	0	1	0	7	0	2	2	0	0	5	0	0	0	0	0	0	1	0	0	0	0	20
501	0	0	1	0	1	0	5	0	0	0	0	0	8	0	2	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	21
535+	0	0	0	0	0	1	3	0	1	0	3	0	8	0	8	2	0	0	0	0	1	0	0	0	0	1	0	1	0	0	29
547	0	1	1	0	0	0	0	0	0	0	5	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	10
554	0	0	7	0	0	0	0	0	0	0	1	0	5	0	4	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	20
591+	0	0	4	0	1	0	0	0	0	0	4	0	4	0	1	1	0	0	0	0	0	0	0	0	0	11	0	2	1	0	29
617	0	0	5	0	0	0	0	0	0	0	1	0	7	0	1	0	2	0	3	0	1	0	0	0	0	0	0	0	0	0	20
620	0	0	5	0	0	0	4	0	0	0	1	0	5	0	1	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	20
621	0	0	1	0	0	0	0	0	0	0	3	0	10	0	1	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	20
640+	0	0	1	1	0	0	2	0	0	0	9	0	13	0	6	4	0	0	0	2	1	0	0	0	0	0	0	1	0	0	40
725	0	0	0	0	0	0	0	0	0	0	12	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	15
729	0	0	1	0	0	0	5	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
738	0	0	0	0	0	0	0	0	0	0	4	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
740	0	0	1	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	10
775	0	0	2	0	0	0	0	0	0	0	3	0	1	0	5	4	1	0	3	0	1	0	0	0	0	0	0	0	0	0	20
779	0	0	3	0	0	0	1	0	0	0	4	0	2	0	2	2	0	2	4	0	0	0	0	0	0	0	0	0	0	0	20
788	0	0	0	0	0	0	0	0	0	0	1	0	11	0	2	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	20
790	0	0	2	0	1	0	0	0	0	0	1	0	2	0	5	4	0	1	4	0	0	0	0	0	0	0	0	0	0	0	20
801+	0	0	2	0	0	0	0	0	0	1	3	0	8	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	20
816	0	0	0	1	4	0	2	0	0	0	0	0	3	0	7	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	20
846	0	0	0	0	0	0	0	0	0	0	0	0	2	0	8	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	12

Table A:6. Counts of wood taxa from Moundville I fine-screened samples (continued).

FSN	Ma	Ca	Hi	Ch	Pe	Be	As	Lo	Wa	Ce	Gu	Mg	Pi	Sy	WO	RO	Oa	Sa	Cy	El	Mz	Ba	Ho	Ha	Pl	Mo	Co	Di	Un	Ot	Total
820	0	0	2	0	0	0	0	0	1	0	2	0	4	0	3	0	3	0	3	0	1	1	0	1	0	0	0	0	0	0	21
884	0	0	7	1	1	0	0	0	0	0	2	0	6	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	2	0	22
886	0	0	10	0	1	0	2	0	0	1	0	0	3	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	21
926	0	0	2	1	0	0	0	0	0	0	2	0	7	0	2	1	0	0	1	0	0	1	0	0	0	0	0	3	0	0	20
972	0	0	4	0	0	0	0	0	0	0	1	0	10	0	0	4	0	0	0	0	1	1	0	0	0	0	0	2	0	0	23
990	0	0	7	0	3	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	20
1005	0	0	7	0	0	0	0	1	0	0	0	0	3	0	1	2	2	0	0	0	3	0	0	0	0	0	0	1	0	0	20
1007	0	0	1	2	4	0	1	0	0	0	0	0	4	0	0	1	2	0	0	1	1	0	0	0	0	0	0	3	0	0	20

Table A:7. Counts of wood taxa from Moundville I flotation samples.

FSN	Ma	Ca	Hi	Ch	Pe	Be	As	Lo	Wa	Ce	Gu	Mg	Pi	Sy	WO	RO	Oa	Sa	Cy	El	Mz	Ba	Ho	Ha	Pl	Mo	Co	Di	Un	Ot	Total
291+	0	0	7	0	5	0	0	0	0	0	3	1	5	0	4	11	1	0	11	0	2	1	0	0	0	0	0	0	0	0	51
293+	0	3	1	14	1	0	0	0	0	0	1	0	30	0	4	12	0	0	4	0	0	0	0	0	0	0	0	0	0	0	70
330+	1	9	2	0	0	0	0	3	0	1	0	0	9	0	4	8	0	0	1	0	1	0	0	0	0	1	0	0	0	0	40
359+	1	4	8	0	2	0	0	0	0	0	10	0	26	0	12	2	3	0	6	2	0	1	0	0	0	0	0	1	1	0	79
370	0	0	2	0	0	0	0	0	0	0	2	0	1	0	8	0	1	0	0	0	0	3	0	0	0	0	0	0	3	0	20
391+	0	0	2	0	0	0	0	0	0	0	1	0	3	0	10	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	20
394+	0	2	1	6	2	0	0	0	0	0	0	0	8	0	6	1	1	0	1	0	0	1	0	0	0	0	0	0	1	0	30
445+	0	0	11	2	1	0	0	0	0	16	8	0	5	0	16	6	1	0	2	2	3	0	0	0	0	0	4	1	2	0	80
476+	0	4	12	1	1	0	4	0	0	2	3	0	16	0	11	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	60
484+	0	0	2	0	1	0	2	0	0	0	2	4	3	0	3	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	20
548+	0	0	2	2	0	0	0	0	0	0	8	0	4	0	0	7	0	1	0	0	4	1	0	0	0	0	0	1	0	0	30
560+	0	1	3	0	0	0	0	0	0	0	0	0	1	0	10	1	1	0	4	0	2	0	0	0	0	0	0	0	0	2	25
584	0	0	1	0	0	1	0	1	0	0	1	0	8	0	2	2	0	0	2	0	0	0	0	0	0	0	0	1	1	0	20
666+	0	1	5	0	0	0	1	0	0	2	4	0	12	0	6	7	0	0	3	0	1	1	0	0	0	1	0	1	3	0	48
667+	0	0	3	2	0	0	0	1	0	2	8	0	11	0	3	6	1	0	0	0	1	1	0	0	0	0	0	0	0	0	39
672	0	0	0	0	0	0	0	0	0	0	1	0	1	0	5	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	10
714+	0	0	2	3	1	0	0	1	0	0	1	0	5	0	2	2	1	0	0	0	1	0	0	0	0	0	0	0	1	0	20
724+	0	0	7	0	0	0	1	0	0	0	3	0	3	0	3	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	20
769+	0	0	0	0	2	0	0	0	0	1	0	0	7	0	0	6	3	0	0	0	0	0	0	0	0	0	0	1	0	0	20
782+	0	0	4	0	0	0	4	0	0	0	1	0	0	0	1	1	5	0	0	0	0	4	0	0	0	0	0	0	0	0	20
807+	0	3	7	0	0	1	0	0	0	0	3	0	2	0	0	4	0	0	0	0	1	2	0	0	0	0	0	2	0	0	25
883+	0	0	1	0	1	0	0	0	0	0	10	0	3	0	1	0	0	0	0	0	0	1	0	0	0	2	0	1	0	0	20
899+	0	0	1	4	0	0	1	0	0	0	1	0	2	0	1	5	4	0	0	0	0	0	0	0	0	0	0	1	0	0	20
916+	0	0	3	2	2	0	1	2	0	0	0	0	2	0	0	5	0	0	0	0	1	0	0	0	0	1	0	1	0	0	20
888	1	0	4	1	0	0	0	0	0	0	5	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	20
943+	0	1	5	0	2	2	1	0	0	0	3	0	28	0	0	3	1	0	2	0	0	1	0	0	0	1	0	0	0	0	50
982	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
1048+	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20

APPENDIX B

NUT AND SEED TAXA IDENTIFIED IN FLOTATION SAMPLES

This appendix presents data on the taxa identified in the flotation samples from West Jefferson and Moundville I contexts.

Tables B:1 and B:2 list provenience data for each sample. For each sample a FSN (field specimen number) is listed. For the West Jefferson samples the FSN's listed in the tables are designations I used to avoid problems with overlapping field specimens numbers for samples from different sites and excavations. For the Moundville I samples a "+" after the FSN indicates that there was more than one sample from a provenience. Multiple samples from a single provenience were combined for analysis and the tables present data for the composite samples. The feature type abbreviations are:

bell pit = bell-shaped pit
bas pit = basin-shaped pit
cyl pit = cylindrical pit
irr pit = irregular pit
con pit = conical pit

Two volume figures are listed in the provenience tables. The provenience volume is the estimated volume in liters for a feature. The sample volume is the size in liters of the soil sample from which plant remains were extracted. Plant weight is the weight in grams of all carbonized plant remains greater than 1.4 mm in size. It is this figure that was used to standardize the count data for analysis.

Tables B:3 and B:4 present quantified data for wood, nutshells, and maize remains in the flotation samples. The counts and weights listed are raw values <u>not</u> the standardized values used for analysis. The FSN column is the key that ties the taxa data to the provenience data.

Tables B:5 and B:6 present counts of seeds identified in the flotation samples. The counts listed are raw counts and include whole seeds and seed fragments. Maize is not listed in the cultigen column because counts and weights for maize remains are given in Tables B:3 and B:4. The FSN column is the key that ties the taxa data to the provenience data.

To conserve space in the data tables, seed taxa are identified by genus only. Table B:7 lists the taxonomic identifications and common names for taxa listed in the data tables.

Table B:1. Provenience data for West Jefferson flotation samples.

FSN	Site	Phase	Context	Unit	Level	Feat.	Volume (l) Prov	Volume (l) Samp	Plant Weight (g)
A	1HA39	W. Jeff.	Bell Pit			1	-	60.0	15.14
B	1HA39	W. Jeff.	Bas. Pit			3	-	20.0	21.37
C	1HA39	W. Jeff.	Bas. Pit			24	-	20.0	8.40
E	1TU44/45	W. Jeff.	Bell Pit	2		1	-	70.0	66.00
G	1JE31	W. Jeff.	Bell Pit			4	-	3.0	4.37
H	1JE31	W. Jeff.	Bell Pit			8	-	15.0	56.60
I	1JE31	W. Jeff.	Bell Pit			10	-	9.0	31.75
J	1JE31	W. Jeff.	Bell Pit			11	-	9.0	21.68
K	1JE31	W. Jeff.	Bell Pit			12	-	6.0	2.91
L	1JE32	W. Jeff.	Bell Pit			2	-	7.0	20.20
M	1JE32	W. Jeff.	Cyl. Pit			20	-	3.0	7.89
N	1JE33	W. Jeff.	Bell Pit			3	-	3.0	10.83
O	1JE33	W. Jeff.	Irr. Pit			16	-	6.0	21.11
P	1JE33	W. Jeff.	Bas. Pit			18	-	3.0	10.54
Q	1JE33	W. Jeff.	Bas. Pit			28	-	3.0	10.62
R	1JE33	W. Jeff.	Bell Pit			36	-	3.0	6.51
S	1HA11	W. Jeff.	Bell Pit			77	-	1.0	1.57
T	1HA8	W. Jeff.	Bas. Pit			3	-	6.0	1.31
U	1HA8	W. Jeff.	Bas. Pit			2	-	6.0	8.50
V	1HA8	W. Jeff.	Cyl. Pit			8	-	6.0	9.05

Table B:2. Provenience data for Moundville I flotation samples.

