8711112

Fritz, Gayle Jeannine

PREHISTORIC OZARK AGRICULTURE: THE UNIVERSITY OF ARKANSAS ROCKSHELTER COLLECTIONS

The University of North Carolina at Chapel Hill PH.D. 1986

University
Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark _✓_.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background _✓_
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy _____
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages _✓_
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _74_. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received _____
16. Other _____

University
Microfilms
International

PREHISTORIC OZARK AGRICULTURE

THE UNIVERSITY OF ARKANSAS ROCKSHELTER COLLECTIONS

by

Gayle Jeannine Fritz

A Dissertation submitted to the faculty of
the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Anthropology

Chapel Hill

1986

Approved by:

Richard A. Yarnell
Advisor

Donald L. Brockington
Reader

[illegible]
Reader

Carole L. Crumley
Reader

Bruce Winterhalder
Reader

GAYLE J. FRITZ. Prehistoric Ozark Agriculture, The University of Arkansas Rockshelter Collections (Under the direction of RICHARD A. YARNELL.)

The dry Ozark rockshelter sites excavated by the University of Arkansas Museum between 1929 and 1934 yielded many samples of well preserved plant remains which are the products of prehistoric agriculture. These collections have been undated in the past and therefore of limited utility. The series of 34 new radiocarbon dates presented here allows the samples to be placed in perspective in Eastern North America. The earliest dates demonstrate that domesticated sunflower and chenopod were stored in Ozark rockshelters as early as 900 B.C., along with ragweed, knotweed, and cucurbits. Thin-testa Chenopodium was an important crop until the early centuries of the first millennium A.D., when a pale colored chenopod seed type was grown. Radiocarbon dates on samples of the pale-seeded type indicate that the importance of this crop may have declined after A.D. 1200. Three dates on maygrass bundles are all relatively early (92 B.C.-A.D. 980), supporting an interpretation of decreasing utilization of starchy seed crops during the Mississippian period. A different, more distinctly domesticated type of Polygonum, however, occurs only in a sample dated to A.D. 1165. Cultigen amaranth is rare in the Ozark assemblages and appears to have been introduced after Chenopodium was an established crop.

Certain samples of sumpweed and sunflower achenes are larger than expected for the time periods to which they date, possibly reflecting their storage context. Two samples of relatively small sumpweed

achenes, however, yielded radiocarbon dates in the late Mississippian period, possibly due to a decline in emphasis, as with the starchy seed crops. Sunflower achene size did not decrease during late prehistory.

Maize evidently became a stored crop just prior to A.D. 1000, although the earliest specimens may not have been dated. It increased in importance after A.D. 1200. Ozark maize differs considerably from midwestern and northeastern samples by having fewer large 8-row cobs and many robust 10 and 12-row cobs that do not fall into the Eastern eight-row, Chapalote, or any intermediate type.

Among the desiccated samples are four peduncles of *Cucurbita mixta*, a species not previously documented prehistorically in eastern North America. There is also morphological evidence for husbandry of the native wild bean, *Phaseolus polystachios.*

CONTENTS

ACKNOWLEDGMENTS

The many people who helped me through this project deserve better thanks than this, but I hope they all understand how much I appreciate their assistance.

Analysis would have been impossible without the dedication and cooperation of the University Museum staff at the University of Arkansas. Mike Hoffman, Curator of Anthropology, handled my incessant requests and made valuable substantive contributions. Allyn Lord, a true saint, bore the responsibility for issuing and renewing loans and for shipping the many boxes. Other Museum staff members whose aid I am aware of include John Gentry, Peggy Hoffman, Marie Demeroukas, Nancy McCartney, Bob Winkleman, and Wanda Doty. I am especially grateful to Mary McGimsey for photographing plant remains and for furnishing prints of old negatives.

The Arkansas Archeological Survey was a continuous source of assistance. I thank C. R. McGimsey III, Hester Davis, and George Sabo III for years of encouragement and for site file information. My two-month stay in Fayetteville in 1984 was enhanced by Hester's hospitality as well as that of George and Deborah Sabo, Norma Hoffrichter, Marvin Kay, and Marvin Jeter. Dan Wolfman was a valuable consultant on matters relating to radiocarbon dating.