FSN	Site	Phase	Context	Unit	Level	Feat.	Volume (l) Prov	Volume (l) Samp	Plant Weight (g)
99	Moundville-NR	Mdvl. I	Floor	6N2W	8		-	6.0	6.29
102+	Moundville-NR	Mdvl. I	Cob Pit	6N2W	8	43	10.3	10.3	150.00
124	Moundville-NR	Mdvl. I	Daub Layer	6N2W	9		-	3.0	2.95
165	Moundville-NR	Mdvl. I	Midden	6N2W	10	A 2	-	3.0	2.60
171	Moundville-NR	Mdvl. I	Midden	8N2E	7		-	3.0	0.97
197	Moundville-NR	Mdvl. I	Floor	6N2W	11	A 1	-	3.0	0.31
204	Moundville-NR	Mdvl. I	Ash Lense	6N2W	11	96	1.0	1.0	3.43
221	Moundville-NR	Mdvl. I	Floor	6N2W	12		-	3.0	1.10
243	Moundville-NR	Mdvl. I	Floor	6N2W	13		-	3.0	0.35
249	Moundville-NR	Mdvl. I	Clay Pit	6N2W	13	109	15.0	15.0	1.50
256	Moundville-NR	Mdvl. I	Floor	6N2W	14		-	3.0	1.08
259	Moundville-NR	Mdvl. I	Midden	8N2E	8		-	3.0	11.21
264	Moundville-NR	Mdvl. I	Daub Layer	8N2E	8		-	3.0	3.06
291+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	10	95	104.0	104.0	72.16
293+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	10	108	105.0	105.0	105.94
294	Moundville-NR	Mdvl. I	Ash Lense	8N2E	9	A 4	-	5.0	3.28
296	Moundville-NR	Mdvl. I	Midden	8N2E	9	A 3	-	3.0	2.08
304	Moundville-NR	Mdvl. I	Floor	8N2E	9	A 6	-	3.0	0.54
318	Moundville-NR	Mdvl. I	Burn	6N2W	14		-	2.0	0.85
322	Moundville-NR	Mdvl. I	Floor	8N2E	10		-	3.0	0.75
330+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	9	135	29.0	29.0	12.78
359+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	15	156	136.0	136.0	14.15
370	Moundville-NR	Mdvl. I	Bas. Pit	6N2W	14	155	32.0	8.1	2.17
375	Moundville-NR	Mdvl. I	Midden	6N2W	15		-	3.0	0.90
379	Moundville-NR	Mdvl. I	Floor	6N2W	16		-	3.0	2.06
381	Moundville-NR	Mdvl. I	Clay Pit	6N2W	17		-	3.0	1.45
383	Moundville-NR	Mdvl. I	Floor	6N2W	18		-	3.0	0.70
384	Moundville-NR	Mdvl. I	Ash Lense	6N2W	19	194	6.0	6.0	2.27
386	Moundville-NR	Mdvl. I	Midden	6N2W	19		-	3.0	0.75
388	Moundville-NR	Mdvl. I	Floor	6N2W	20		-	3.0	0.45
391+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	A	150	44.0	44.0	7.43
394+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	18	195	8.5	8.5	8.07
416	Moundville-NR	Mdvl. I	Floor	6N2W	21		-	3.0	0.74
424	Moundville-NR	Mdvl. I	Midden	6N2W	22		-	3.0	0.74
445+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	21	198	106.0	53.0	10.92
446	Moundville-NR	Mdvl. I	Ash Lense	6N2W	22	A	-	10.0	0.96
447	Moundville-NR	Mdvl. I	Floor	8N2E	11		-	3.0	1.01
455	Moundville-NR	Mdvl. I	Burn	6N2W	22	231	11.0	11.0	0.43
456+	Moundville-NR	Mdvl. I	Cob Pit	8N2E	11	161	50.0	50.0	174.62
460	Moundville-NR	Mdvl. I	Floor	6N2W	23		-	3.0	0.07

Table B:2. Provenience data for Moundville I flotation samples (continued).

FSN	Site	Phase	Context	Unit	Level	Feat.	Volume (l) Prov	Volume (l) Samp	Plant Weight (g)
468	Moundville-NR	Mdvl. I	Ash Lense	6N2W	23	B	-	3.0	3.50
469	Moundville-NR	Mdvl. I	Ash Lense	6N2W	23	A	-	8.0	1.30
476+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W		230	82.0	82.0	12.54
479	Moundville-NR	Mdvl. I	Clay Pit	6N2W	23	236	1.0	1.0	0.47
480	Moundville-NR	Mdvl. I	Ash Lense	8N2E	12	A 8	-	3.0	0.31
484+	Moundville-NR	Mdvl. I	Bas. Pit	6N2W	23	226	5.0	5.0	1.54
488	Moundville-NR	Mdvl. I	Ash Lense	8N2E	12	A 9	-	2.0	0.59
489	Moundville-NR	Mdvl. I	Floor	8N2E	12		-	3.0	1.37
502	Moundville-NR	Mdvl. I	Midden	6N2W	24		-	3.0	0.32
534+	Moundville-NR	Mdvl. I	Midden	6N2W	25		-	6.0	0.64
546	Moundville-NR	Mdvl. I	Floor	8N2E	13		-	3.0	0.19
548+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	25	258	8.5	8.5	17.98
560+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	B	150	32.0	32.0	10.31
564	Moundville-NR	Mdvl. I	Midden	8N2E	14		-	3.0	0.76
584	Moundville-NR	Mdvl. I	Bas. Pit	8N2E	13	252	3.0	3.0	1.39
592	Moundville-NR	Mdvl. I	Midden	6N2W	26		-	3.0	0.46
618	Moundville-NR	Mdvl. I	Floor	8N2E	15		-	3.0	0.43
619	Moundville-NR	Mdvl. I	Midden	4N2W	27S		-	3.0	0.39
634	Moundville-NR	Mdvl. I	Floor	8N2E	16		-	3.0	0.27
641+	Moundville-NR	Mdvl. I	Midden	8N2E	17		-	6.0	2.88
666+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	15	275	18.0	18.0	14.65
667+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	15	274	60.0	60.0	15.85
672	Moundville-NR	Mdvl. I	Bas. Pit	6N2W	27	302	2.5	2.5	0.87
714+	Moundville-NR	Mdvl. I	Cyl. Pit	6N2W	27	313	13.0	6.5	2.07
724+	Moundville-NR	Mdvl. I	Bas. Pit	6N2W	27	315	60.0	60.0	8.43
728	Moundville-NR	Mdvl. I	Floor	8N2E	18		-	3.0	0.12
730+	Moundville-NR	Mdvl. I	Floor	8N2E	19		-	6.0	0.15
731+	Moundville-NR	Mdvl. I	Floor	8N2E	20		-	6.0	0.19
736	Moundville-NR	Mdvl. I	Clay Pit	6N2W	27	D	-	3.0	0.10
741	Moundville-NR	Mdvl. I	Floor	8N2E	21		-	3.0	0.12
767	Moundville-NR	Mdvl. I	Ash Lense	6N2W	28B	341	1.0	1.0	0.91
768+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	18	317	174.0	9.0	0.54
769+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	18	318	11.0	11.0	1.15
776	Moundville-NR	Mdvl. I	Floor	8N2E	22		-	3.0	0.25
780	Moundville-NR	Mdvl. I	Floor	8N2E	23		-	3.0	1.09
782+	Moundville-NR	Mdvl. I	Bas. Pit	6N2W	28	345	5.0	2.5	4.73
785	Moundville-NR	Mdvl. I	Burn	8N2E	23	A13	-	8.0	5.19
789	Moundville-NR	Mdvl. I	Floor	8N2E	24		-	3.0	1.29
791	Moundville-NR	Mdvl. I	Midden	8N2E	25		-	3.0	0.19
802+	Moundville-NR	Mdvl. I	Midden	6N2W	28		-	12.0	3.47
807+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	22	342	8.0	8.0	6.45
814	Moundville-NR	Mdvl. I	Burn	8N2E	24	A13	-	8.0	6.08
817	Moundville-NR	Mdvl. I	Midden	8N2E	26		-	3.0	0.37
847	Moundville-NR	Mdvl. I	Midden	6N2E	27		-	3.0	0.01
883+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E	26	394	86.0	43.0	11.68
899+	Moundville-NR	Mdvl. I	Cyl. Pit	8N2E		368	44.0	44.0	8.28
916+	Moundville-NR	Mdvl. I	Con. Pit	8N2E	26	401	60.0	60.0	3.13

Table B:2. Provenience data for Moundville I flotation samples (continued).

FSN	Site	Phase	Context	Unit	Level	Feat.	Volume (l) Prov	Volume (l) Samp	Plant Weight (g)
822	Moundville-SCB	Mdvl. I	Midden	TUA	2		-	3.0	0.81
885	Moundville-SCB	Mdvl. I	Midden	TUA	3		-	3.0	0.60
887	Moundville-SCB	Mdvl. I	Midden	TUA	4		-	3.0	0.30
888	Moundville-SCB	Mdvl. I	Ash Lense	TUA	4	2	3.0	3.0	1.86
918	Moundville-SCB	Mdvl. I	Hearth	TUA	6	9	4.0	4.0	1.30
920	Moundville-SCB	Mdvl. I	Floor	TUA	5		-	3.0	0.24
928	Moundville-SCB	Mdvl. I	Midden	TUA	6		-	3.0	0.33
931	Moundville-SCB	Mdvl. I	Midden	TUA	7		-	3.0	0.28
936+	Moundville-SCB	Mdvl. I	Hearth	TUA/D	5	10	10.0	10.0	0.87
943+	Moundville-SCB	Mdvl. I	Bas. Pit	TUA/D	3	5	575.0	290.0	36.00
956+	Moundville-SCB	Mdvl. I	Ash Lense	TUA	9	12	30.0	30.0	1.65
982	Moundville-SCB	Mdvl. I	Con. Pit	TUA	9	16	10.0	10.0	3.75
1001	Moundville-SCB	Mdvl. I	Midden	TUD	3		-	3.0	0.90
1035	Moundville-SCB	Mdvl. I	Floor	TUD	4		-	3.0	0.37
1048+	Moundville-SCB	Mdvl. I	Bas. Pit	TUD	4	4	11.0	11.0	2.97
1052	Moundville-SCB	Mdvl. I	Midden	TUD	5		-	3.0	0.78
1053	Moundville-SCB	Mdvl. I	Bas. Pit	TUA	8	11	4.0	4.0	1.08
1059	Moundville-SCB	Mdvl. I	Midden	TUD	2		-	3.0	0.72

Table B:3. Quantities of wood, nutshell, and maize remains in the West Jefferson flotation samples.

FSN	Wood Weight (g)	Hickory Count	Hickory Weight (g)	Acorn Count	Acorn Weight (g)	Maize Kernels Count	Maize Kernels Weight (g)	Maize Cupules Count	Maize Cupules Weight (g)	Other Count	Other Weight (g)
A	7.60	862	4.32	235	0.39	22	0.05	7	0.01		
B	12.05	1056	6.77	140	0.24	12	0.03	5	0.01	26	0.21 b,h
C	5.44	442	2.21	67	0.11	7	0.01	3	0.01	7	0.04 b,d
E	45.71	537	4.26	3036	7.15	1024	4.56	323	1.41	620	1.70 b,c
G	2.86	145	1.15	46	0.09	8	0.01	9	0.03		
H	12.03	5722	37.37	859	1.80	468	2.19	47	0.12	415	3.53 b
I	16.94	1437	11.41	488	1.20	115	0.40	71	0.11		
J	15.85	467	4.60	191	0.32	18	0.02	56	0.13	18	0.08 b
K	2.17	71	0.51	16	0.03	2	0.01	3	0.01		
L	15.34	479	3.20	468	0.85	20	0.09	2	0.01	32	0.34 b,c
M	6.32	96	0.71	82	0.16	15	0.02				
N	7.56	250	1.23	133	0.24	8	0.05	14	0.04	29	0.42 b
O	11.62	1052	8.08	119	0.20	74	0.31	45	0.08	1	0.01 f
P	7.12	454	1.97	65	0.12	29	0.12	164	0.63		
Q	6.29	458	2.35	691	1.53	21	0.04	9	0.01	14	0.08 b
R	3.26	482	2.74	46	0.11	27	0.10	19	0.05		
S	1.25	14	0.10	6	0.01						
T	1.07	46	0.14	18	0.01			3	0.01		
U	5.18	131	0.61	790	1.67	15	0.02	3	0.01	14	0.14 b
V	7.03	228	1.24	204	0.42	20	0.07	21	0.02		

Table B:4. Quantities of wood, nutshell, and maize remains in the Moundville I flotation samples.

FSN	Wood Weight (g)	Hickory Count	Hickory Weight (g)	Acorn Count	Acorn Weight (g)	Maize Kernels Count	Maize Kernels Weight (g)	Maize Cupules Count	Maize Cupules Weight (g)	Other Count	Other Weight (g)
99	4.17	8	0.08	6	0.01	45	0.62	204	1.10		
102+	21.71	12	0.07	18	0.04	207	1.59	19150	102.11	167	20.61 a
124	2.60	4	0.01	2	0.01	27	0.20	24	0.10		
165	2.10	3	0.01	2	0.01	45	0.17	2	0.01		
171	0.91	2	0.01	5	0.01	3	0.01	3	0.01		
197	0.20	6	0.04	3	0.01			21	0.06		
204	2.10	3	0.01	5	0.01	9	0.13	5	0.01		
221		3	0.03	3	0.01	10	0.05	6	0.01		
243	0.30	2	0.01	3	0.02	4	0.01	2	0.01		
249	1.32	1	0.01	5	0.01	9	0.01	17	0.04		
256	0.50	1	0.01	7	0.01	5	0.01	4	0.01		
259	10.89	1	0.01			2	0.01	3	0.01		
264	2.74	1	0.01	1	0.01	3	0.01	7	0.01		
291+	59.85	56	0.41	288	0.52	327	1.61	168	0.70		
293+	81.19	45	0.28	170	0.30	724	3.56	276	0.72		
294	2.87			2	0.01	7	0.01	4	0.01		
296	1.92			9	0.01	6	0.01	4	0.01		
304	0.41	1	0.01	21	0.02	4	0.02	2	0.01		
318	0.80	1	0.01	5	0.01	2	0.01	3	0.02		
322	0.71	3	0.01	2	0.01	1	0.01	5	0.01		
330+	11.12	27	0.75	84	0.11	56	0.13	71	0.21	19	0.13 b
359+	12.50	37	0.21	186	0.34	79	0.20	115	0.25	1	0.01 d
370	1.69	11	0.12	5	0.01	13	0.05	38	0.22		
375	0.60	2	0.01	1	0.01	1	0.01				
379	0.20	1	0.01	4	0.02	3	0.01	3	0.02		
381	1.40			3	0.01	2	0.01	3	0.02		
383	0.50			1	0.01	5	0.03				
384	2.17			2	0.01	1	0.01				
386	0.70	2	0.01	4	0.01	2	0.01				
388	0.40			1	0.01	4	0.01	3	0.01	2	0.01 e
391+	6.06	28	0.39	228	0.40	22	0.05	48	0.15		
394+	7.21	4	0.04	20	0.06	31	0.20	21	0.18		
416	0.70	1	0.02	1	0.01	2	0.01				
424	0.70			5	0.02	4	0.02				
445+	8.86	59	1.10	37	0.04	33	0.06	55	0.09	2	0.02 f,g
446	0.51	2	0.01	5	0.01	13	0.04	8	0.05		
447	0.81	2	0.01	6	0.01	3	0.01	5	0.01		
455	0.36	1	0.01			2	0.01	2	0.01		
456+	140.87	4	0.01	18	0.05	2	0.01	6659	24.12	34	4.40 a
460	0.04	1	0.01	1	0.01						
468	2.94	6	0.02	81	0.13	8	0.02	6	0.01	1	0.01 c
469	1.02	4	0.03	2	0.01	5	0.02	7	0.01		
476+	11.56	30	0.20	108	0.16	63	0.14	53	0.14		

Table B:4. Quantities of wood, nutshell, and maize remains in the Moundville I flotation samples (continued).

FSN	Wood Weight (g)	Hickory Count	Hickory Weight (g)	Acorn Count	Acorn Weight (g)	Maize Kernels Count	Maize Kernels Weight (g)	Maize Cupules Count	Maize Cupules Weight (g)	Other Count	Other Weight (g)
479	0.40	3	0.01	1	0.01			1	0.01		
480	0.23	4	0.01	2	0.01	3	0.01	2	0.01		
484+	1.51	3	0.03	21	0.04	10	0.02	5	0.01		
488	0.50	4	0.01	6	0.01	8	0.02	3	0.01		
489	1.24	4	0.02	4	0.01			16	0.03		
502	0.30							2	0.02		
534+	0.56	3	0.02	5	0.02	8	0.03	2	0.01		
546	0.16	1	0.01	1	0.01			4	0.01		
548+	16.87	1	0.01	155	0.32			7	0.03	2	0.01 b
560+	7.63	52	0.30	690	1.33	65	0.23	103	0.32	1	0.01 d
564	0.70	4	0.04	1	0.01	6	0.01	5	0.01		
584	1.14	4	0.01	4	0.01	4	0.01	7	0.01		
592	0.37			3	0.01	9	0.20	2	0.01		
618	0.35	2	0.01	2	0.01	4	0.01	4	0.01		
619	0.32	1	0.03	1	0.01	4	0.01				
634	0.26	1	0.01	1	0.01	1	0.01	2	0.01		
641+	2.49	5	0.02	6	0.01	16	0.08	10	0.02		
666+	12.40	46	0.66	80	0.06	73	0.17	54	0.08		
667+	13.80	41	0.25	85	0.10	74	0.16	60	0.07	1	0.01 b
672	0.71			1	0.01	3	0.01				
714+	1.74			4	0.01			4	0.01		
724+	7.86	7	0.02	16	0.02	32	0.05	6	0.01	2	0.01 b
728	0.08										
730+	0.04					3	0.01	1	0.01	1	0.01 c
731+	0.12			1	0.01	1	0.01	1	0.01		
736	0.08					2	0.01				
741	0.10					1	0.01				
767	0.85	2	0.01	1	0.01						
768+	0.37			3	0.01	2	0.01	1	0.01		
769+	0.97	1	0.01	19	0.01	8	0.01	4	0.01		
776	0.20					6	0.01				
780	0.98					3	0.01	5	0.01		
782+	4.38	17	0.04	5	0.01	1	0.01	3	0.01		
785	4.21	7	0.01	1	0.01	30	0.08	8	0.02		
789	1.24			2	0.01	3	0.01	3	0.01		
791	0.17					1	0.01				
802+	2.37			2	0.01	5	0.03	3	0.02		
807+	5.37	18	0.04	21	0.01	41	0.23	27	0.11		
814	5.00	9	0.06	1	0.01	24	0.07	8	0.01		
817	0.35							2	0.01		
847	0.01										

Table B:4. Quantities of wood, nutshell, and maize remains in the Moundville I flotation samples continued.

FSN	Wood Weight (g)	Hickory Count	Hickory Weight (g)	Acorn Count	Acorn Weight (g)	Maize Kernels Count	Maize Kernels Weight (g)	Maize Cupules Count	Maize Cupules Weight (g)	Other Count	Other Weight (g)
883+	10.73	14	0.02	7	0.01	32	0.08	9	0.03		
899+	6.79	7	0.03	11	0.05	27	0.05	16	0.04		
916+	2.64	10	0.01	2	0.01	20	0.07	3	0.01	1	0.05 a
922	0.66	1	0.01	4	0.01			4	0.01		
885	0.50	3	0.01	5	0.01	1	0.01	1	0.01		
887	0.30	1	0.01								
888	1.67	1	0.01	3	0.01	9	0.01	5	0.01	1	0.01 b
918	1.14	3	0.01	5	0.01					3	0.01 b
920	0.18	1	0.01	1	0.01						
928	0.27	1	0.01			1	0.01				
931	0.17	1	0.01								
936+	0.77	3	0.01					1	0.01		
943+	34.35	51	0.32	11	0.03	109	0.03	88	0.16		
956+	1.50	1	0.01					1	0.01		
982	3.62	2	0.01			2	0.01	4	0.01		
1001	0.73			2	0.01	2	0.01			5	0.01 b
1035	0.23							1	0.01		
1048+	2.82	3	0.01			4	0.01				
1052	0.68							1	0.01		
1053	0.89	6	0.01	4	0.01					1	0.01 b
1059	0.48	4	0.04			5	0.04	3	0.01		

Notes:

a = cob fragment
b = acorn meat
c = acorn cap
d = hazel nutshell
e = beech nut husk
f = wanut
g = chestnut
h = pecan

Table B:5. Counts of seeds identified in the West Jefferson flotation samples.

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
A		Chenopodium (1) Phalaris (2)	Diospyros (9)		Unidentified (1) Unidentifiable (2)
B	Cucurbita (2)	Phalaris (5)	Diospyros (43) Prunus am. (1)		Unidentified (1) Unidentifiable (16)
C			Diospyros (11)		Ilex (1) Unidentifiable (14)
E		Amaranthus (3) Chenopodium (16) Fabaceae (4) Phalaris (58) Poaceae (3) Portulaca (1) Strophostyles (5) Vicia (1)	Diospyros (8) Prunus am. (12) Vitis (1) Sambucus (3)		Galium (2) Malvaceae (3) Polanisia (1) Unidentifiable (42)
G		Amaranthus (2) Fabaceae (1)			Unidentifiable (6)
H		Chenopodium (8) Fabaceae (1) Phalaris (165) Poaceae (2) Polygonum (1)	Diospyros (39) Passiflora (1) Prunus am. (2)	Acalypha (2)	Magnolia (1) Unidentifiable (24)
I		Amaranthus (1) Helianthus (1) Phalaris (25) Poaceae (1)	Diospyros (30)		Compositae (2) Unidentifiable (10)
J		Fabaceae (1) Phalaris (8) Chenopodium (1) Portulaca oleracea (1)	Diospyros (15) Rhus (4)		Unidentifiable (10)
K		Phalaris (9)	Diospyros (7)		Unidentifiable (8)
L		Arundinaria (1) Chenopodium (3) Fabaceae (2) Phalaris (35) Portulaca (2)	Diospyros (25) Prunus (2) Rhus (1)	Mollugo (2)	Unidentified (1) Unidentifiable (24)
M	Zea [cupule] (1)	Chenopodium (3) Fabaceae (1)	Diospyros (4) Gleditsia (1) Prunus (1)		Unidentifiable (13)
N		Amaranthus (2) Chenopodium (44) Phalaris (1)	Diospyros (13) Rhus (309)	Phytolacca (2)	Unidentified (1) Unidentifiable (9)

Table B:5. Counts of seeds identified in the West Jefferson flotation samples (continued).

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
O		Phalaris (5)	Diospyros (29) Prunus (4) Rhus (1)		Unidentified (1) Unidentifiable (1)
P		Amaranthus (1) Polygonum (1) Portulaca (2)	Diospyros (4) Passiflora (1)	Euphorbia (1)	Unidentified (1) Unidentifiable (4)
Q		Phalaris (16) Poaceae (10) Portulaca (1)	Diospyros (15) Rhus (1)		Unidentified (1) Unidentifiable (5)
R		Chenopodium (1) Phalaris (2) Poaceae (2) Polygonum (1) Portulaca (1) Poaceae (1)	Diospyros (6) Rhus (1)		Unided. [other] (3) Compositae (1) Unidentifiable (15)
S					Unidentifiable (17)
T		Phalaris (6) Hypoxis (1)	Vitis (4)		Unidentifiable (9)
U		Cyperaceae (1) Amaranthus (1)	Vitis (1) Sabal minor (2)		Unidentifiable (14)
V		Phalaris (1)	Diospyros (3 Vitis (2)		Unidentifiable (13)

Table B:6. Counts of seeds identified in the Moundville I flotation samples.

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
99		Chenopodium (2) Poaceae (1)	Diospyros (5) Vaccinium (1)		Unidentified (2)
102+	Cucurbita (1) Phaseolus (11)	Arundinaria (2) Chenopodium (9) Fabaceae (5) Phalaris (1) Poaceae (2) Polygonum (1)	Diospyros (4) Passiflora (1)		Unidentifiable (5)
109+		Chenopodium (1)	Diospyros (1)		Unidentifiable (2)
124		Arundinaria (2) Chenopodium (5) Fabaceae (1) Phalaris (1)	Rhus (1)		Unidentifiable (1)
148		Chenopodium (1)	Diospyros (5)		
165		Arundinaria (1) Chenopodium (1) Fabaceae (1)	Diospyros (66)		Unidentifiable (2)
171					Unidentifiable (2)
197					Unidentifiable (2)
204		Chenopodium (8) Poaceae (1) Scleria (1)	Diospyros (1)		Unidentifiable (6)
221			Diospyros (1)		
249		Phalaris (1)	Diospyros (1)		
256		Phalaris (1) Polygonum (1)			Unidentifiable (1)
259		Chenopodium (6) Fabaceae (2)	Diospyros (1) Rubus (1)		
264		Arundinaria (1) Chenopodium (8) Poaceae (3) Cyperus (1) Cyperaceae (2)			Ipomoea (2) Unidentifiable (9)
291+	Cucurbita (1)	Amaranthus (4) Arundinaria (1) Chenopodium (24) Fabaceae (1) Phalaris (4) Poaceae (32) Polygonum (1) Scleria (2)	Diospyros (22) Passiflora (4) Rhus (1) Sambucus (3)	Croton (2)	Ilex vom. (2) Ipomoea (1) Unidentifiable (13)

Table B:6. Counts of seeds identified in the Moundville I flotation samples (continued).

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
293+	Phaseolus (11)	Amaranthus (5)	Diospyros (52)	Acalypha (1)	Galium (2)
		Arundinaria (7)	Vaccinium (8)	Mollugo (2)	Ipomoea (4)
		Chenopodium (56)	Vitis (2)		Compositae (1)
		Fabaceae (5)	Sambucus (10)		Malvaceae (2)
		Phalaris (7)			
		Poaceae (10)			
		Sesbania (2)			
294		Chenopodium (3)			Unidentifiable (4)
		Poaceae (1)			
		Scleria (1)			
296		Arundinaria (1)	Diospyros (6)		Unidentifiable (3)
		Chenopodium (3)	Vaccinium (1)		
		Fabaceae (2)			
		Poaceae (1)			
		Lespedeza (1)			
318		Chenopodium (2)	Diospyros (1)		Unidentifiable (1)
		Helianthus (1)	Sambucus (1)		
		Poaceae (1)			
330+	Phaseolus (26)	Arundinaria (1)	Diospyros (56)		Ipomoea (3)
		Chenopodium (5)	Rubus (1)		Malvaceae (2)
		Phalaris (1)	Vaccinium (1)		Unidentifiable (33)
		Poaceae (5)			
		Strophostyles (1)			
359+		Amaranthus (4)	Diospyros (8)		Ipomoea (1)
		Chenopodium (3)	Rubus (1)		Unidentifiable (2)
		Phalaris (4)	Passiflora (1)		
370		Poaceae (1)	Diospyros (3)		
381			Diospyros (1)		Unidentifiable (1)
383			Diospyros (2)		
388			Diospyros (2)		
391+		Arundinaria (1)	Diospyros (8)		Unidentifiable (3)
		Fabaceae (2)			
		Poaceae (1)			
394+		Chenopodium (7)	Diospyros (4)		Unidentifiable (6)
		Phalaris (1)	Passiflora (1)		
		Poaceae (1)	Vitis (1)		
416		Arundinaria (1)	Diospyros (1)		
		Chenopodium (1)			
424			Diospyros (1)		

Table B:6. Counts of seeds identified in the Moundville I flotation samples (continued).

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
445+		Arundinaria (1) Chenopodium (2) Fabaceae (1) Phalaris (1) Poaceae (2)	Diospyros (8)	Euphorbiaceae (1)	Unidentified (3) Unidentifiable (17)
446			Diospyros (3)	Phytolacca (1)	
447		Arundinaria (2)			Unidentifiable (2)
455			Diospyros (3)		
456+	Phaseolus (3)		Diospyros (4)		
460			Diospyros (3)		
468			Diospyros (44)		Unidentifiable (1)
469		Phalaris (1) Polygonum (1)	Diospyros (3)		Unidentifiable (1)
476+	Helianthus (2)	Arundinaria (3) Chenopodium (1) Phalaris (3) Poaceae (5) Portulaca (1)	Diospyros (10)		Ipomoea (1) Unidentifiable (2)
484+		Phalaris (1) Poaceae (1)	Diospyros (1)		
488					Unidentified (1)
489	Zea [Kernel] (1)				
534+		Phalaris (1)	Diospyros (4) Vaccinium (1)		Ipomoea (2)
548+		Chenopodium (2)	Rubus (2)		Unidentifiable (1)
560+		Chenopodium (2) Phalaris (1) Poaceae (1) Polygonum (1)	Diospyros (9) Rubus (1)		Ipomoea (1) Unidentified (1) Unidentifiable (15)
564					Unidentifiable (1)
584		Phalaris (1) Cyperaceae (1)	Diospyros (1) Sambucus (1)		Unidentifiable (1) Compositae (1)
618			Diospyros (2)		Unidentifiable (1)
619		Chenopodium (1)	Diospyros (3)		
634					Unidentifiable (1)
641+		Polygonum (1)	Diospyros (6)		Unidentified (1) Unidentifiable (19)

Table B:6. Counts of seeds identified in the Moundville I flotation samples (continued).

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
666+		Amaranthus (3) Arundinaria (2) Chenopodium (6) Phalaris (6) Poaceae (2) Polygonum (1)	Diospyros (27) Passiflora (1) Vitis (1)		Galium (1) Unidentified (1) Unidentifiable (24)
667+		Amaranthus (2) Arundinaria (3) Phalaris (12)	Diospyros (37) Passiflora (1)	Euphorbiaceae (1)	Galium (1) Ipomoea (1) Compositae (1) Unidentifiable (14)
672			Diospyros (2)		
714+		Chenopodium (1) Phalaris (3)			Unidentifiable (3)
724+		Chenopodium (1)	Diospyros (40)		Unidentifiable (10)
724+		Polygonum (1) Hypoxis (1)	Prunus am. (2) Vaccinium (3) Passiflora (2)		
728					Unidentifiable (1)
731+					Unidentifiable (1)
741			Diospyros (1)		
768+		Amaranthus (1)	Diospyros (2)		
769+		Arundinaria (1)	Diospyros (3)		
776		Chenopodium (1) Phalaris (2) Portulaca (1)	Diospyros (1)		Compositae (1) Unidentifiable (4)
780		Phalaris (6)	Diospyros (4)		Compositae (1) Malvaceae (1) Oenothera (3) Unidentifiable (1)
782+			Diospyros (6)		Ilex (1)
782+		Phalaris (2)			Unidentifiable (2)
785		Amaranthus (1) Phalaris (103) Polygonum (11) Portulaca (1) Chenopodium (93)	Diospyros (17) Vitis (2)	Euphorbiaceae (1))	Ipomoea (1) Compositae (1) Unidentifiable (21)
789		Phalaris (2)	Diospyros (3)		
802+			Diospyros (1)	Mollugo (1)	
807+		Chenopodium (5) Poaceae (2)	Diospyros (18) Vaccinium (1) Passiflora (2)		Ipomoea (2) Unidentified (1) Unidentifiable (11)

Table B:6. Counts of seeds identified in the Moundville I flotation samples (continued).

FSN	Counts				
	Cultigens	Small Grain and Oil Seeds	Fleshy Fruits	Greens	Others
814		Chenopodium (5) Phalaris (1)	Diospyros (50)	Mollugo (1)	Unidentifiable (9)
817		Cyperus (1)	Diospyros (1)	Mollugo (1)	
883+		Chenopodium (1) Poaceae (1)			Ipomoea (1) Unidentifiable (9)
899+		Amaranthus (1) Chenopodium (2)	Diospyros (11)		Unidentifiable (4)
916+		Arundinaria (1) Phalaris (1) Poaceae (4) Strophostyles (1) Chenopodium (1)	Diospyros (9)	Mollugo (2)	Ipomoea (1) Unidentifiable (2)
822					Unidentifiable (1)
885		Poaceae (1)			
888			Diospyros (4)		
918					Unidentifiable (2)
920					Unidentifiable (1)
928					Unidentifiable (1)
931					Unidentifiable (1)
936+			Diospyros (2)		Unidentifiable (4)
943+		Amaranthus (1) Chenopodium (2) Fabaceae (2) Poaceae (1) Polygonum (3)	Diospyros (8) Passiflora (2) Vaccinium (1) Vitis (1)	Euphorbiaceae (1) Phytolacca (76) Mollugo (2) Portulaca (2)	Compositae (1) Malvaceae (1) Unidentifiable (11)
956+					Unidentifiable (2)
1001			Diospyros (4)	Phytolacca (3)	Unidentifiable (7)
1048+		Phalaris (1)			Unidentified (1)
1052					Unidentifiable (2)
1053		Poaceae (1)	Diospyros (7)		
1059			Diospyros (1)		Unidentifiable (2)

Table B:7. Taxa identified in the flotation samples

TAXONOMIC NAME	COMMON NAME
NUTS	
Carya sp.	Hickory (shell, meat)
Carya illinoensis	Pecan
Castanea dentata	Chestnut
Corylus sp.	Hazel
Fagus grandifolia	Beech (husk)
Juglans nigra	Walnut
Quercus sp.	Acorn (cap, meat, shell)
CULTIGENS	
Cucurbita pepo	Squash
Cucurbita sp.	Cucurbit rind
Phaseolus vulgaris	Bean
Zea mays	cob, kernel, cupule
SMALL GRAIN AND OIL SEEDS	
Amaranthus sp.	Amaranth
Arundinaria sp.	Cane
Chenopodium sp.	Chenopod
Cyperaceae	Sedge
Cyperus sp.	Sedge
Fabaceae	Legume
Helianthus annuus	Sunflower
Hypoxis sp.	Yellow Star-grass
Iva sp.	Sumpweed
Lespedeza sp.	Lespedeza
Phalaris caroliniana	Maygrass
Poaceae	Grass
Polygonum sp.	Knotweed
Portulaca oleracea	Purslane
Scirpus sp.	Bulrush
Scleria sp.	Nut Rush
Sesbania sp.	Sesbania
Strophostyles sp.	Wild Bean
Vicia sp.	Vetch

Table B:7. Taxa identified in the flotation samples (continued).

TAXONOMIC NAME	COMMON NAME
FLESHY FRUITS	
Diospyros virginiana	Persimmon
Gleditsia triacanthos	Honey Locust
Passiflora incarnata	Maypop
Prunus sp.	Cherry/Plum
Prunus americana	Plum
Rhus sp.	Sumac
Rubus sp.	Bramble
Sabal minor	Palmetto
Sambucus canadensis	Elderberry
Vaccinium sp.	Blueberry
Vitis sp.	Grape
GREENS	
Acalypha sp.	Three-seeded Mercury
Croton sp.	Croton
Euphorbiaceae	Spurge
Euphorbia sp.	Spurge
Mollugo verticillata	Carpetweed
Phytolacca americana	Pokeweed
OTHERS	
Compositae	Composite
Galium sp.	Bedstraw
Ilex sp.	Holly
Ilex vomitoria	Yaupon
Ipomoea sp.	Morning Glory
Magnolia sp.	Magnolia
Malvavaceae	Mallow
Nyssa biflora	Black Gum
Oenothera sp.	Evening Primrose
Pinus sp.	Pine Cone
Polanisia sp.	Clammyweed
Unidentified	plant structure
Unidentified	seed
Unidentifiable	seed
Wood	

APPENDIX C

NUT AND SEED TAXA IDENTIFIED IN FINE-SCREEN SAMPLES

This appendix presents data on the taxa identified in the fine-screen samples from Moundville I contexts. No fine-screen samples from West Jefferson contexts were analyzed.

Table C:1 lists provenience data for the fine-screen samples. For each sample a FSN (field specimen number) is listed. A "+" after the FSN indicates that there was more than one sample from a provenience. Multiple samples from a single provenience were combined for analysis and the tables present data for the composite samples. Three columns in Table C:1 present weight data. The provenience weight is the total weight in grams of materials caught in the 1/16-inch screen. The sample weight is the weight in grams of the subsample from which plant remains were extracted using zinc chloride. Plant weight is the weight in grams of all carbonized plant remains greater than 1.4 mm in size. It is this figure that was used to standardize the count data for analysis.

Table C:2 presents quantified data for wood, nutshells, and maize remains in the fine-screen samples. The counts and weights listed are raw values <u>not</u> the standardized values used for analysis. The FSN column is the key that ties the taxa data to the provenience data.

Table C:3 presents counts of seeds identified in the fine-screen samples. The counts listed are raw counts and include whole seeds and seed fragments. Maize is not listed in the cultigen column because counts and weights for maize remains are given in Table C:2. The FSN column is the key that ties the taxa data to the provenience data. To conserve space in the data tables, seed taxa are identified by genus only (see Appendix B, Table B:7 for the taxonomic identifications and common names for taxa listed in the data tables).

Table C:1. Provenience data for Moundville I fine-screen samples.

FSN	Site	Phase	Context	Unit	Level		Weight (g)		
							Provience	Sample	Plant
101	Moundville-NR	Mdvl. I	Floor	6N2W	8		1737.0	500.0	7.84
118+	Moundville-NR	Mdvl. I	Daub	6N2W	9		15862.0	3145.0	33.56
154	Moundville-NR	Mdvl. I	Floor	8N2E	7		4151.0	500.0	4.00
169	Moundville-NR	Mdvl. I	Midden	6N2W	10		630.3	500.0	5.76
170+	Moundville-NR	Mdvl. I	Midden	8N2E	7		2005.3	1423.1	11.35
196+	Moundville-NR	Mdvl. I	Floor	6N2W	11		764.6	642.7	3.89
219	Moundville-NR	Mdvl. I	Floor	6N2W	12		928.5	500.0	5.46
244	Moundville-NR	Mdvl. I	Floor	6N2W	13		692.3	500.0	6.42
258	Moundville-NR	Mdvl. I	Midden	8N2E	8		3855.5	500.0	4.50
261+	Moundville-NR	Mdvl. I	Floor	6N2W	14		2640.4	1852.9	23.95
263	Moundville-NR	Mdvl. I	Daub	8N2E	8		4876.1	500.0	3.59
295	Moundville-NR	Mdvl. I	Ash Lense	8N2E	9		666.1	666.1	10.33
305	Moundville-NR	Mdvl. I	Floor	8N2E	9A	A34	1177.0	500.0	4.96
321+	Moundville-NR	Mdvl. I	Floor	8N2E	10		1130.3	922.8	12.75
326	Moundville-NR	Mdvl. I	Midden	6N2W	15		9355.3	500.0	5.65
378	Moundville-NR	Mdvl. I	Floor	6N2W	16		400.9	400.9	3.30
380	Moundville-NR	Mdvl. I	Clay	6N2W	17		1849.2	500.0	3.71
382	Moundville-NR	Mdvl. I	Floor	6N2W	18		420.5	420.5	3.60
385	Moundville-NR	Mdvl. I	Midden	6N2W	19		351.9	351.9	3.96
415	Moundville-NR	Mdvl. I	Floor	6N2W	21		1033.8	500.0	6.07
423	Moundville-NR	Mdvl. I	Midden	6N2W	22		639.2	500.0	6.33
425	Moundville-NR	Mdvl. I	Floor	8N2E	11		1373.8	500.0	2.84
459	Moundville-NR	Mdvl. I	Floor	6N2W	23		3592.8	500.0	1.37
492	Moundville-NR	Mdvl. I	Floor	8N2E	12		3575.8	500.0	3.51
501	Moundville-NR	Mdvl. I	Midden	6N2W	24		6114.2	500.0	1.06
535+	Moundville-NR	Mdvl. I	Midden	6N2W	25		9300.5	1374.1	3.94
547	Moundville-NR	Mdvl. I	Floor	8N2E	13		237.0	237.0	0.59
554	Moundville-NR	Mdvl. I	Midden	8N2E	14		10392.4	500.0	4.23
591+	Moundville-NR	Mdvl. I	Midden	6N2W	26		5042.9	1000.0	4.89
617	Moundville-NR	Mdvl. I	Floor	8N2E	15		1245.5	500.0	4.74
620	Moundville-NR	Mdvl. I	Midden	6N2W	27	S	5863.1	500.0	2.70
621	Moundville-NR	Mdvl. I	Floor	8N2E	16		1816.3	500.0	3.55
640+	Moundville-NR	Mdvl. I	Midden	8N2E	17		4276.2	1893.5	26.78
725	Moundville-NR	Mdvl. I	Floor	8N2E	18		773.7	500.0	0.72
729	Moundville-NR	Mdvl. I	Floor	8N2E	19		2791.0	500.0	0.48
738	Moundville-NR	Mdvl. I	Midden	8N2E	20		1848.4	500.0	0.47
740	Moundville-NR	Mdvl. I	Floor	8N2E	21		1360.0	500.0	0.53
775	Moundville-NR	Mdvl. I	Floor	8N2E	22		1872.1	500.0	2.21
779	Moundville-NR	Mdvl. I	Floor	8N2E	23		1084.4	500.0	6.46

Table C:1. Provenience data for Moundville I fine-screen samples (continued).

FSN	Site	Phase	Context	Unit	Level	Weight (g)		
						Provience	Sample	Plant
788	Moundville-NR	Mdvl. I	Floor	8N2E	24	527.6	527.6	9.96
790	Moundville-NR	Mdvl. I	Midden	8N2E	25	529.0	529.0	2.45
801+	Moundville-NR	Mdvl. I	Midden	6N2W	28	5400.4	2500.0	7.73
816	Moundville-NR	Mdvl. I	Midden	8N2E	26	1154.6	500.0	2.26
846	Moundville-NR	Mdvl. I	Midden	8N2E	27	1923.9	500.0	0.51
820	Moundville-SCB	Mdvl. I	Midden	TUA	2	1652.0	500.0	9.41
884	Moundville-SCB	Mdvl. I	Midden	TUA	3	1661.6	500.0	10.06
886	Moundville-SCB	Mdvl. I	Midden	TUA	4	1494.0	500.0	12.69
926	Moundville-SCB	Mdvl. I	Floor	TUA	5	291.0	291.0	1.85
972	Moundville-SCB	Mdvl. I	Midden	TUD	2	3313.7	500.0	13.43
990	Moundville-SCB	Mdvl. I	Midden	TUD	5	699.0	699.0	13.89
1005	Moundville-SCB	Mdvl. I	Midden	TUD	3	2533.0	500.0	9.86
1007	Moundville-SCB	Mdvl. I	Floor	TUD	4	425.6	425.6	4.71

Table C:2. Quantities of wood, nutshell, and maize remains in Moundville I fine-screen samples.

FSN	Hickory		Acorn		Wood	Maize				Other	
						Kernels		Cupules			
	Count	Weight	Count	Weight	Weight	Count	Weight	Count	Weight	Count	Weight
101	92	0.47	28	0.04	5.88			96	0.36		
108+	157	2.51	162	1.24	17.06	222	0.86	316	1.02		
113+	96	0.48			8.50	125	0.33	116	0.40		
118+	50	0.30	66	0.11	22.07	772	3.84				
154	22	0.10	65	0.12	3.53	19	0.07	49	0.17		
169	17	0.10	9	0.02	5.06	67	0.30	31	0.09		
170+	74	0.45	156	0.28	9.31	88	0.32	114	0.37	8	0.02 a
196+	37	0.16	40	0.05	3.18	52	0.21	58	0.18		
219	59	0.34	24	0.05	4.62	47	0.13	85	0.20		
244	88	0.42	88	0.14	4.74	44	0.16	297	0.71		
258	25	0.09	43	0.06	3.97	36	0.10	48	0.13		
261+	282	1.55	253	0.40	19.00	215	0.65	388	1.11		
263	2	0.01	7	0.01	3.40	13	0.05	20	0.06		
295	47	0.29	62	0.15	9.18	29	0.17	62	0.19		
305	29	0.15	68	0.09	4.27	29	0.08	74	0.21		
321+	70	0.43	113	0.17	11.61	51	0.13	120	0.38	4	0.03 b
326	35	0.23	33	0.07	4.76	39	0.14	60	0.26		
378	24	0.10	43	0.05	2.82	22	0.05	50	0.11		
380	16	0.07	19	0.02	3.38	24	0.06	45	0.11		
382	25	0.12	53	0.08	3.30	18	0.06	15	0.03		
385	21	0.07	72	0.12	3.62	14	0.04	22	0.06		
415	18	0.16	27	0.09	5.06	61	0.15	28	0.12		
423	27	0.15	19	0.04	5.70	49	0.12	15	0.03		
425	10	0.04	40	0.07	2.41	31	0.09	42	0.12		
459	6	0.01	9	0.03	1.20	14	0.04	6	0.02		
492	26	0.10	42	0.06	2.95	35	0.12	72	0.16		
501	2	0.02	4	0.01	0.97	16	0.04	1	0.01		
535+	10	0.01	70	0.14	3.40	63	0.07	9	0.02		
547			9	0.01	0.54	6	0.01	13	0.02		
554	22	0.14	33	0.04	3.68	36	0.12	47	0.13		
591+	7	0.08	25	0.07	4.09	58	0.24	19	0.07		
617	26	0.09	80	0.14	4.14	30	0.06	62	0.16		
620	10	0.06	15	0.03	2.37	38	0.14	6	0.02		
621	35	0.19	13	0.01	2.99	35	0.10	28	0.05		
640+	218	0.88	128	0.21	22.03	254	0.79	323	0.[illegible]		
725	1	0.01	7	0.01	0.66	5	0.01				
729	1	0.01	11	0.01	0.43			3	0.01		
738	3	0.01			0.35	2	0.01	4	0.01		
740	6	0.02	3	0.01	0.47	9	0.01				
775	6	0.01	2	0.01	1.99	35	0.07	17	0.05		
779	6	0.03	7	0.01	5.17	25	0.05	21	0.06		
788	9	0.04	7	0.01	8.59	23	0.04	13	0.03		
790	8	0.01	5	0.01	2.37	14	0.04	2	0.01		
801+	5	0.07	12	0.04	6.45	43	0.13	4	0.01		
816	2	0.02	2	0.01	2.11	9	0.02	8	0.01		

Table C:2. Quantities of wood, nutshell, and maize remains in Moundville I fine-screen samples.

FS	Hickory		Acorn		Wood	Maize				Other	
						Kernels		Cupules			
	Count	Weight	Count	Weight	Weight	Count	Weight	Count	Weight	Count	Weight
820	78	0.28	125	0.24	8.11	52	0.13	82	0.18		
846			1	0.01	0.49						
884	58	0.45	34	0.06	9.49	37	0.14	40	0.11		
886	37	0.17	17	0.02	11.56	48	0.18	51	0.30		
926	2	0.01	1	0.01	1.74	4	0.02	2	0.01		
972	93	0.69	3	0.01	12.19	60	0.30	31	0.09		
990	54	0.20	15	0.01	13.23	30	0.11	17	0.02		
1005	21	0.07	6	0.01	9.23	90	0.30	18	0.02		
1007	15	0.05	5	0.01	4.31	24	0.08	9	0.01		

Notes:

a = chestnut
b = walnut

Table C:3. Counts of seeds indentified in Moundville I fine-screen samples.

FSN	Cultigens	Small Grain	Fleshy Fruits	Greens	Others
1005		Vicia (2)	Diospyros (23) Passiflora (2)	Phytolacca (19)	Unidentifiable (33)
1007		Arundinaria (3)	Diospyros (10)		Unidentified (1) Unidentifiable (11)
101	Phaseolus (4)	Fabaceae (2) Sesbania (2)	Diospyros (28) Passiflora (1)		Unidentifiable (2)
108+	Phaseolus (2)	Arundinaria (3) Fabaceae (1)	Diospyros (56)		Unidentifiable (2)
113+		Arundinaria (3) Fabaceae (1)	Passiflora (2)		Ipomoea (1)
118+	Phaseolus (4)	Arundinaria (4) Fabaceae (5) Polygonum (1)	Diospyros (32) Passiflora (7) Vitis (1)	Croton (2)	Ipomoea (4) Unidentifiable (11)
154		Arundinaria (1) Polygonum (1)	Diospyros (5) Vitis (1)		
169		Chenopodium (4) Fabaceae (14) Lespedeza (1)	Diospyros (7) Passiflora (2)		Ipomoea (3) Unidentifiable (12)
170+	Phaseolus (30)	Arundinaria (9) Chenopodium (1) Fabaceae (28) Phalaris (1)	Diospyros (16) Passiflora (3)	Croton (1)	Compositae (1) Unidentifiable (13) Ipomoea (1)
196+		Arundinaria (2)	Diospyros (16)		Unidentifiable (2)

Table C:3. Counts of seeds indentified in Moundville I fine-screen samples.

FSN	Cultigens	Small Grain	Fleshy Fruits	Greens	Others
219		Arundinaria (1) Fabaceae (1)	Diospyros (8) Passiflora (1)		Unidentifiable (1)
244		Arundinaria (3)	Diospyros (20)	Acalypha (1)	
258	Phaseolus (8)	Arundinaria (1)	Diospyros (11) Passiflora (1)		Ipomoea (2) Unidentified (1) Unidentifiable (10)
261+		Arundinaria (8) Polygonum (1)	Diospyros (48) Passiflora (3) Vitis (3)		Unidentifiable (22)
263		Arundinaria (1) Chenopodium (2) Fabaceae (3) Strophostyles (4)	Diospyros (7)		Ipomoea (2) Unidentifiable (2)
295	Phaseolus (1)	Arundinaria (2) Chenopodium (1) Fabaceae (3)	Diospyros (10) Prunus am. (1)		Unidentifiable (1)
305		Arundinaria (2)	Diospyros (1)		Ipomoea (1)
321+	Cucurbita [r] (2)	Arundinaria (4) Chenopodium (1) Fabaceae (3)	Diospyros (23)		
326			Diospyros (5)		Unidentifiable (2)
378		Arundinaria (3) Polygonum (1)	Diospyros (4)	Croton (1)	
380			Diospyros (1)		
382		Arundinaria (2)			Unidentifiable (2)
385		Arundinaria (2)	Diospyros (1)		
415			Diospyros (2)		
423		Phalaris (1)	Diospyros (1)		
425		Arundinaria (2)	Passiflora (1)		Unidentifiable (2)
492	Phaseolus (3)	Arundinaria (2)	Diospyros (2) Vitis (1)		Ipomoea (1)
501			Diospyros (2)		
535+		Strophostyles (1) Scirpus (1)	Diospyros (9)		Unidentifiable (3)
554		Arundinaria (1) Iva (1) Polygonum (1)	Passiflora (1)		Unidentifiable (3)
591+			Diospyros (21) Prunus (1)		Unidentifiable (3)
617	Cucurbita [r] (1)	Arundinaria (26) Phalaris (1)	Diospyros (5)		Unidentifiable (3)
620			Diospyros (18)		Ipomoea (1)
621			Diospyros (3)		
640+		Arundinaria (2)	Diospyros (76)		Nyssa (1)
640+		Chenopodium (1)	Passiflora (2)		Unidentifiable (22)
640+		Fabaceae (1) Polygonum (3)	Vitis (8)		
725					Unidentifiable (1)
775		Polygonum (1)			

Table C:3. Counts of seeds indentified in Moundville I fine-screen samples.

FSN	Cultigens	Small Grain	Fleshy Fruits	Greens	Others
779			Diospyros (3)		
			Passiflora (2)		
788	Cucurbita [r] (2)	Strophostyles (2)	Diospyros (20)		Unidentifiable (2)
790			Diospyros (4)		Unidentifiable (2)
801+			Diospyros (2)		
816			Diospyros (1)		Unidentifiable (2)
820		Chenopodium (1)	Diospyros (10)		Nyssa (1)
			Passiflora (1)		Unidentified (5)
					Unidentifiable (34)
884			Diospyros (18)		Unidentifiable (10)
886		Poaceae (2)	Diospyros (28)		Ipomoea (1)
					Unidentifiable (20)
926			Diospyros (1)		Unidentifiable (3)
972		Poaceae (1)	Diospyros (13)		Ipomoea (2)
			Passiflora (1)		Unidentified (2)
					Unidentifiable (4)
990			Diospyros (9)		Unidentifiable (6)

APPENDIX D

MAIZE COB DATA FROM MOUNDVILLE AND THE WHITE SITE

This appendix presents data on maize cobs from Moundville and the White site. Table D:1 lists the provenience data for the contexts from which the cobs were recovered. Table D:2 presents attribute descriptions for each cob I measured from the two sites. Descriptions of the attributes are presented in detail in Chapter IX and need not be repeated here. The FSN (field specimen number) column in Table D:2 is the key to the provenience data presented in Table D:1.

Table 1. Provenience data for maize cobs from Moundville and the White site.

Site	FSN	Provenience	Phase
Moundville-NR	456+	8N2E FEAT 161 L 14	Moundville I
Moundville-NR	118+	6N2W L 9	Moundville I
Moundville-NR	102+	6N2W FEAT 43 L 8	Moundville I
Moundville-NR	81	6N2W L 7	Moundville II
Moundville-NR	96+	8N2E FEAT 3	Moundville III
Moundville-NR	43	6N2W L 5	Moundville III
Moundville-NW	51	WPA Excavations	Moundville
Moundville-NW	44	WPA Excavations	Moundville
Moundville-W	A250	WPA Excavations	Moundville
Moundville-WP	252	WPA Excavations	Moundville
Moundville-EE	268	WPA Excavations	Moundville
Moundville	?	WPA Excavations	Moundville
White Site	112	164/105 L 2	Moundville III
White Site	170	FEAT 22 W HALF	Moundville III
White Site	283	FEAT 56	Moundville III

Table D:2. Attribute descriptions of maize cobs from Moundville and the White site.

FSN	Cob[a] Frag. Type	Row Number	Strength[b] of Row Pairing	Cob[c] Shape	Cob[d] Frag. Length	Diameter[d] Max.	Diameter[d] Min.	Cupule[d] Ht.	Cupule[d] Wd.	Glume[d] Width	Cross[e] Section Shape	Irreg. Rows (P/A)	Conden. Index
456+	T	8	W	T	15.5	7.5	5.3	2.5	6.4	-	E	A	3.20
456+	M	10	W	S	21.6	11.4	10.7	4.0	8.0	-	C	A	2.50
456+	M-B	10	W	T	20.8	8.5	7.2	2.5	5.6	2.7	E	P	4.00
456+	M	10	W	S	16.1	7.0	6.6	2.2	5.1	-	C	A	4.54
456+	M	10	W	S	10.5	8.5	-	3.2	5.6	3.3	C	A	3.12
456+	M	10	W	S	11.4	8.5	-	3.7	5.2	3.0	C	A	2.70
456+	M	8	W	S	17.8	8.0	6.8	2.8	6.4	3.4	E	A	2.85
456+	T	10	W		7.4	4.4	-	1.5	2.4	-	C	A	6.66
456+	T-M	10	M	T	18.5	7.2	5.2	2.3	3.4	2.6	C	A	4.34
456+	M	10	W	S	12.3	7.3	7.3	2.5	4.5	-	C	A	4.00
456+	M	8	M	S	12.1	-	-	2.7	5.5	-	E	A	2.96
456+	M-T	10	W	T	11.5	7.4	5.9	2.9	4.3	2.3	C	A	3.44
456+	T	10	M	S	8.2	5.6	-	1.8	3.2	2.1	C	A	5.55
456+	T	8	W		7.8	6.6	-	2.7	4.0	3.3	C	P	2.96
456+	T	12	W	T	10.4	7.0	5.1	2.7	3.7	-	C	A	4.44
456+	M	8	M	S	7.4	5.5	-	2.2	3.8	-	C	A	3.63
118+	M-T	12	M	S	15.7	9.0	8.4	3.2	5.5	3.3	C	A	3.75
118+	M	12	W	S	14.2	10.2	-	3.4	5.2	-	E	P	3.52
118+	M-B	14	W	S	38.6	13.7	13.5	3.3	6.8	-	C	A	4.24
43	T-M	10	W	T	12.3	9.0	6.9	3.2	6.1	-	C	A	3.12
102+	M-T	14	W	T	25.6	10.5	9.2	3.6	6.1	3.3	C	A	3.88
102+	M	16	M	S	37.0	13.4	10.9	3.3	5.5	3.6	E	A	4.84
102+	M	14	W	T	54.5	14.8	13.2	3.4	6.4	3.5	C	A	4.11
102+	M-B	16	W	S	12.3	16.8	-	3.5	6.2	3.1	C	A	4.57
102+	M	14	M	S	13.1	12.1	-	3.5	6.7	-	E	A	4.00
81	M	10	M	S	36.0	14.6	9.4	2.5	6.9	-	C	A	4.00
170	T	10	W		8.1	7.2	-	2.7	5.5	-	C	A	3.70
170	T	8	W		10.6	7.6	-	2.5	6.9	-	E	A	3.20
170	M	8	W		11.4	8.4	-	2.8	5.7	-	C	A	2.85
170	M	10	W		7.0	12.1	-	3.2	6.6	-	E	A	3.12
170	M	10	M		9.6	8.3	-	2.7	4.2	-	C	A	3.70
170	M	10	W		9.1	9.7	-	2.9	5.5	-	C	A	3.44
170	M	8	M		8.9	11.4	-	3.6	7.7	4.1	Q	A	2.22
170	M	8	M		10.0	-	-	2.9	5.1	-	Q	A	2.75
170	M	8	M		7.3	9.7	-	2.6	7.1	-	Q	A	3.07
170	T	8	M		11.2	9.0	-	3.1	5.3	-	Q	A	2.58
170	M	8	S		4.6	8.3	-	2.7	5.2	-	Q	A	2.96
170	M	8	M		10.2	-	-	2.9	7.0	-	Q	A	2.75
170	M	10	M	S	12.7	9.6	-	3.0	5.5	-	C	A	3.33
170	M	10	M	S	9.8	12.1	-	3.6	7.4	-	C	A	2.77
170	T	8	M	S	11.7	11.1	-	3.2	7.9	-	C	A	2.50
170	M	10	W	S	13.3	9.6	-	2.7	5.6	-	C	A	3.70
170	T	8	M	S	14.1	10.5	-	2.7	7.2	-	E	A	2.96
170	M	12	M	S	10.6	12.2	-	3.3	5.2	-	C	A	3.63
170	T	8	M	T	12.2	8.5	-	2.8	5.7	-	C	A	2.85
170	M	12	W	S	13.0	9.0	-	2.4	5.3	-	C	A	5.00
170	T-M	10	W	S	22.6	8.3	7.9	2.9	5.3	-	C	A	3.44
170	T	10	W	S	14.7	9.3	-	3.1	5.4	-	C	A	3.22
170	T	12	M	S	15.4	10.0	9.3	3.0	5.3	-	E	A	4.00
170	T	10	W	S	16.7	8.5	-	3.2	5.3	-	C	A	3.12

Table D:2. Attribute descriptions of maize cobs from Moundville and the White site (continued).

FSN	Cob Frag. Type	Row Number	Strength of Row Pairing	Cob Shape	Cob Frag. Length	Diameter Max.	Diameter Min.	Cupule Ht.	Cupule Wd.	Glume Width	Cross Section Shape	Irreg. Rows (P/A)	Conden. Index
170	M	10	M	S	13.7	10.5	-	2.9	5.9	-	C	A	2.29
170	T-M	10	W	S	22.9	9.6	8.5	3.3	5.9	-	E	A	3.03
170	M	10	W	S	18.1	10.8	10.2	3.1	6.5	-	C	A	3.22
170	T-M	10	M	S	21.4	9.6	8.8	3.5	6.3	-	C	A	2.85
170	T	10	M	S	13.4	9.6	-	3.6	6.2	-	C	A	2.77
170	T	12	M	S	18.8	11.5	-	3.2	6.6	-	C	A	3.75
170	T-M	12	W	S	30.3	11.9	10.2	3.6	6.5	-	C	A	3.33
170	M	12	W	S	23.0	12.6	11.0	2.2	5.9	-	C	A	5.45
170	M	8	M	S	22.1	10.6	10.6	3.2	7.5	-	E	A	2.50
170	T-M	10	M	S	20.4	10.2	10.0	2.7	6.2	-	C	A	3.70
170	M	8	M	S	13.6	7.1	-	2.8	6.4	-	C	A	2.85
170	T-M	8	S	S	30.6	10.0	7.9	3.1	6.7	-	Q	A	2.58
170	T-M	12	W	S	25.6	9.2	9.4	3.5	6.1	-	C	A	3.42
170	M	10	W	S	19.3	11.9	-	3.4	7.7	-	C	A	2.94
170	M	10	M	S	15.8	13.3	10.3	2.7	7.3	-	E	A	3.70
170	T	10	W	S	15.1	10.8	-	3.5	6.6	2.9	C	A	2.85
170	T-M	10	W	S	23.7	11.2	9.5	3.5	7.6	-	C	A	2.85
170	M	12	M	S	25.1	11.7	9.6	2.8	5.7	-	E	A	4.28
170	M	12	W	S	21.7	14.1	11.6	2.9	5.8	-	E	A	4.13
170	T-M	10	M	S	23.9	12.1	10.1	2.5	6.9	-	E	A	4.00
170	M	12	M	S	12.6	12.3	-	3.1	6.0	-	C	A	3.87
170	M	10	M	S	14.5	11.0	-	2.9	6.3	-	C	A	3.44
170	B	12	M	S	22.6	13.4	12.0	3.5	7.2	-	E	A	3.42
170	M	8	M	S	15.3	7.9	7.0	2.6	6.0	-	Q	A	3.07
170	M-T	10	M	T	18.3	9.6	8.2	3.1	5.5	-	E	A	3.22
170	W	10	W	S	50.6	15.0	10.7	3.1	7.5	-	C	P	3.22
170	M-B	12	W	S	40.2	17.4	14.2	3.2	8.6	-	E	P	3.75
170	M-B	10	W	S	42.2	13.2	12.3	3.1	8.0	4.2	C	A	3.22
170	M-T	10	W	S	42.5	11.0	10.2	2.9	7.1	-	C	A	3.44
170	M-T	12	W	S	25.3	11.3	9.7	2.9	5.5	-	C	A	4.13
170	M	10	W	S	17.5	9.6	8.9	3.5	5.8	-	E	A	2.85
170	M	10	M	S	10.4	10.2	-	3.4	6.2	-	C	A	2.94
170	T-M	12	W	S	19.4	8.7	7.7	2.5	4.2	-	C	A	4.80
170	M	8	M	S	19.8	10.0	9.0	3.1	6.9	-	Q	A	2.58
170	M	12	W	S	18.4	10.9	10.3	2.8	5.9	-	C	A	4.28
170	M	8	M	S	20.3	10.2	8.3	2.5	7.1	-	C	A	3.20
170	T-M	12	W	T	12.2	13.1	11.5	3.3	6.3	-	E	A	3.63
170	M-T	10	M	S	31.9	15.0	13.3	3.1	7.5	-	C	A	3.22
170	T-M	10	W	T	21.9	10.9	7.9	2.7	5.4	3.2	E	A	3.70
170	M	12	W	S	24.2	12.2	10.2	3.0	6.6	-	C	A	4.00
170	M	8	S	S	21.4	10.3	8.7	3.1	7.3	-	Q	A	2.58
170	T-M	10	M	S	13.2	7.4	5.6	2.7	3.6	-	C	A	3.70
170	M	10	M	S	20.9	10.4	9.3	2.8	5.9	-	E	A	3.57
170	M	12	W	S	22.3	12.7	12.2	3.7	6.7	-	E	A	3.24
170	T-M	10	M	S	22.1	10.1	7.2	2.9	5.8	3.5	E	A	3.44
170	M-T	10	M	S	25.9	10.1	8.3	2.9	6.6	-	C	A	3.44
170	M	10	M	S	18.2	12.3	9.2	3.4	7.2	4.3	E	A	2.94
170	M	10	W	S	22.2	14.1	11.3	2.6	6.5	-	E	A	3.84

Table D:2. Attribute descriptions of maize cobs from Moundville and the White site (continued).

FSN	Cob Frag. Type	Row Number	Strength of Row Pairing	Cob Shape	Cob Frag. Length	Diameter Max.	Diameter Min.	Cupule Ht.	Cupule Wd.	Glume Width	Cross Section Shape	Irreg. Rows (P/A)	Conden. Index
170	M-T	8	M	S	16.6	6.4	6.3	2.8	5.5	-	Q	A	2.85
170	M-B	8	M	T	26.3	10.9	10.0	2.9	8.2	-	Q	A	2.75
170	M-T	12	W	S	32.7	12.3	11.7	3.4	7.5	-	C	P	3.52
170	M-B	12	W	S	26.5	10.3	8.6	2.5	5.3	-	C	A	4.80
170	M-T	12	W	T	23.8	11.6	9.2	2.8	5.9	-	C	A	4.28
170	M-B	10	W	S	-	10.8	10.3	3.2	6.9	-	C	A	3.12
170	M	8	M	S	25.9	9.6	7.7	3.3	7.0	-	Q	A	2.42
170	M-B	8	M	S	24.3	9.7	9.2	2.5	6.3	-	Q	A	3.20
170	M-B	8	M	S	38.6	12.1	-	3.2	8.1	-	Q	A	2.50
170	M-B	10	W	S	33.8	10.8	10.3	2.6	7.2	3.3	C	A	3.84
170	M-T	8	M	S	23.0	10.2	8.2	3.0	7.3	3.7	Q	A	2.66
170	M	12	W	S	20.8	11.0	9.7	2.6	5.5	-	C	A	4.61
170	M-B	10	M	S	22.5	13.1	11.5	2.9	7.8	-	C	A	3.44
170	M	8	M	S	31.4	10.0	7.9	2.9	6.6	-	Q	A	2.75
170	M	8	M	S	23.7	10.0	9.5	2.4	6.9	-	Q	A	3.33
170	M	10	W	S	21.5	11.6	11.2	3.4	8.3	4.1	C	A	2.94
283	M	10	W	S	20.0	8.9	7.4	3.1	5.1	-	C	A	3.22
283	M	8	M	S	21.8	8.2	8.1	3.2	7.3	3.7	Q	A	2.50
283	M-T	12	W	S	20.5	7.6	6.5	2.8	4.4	-	C	A	4.28
112	M	8	M	S	10.1	5.8	-	3.3	4.2	-	Q	A	2.42
36+	M	10	W	S	8.8	8.8	-	2.6	5.3	-	E	A	3.84
36+	M	10	M	S	18.4	10.7	9.4	3.0	6.3	3.3	C	A	3.33
36+	T	10	W	T	11.6	9.5	-	3.5	5.9	3.5	C	A	2.85
36+	M	8	M	S	23.4	10.4	9.1	2.7	6.4	-	E	A	2.96
36+	M-T	8	M	S	20.3	10.1	8.3	3.1	6.5	4.3	Q	A	2.58
36+	T-M	14	W	S	25.7	13.2	10.7	3.2	6.5	-	C	A	4.37
36+	T-M	10	W	S	18.8	10.3	9.6	2.6	5.9	-	C	A	3.84
36+	T-M	10	M	T	13.1	12.6	-	3.2	7.1	4.2	C	A	3.12
36+	M	10	M	S	19.4	13.2	-	3.9	7.2	5.2	C	A	2.56
36+	M	10	M	S	15.0	7.9	7.4	2.7	5.4	-	C	A	3.70
36+	T-M	10	M	T	10.9	11.8	10.3	3.4	6.9	3.2	E	A	2.94
36+	M-T	10	M	S	31.7	10.4	7.2	3.6	6.4	3.5	E	A	2.77
36+	M	12	M	S	19.1	11.5	10.1	2.7	6.4	3.4	C	A	4.44
36+	M-T	8	S	S	21.7	11.1	9.1	2.9	7.3	4.8	Q	A	2.75
36+	M-T	10	M	T	16.5	10.0	8.6	3.3	6.6	-	C	A	3.03
36+	T	8	S	T	13.1	8.9	-	3.4	6.7	3.9	Q	A	2.35
36+	M	10	M	S	15.5	12.0	-	3.4	6.6	3.9	C	A	2.94
36+	M	10	M	S	23.3	10.6	9.2	3.1	6.6	-	E	P	3.22
36+	T	6	S	T	6.9	6.9	-	3.2	6.6	-	C	P	1.87
36+	M	10	M	S	8.8	10.6	-	3.3	7.1	-	E	A	3.03
36+	T-M	10	M	S	11.1	11.1	-	3.3	5.7	3.4	E	A	3.03
36+	M	10	M	S	15.1	10.0	8.1	3.6	5.6	-	C	A	2.77
36+	M	10	M		15.4	9.8	9.7	3.4	6.7	-	E	A	2.94
36+	T	8	S	S	13.9	9.5	-	2.7	6.2	-	E	A	2.96
36+	M	10	M	S	16.2	7.3	7.3	3.0	4.7	-	C	A	3.33
51	M-T	10	M	S	33.3	12.5	11.8	3.4	8.0	4.4	C	A	2.94
51	T-M	10	M	S	18.3	9.1	8.2	3.2	6.7	3.8	C	A	3.12
51	M-T	10	S	S	29.9	11.0	9.3	3.4	5.8	-	E	A	2.94
51	M	10	M	S	26.2	12.6	10.1	3.6	7.2	4.4	C	A	2.77

Table D:2. Attribute descriptions of maize cobs from Moundville and the White site (continued).

FSN	Cob Frag. Type	Row Number	Strength of Row Pairing	Cob Shape	Cob Frag. Length	Diameter Max.	Diameter Min.	Cupule Ht.	Cupule Wd.	Glume Width	Cross Section Shape	Irreg. Rows (P/A)	Conden. Index
51	M-T	8	S	T	29.9	9.9	7.0	3.1	6.3	-	Q	A	2.58
51	T-M	10	M	T	34.1	9.0	5.3	3.3	5.9	4.0	C	P	3.03
51	M	8	M	S	29.2	10.6	9.3	3.2	8.0	3.3	C	A	2.50
51	M-B	10	M	S	16.1	14.1	-	3.3	8.3	4.2	E	A	3.03
51	M	8	S	S	18.4	10.1	8.5	3.9	7.5	-	Q	A	2.05
51	M	8	S	S	20.7	11.3	9.0	3.7	8.4	4.2	C	A	2.16
51	M	10	M	S	27.1	9.4	9.2	3.9	5.7	-	E	P	2.56
51	M-T	10	M	S	22.5	10.4	-	3.3	7.3	4.1	E	A	3.03
51	M	10	M	S	19.6	7.3	7.0	3.2	6.1	4.0	E	A	3.12
51	M	10	M	S	13.9	12.1	8.6	2.7	6.1	3.5	E	A	3.70
51	T-M	8	M	S	14.4	10.1	-	3.2	5.9	3.8	C	A	2.50
51	M-T	8	M	T	20.3	10.8	8.3	3.6	6.6	4.1	Q	A	2.22
51	M	8	M	S	11.6	9.2	-	3.2	6.9	3.6	Q	A	2.50
51	T-M	8	S	T	20.8	10.8	8.0	3.6	7.4	3.2	Q	A	2.22
51	M-T	8	S	T	18.0	11.1	8.3	2.6	6.9	3.8	Q	A	3.07
51	M	8	W	S	10.1	11.1	-	3.1	7.9	4.1	C	A	2.58
51	T-M	8	M	S	12.6	8.3	8.2	3.1	6.3	-	Q	A	2.58
51	M	8	S	S	38.8	13.[illegible]	11.4	3.5	9.4	5.5	Q	A	2.28
51	M-T	10	M	S	30.3	10.2	8.3	3.1	7.8	4.2	C	A	3.22
51	M	8	S	S	21.9	14.3	13.1	3.9	8.6	5.1	C	A	2.05
51	T-M	12	W	T	30.9	11.2	8.9	3.2	5.6	3.4	E	A	3.75
51	M	8	W	S	20.8	10.6	9.2	3.0	6.7	4.1	C	A	2.66
51	M-T	10		S	22.1	13.6	10.8	3.0	8.0	4.4	E	A	3.33
51	M-T	8	S	T	22.4	9.9	7.8	3.7	6.7	3.5	Q	A	2.16
51	M	10	W	S	14.3	11.3	10.1	3.3	6.7	3.8	C	A	3.03
51	M	8	S	S	26.0	12.1	9.7	3.2	7.9	4.4	Q	A	2.50
51	T-M	10	M	S	29.0	9.3	7.6	3.0	5.3	-	C	A	3.33
51	M	8	W	S	10.7	11.1	-	3.4	7.3	4.3	C	A	2.35
51	T-M	10	M	S	18.2	10.1	8.6	3.1	7.1	3.4	E	A	3.22
51	T-M	12	M	T	18.1	10.7	8.7	3.0	5.5	-	E	A	4.00
51	T-M	8	M	T	14.6	7.6	6.9	3.9	6.7	4.2	Q	A	2.05
51	T-M	10	M	S	23.8	9.2	8.2	3.1	5.8	3.9	C	P	3.22
44	M	8	S	S	24.3	10.9	9.6	3.2	7.5	3.9	Q	A	2.50
44	M	8	S	S	9.4	8.8	-	3.6	6.4	4.1	C	A	2.22
44	M	10	M	S	16.6	12.5	12.1	3.9	8.0	-	C	A	2.56

Table D:2. Attribute descriptions of maize cobs from Moundville and the White site (continued).

FSN	Cob Frag. Type	Row Number	Strength of Row Pairing	Cob Shape	Cob Frag. Length	Diameter Max.	Diameter Min.	Cupule Ht.	Cupule Wd.	Glume Width	Cross Section Shape	Irreg. Rows (P/A)	Conden. Index
A250	M-B	8	S	S	23.7	12.7	10.7	3.5	8.2	4.7	C	P	2.28
A250	M-T	8	S	S	39.5	9.8	8.5	3.8	7.5	4.8	Q	A	2.10
A250	M	8	S	S	15.4	9.8	9.4	3.3	7.2	4.4	Q	A	2.42
A250	M-B	10	M	S	28.0	11.5	8.4	3.1	7.2	-	E	P	3.22
A250	T	8	M	S	13.2	10.8	-	3.1	6.7	3.9	C	P	2.58
A250	T	8	M	T	11.5	8.3	-	2.7	4.6	-	E	A	2.96
252	T-M	10	M	T	25.0	9.8	7.3	2.6	5.1	3.1	E	A	3.84
252	M-T	10	M	S	16.6	7.8	6.4	3.6	4.9	-	C	A	2.77
268	M	8	M	S	27.7	9.1	9.0	2.9	7.6	-	Q	A	2.75
?	M	12	W	S	23.9	10.6	9.6	3.0	6.3	4.1	C	P	4.00
?	M	12	W	S	23.5	13.2	10.3	3.6	5.6	3.6	E	A	3.33

Notes:

a. Cob fragment types: M--midsection; T--tip; B--butt; W--whole.
b. Strength of row pairing: S--strong; M--moderate; W--weak.
c. Cob shape: S--straight; T--tapered; C--cigar-shaped.
d. All measurements in mm.
e. Cross section shape: C--circular; E--elliptical; Q--quadrilateral.

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