I would like to thank the Museum of the American Indian, Heye Foundation, for allowing me to examine their Ozark collections. Mary

Jane Lenz, Curator, scheduled my visit, and Shira Birnbaum assisted me with the collections.

Necessary funding was provided by the Graduate School, University of North Carolina at Chapel Hill, in the form of an Off-campus Dissertation Research Grant. The National Science Foundation funded a Dissertation Improvement Grant for radiocarbon dating and Scanning Electrope Microscope analysis. The Southern Methodist University Radiocarbon Laboratory provided 10 free dates, and Dr. Herbert Haas took great care with all chronometric analysis. Bruce Smith at the Smithsonian Institution provided two radiocarbon dates and helped enormously with analysis of Chenopodium.

The members of my committee, Richard Yarnell, Bruce Winterhalder, Carole Crumley, Donald Brockington, Roy Dickens, and Joffre Coe, were excellent teachers and advisors throughout my graduate student career. I am indebted especially Dr. Yarnell , my chairman, for the many precious afternoons of ethnobotanical instruction and for patience as I cluttered his laboratory with boxes and papers. My fellow graduate students helped with ideas and technical skills. Special thanks go to Homes Hogue Wilson for photographic assistance and to Julie Hammett for help with photography and word processing.

To my friends and neighbors in Chapel Hill, I am extremely grateful. A few who always came through when I needed child care or other help were Kris Borre, Marshi and Keith Huneycutt, and the Herrick family: Allan, Betsy, Ann Hart, and especially Harry.

My parents, Ned and Genie Fritz, can not possibly be acknowledged sufficiently, but they gave me the base to undertake this endeavor, and I truly could not have done it without them. My daughter, Jo Shannon

Cochran, was chief moral supporter during more years of graduate school than any child should have to endure. She was ready with a Chenopodium joke whenever things looked bleak, and she deserves the final credit for this dissertation's completion.

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION TO THE COLLECTIONS AND THE SITES

Ozark rockshelter archaeobotanical remains have been recognized as valuable sources of information about prehistoric agriculture since Mark Harrington introduced them to the archaeological community in 1924. Melvin Gilmore pointed out the special significance of certain specimens in 1931 after he had analyzed the plant remains excavated by Harrington. When the University of Arkansas Museum had begun a program of rockshelter excavations in the late 1920's, Gilmore urged the investigators to collect as many plant remains as possible (letter to S. C. Dellinger, February 3, 1932). Gilmore examined several shipments of desiccated rockshelter material from Arkansas in the early 1930's and spent time going through the samples in person at the University Museum in Fayetteville. In November, 1936, he wrote a letter to the botanist Edgar Anderson lamenting that he had been unable to publish the results of his later studies. Citing poor health as the inhibiting factor, Gilmore referred to the rockshelter specimens as "about the most interesting piece of work which I have ever found."

After Gilmore's death, the desiccated plants assumed an almost legendary status. They were mentioned often, but few researchers took the time to examine the collections themselves. Specimens retained by Gilmore at the University of Michigan Museum of Anthropology received the most direct attention, but isolated from their cultural contexts and of undetermined ages, interpretation had to remain limited. Still, the near-perfect state of preservation of these uncarbonized plants kept them in a position of esteem among paleoethnobotanists.

Beginning in the 1960's, advances in the ecological approach to the study of prehistory resulted in a more intense focus upon subsistence. Flotation recovery brought with it important discoveries concerning the antiquity of plant husbandry in the eastern Unites States. Domestication of sunflower, sumpweed, and chenopod had occurred by the first millennium before Christ. Some societies of the Middle Woodland period (broadly 300 B.C. to 400 A.D.) utilized these and at least two other native grain crops--maygrass and a knotweed. Maize does not enter the archaeological record in the east until later and is now seen as a cultigen introduced into an established gardening system based on gourds, oily seeds, and the small starchy grains (D. Asch and N. Asch 1985b; Ford 1981 and 1985; Johannessen 1984; Smith 1986b; Yarnell 1983 and 1985).

Using carbonized specimens, it has been difficult to distinguish morphological changes derived during domestication from natural variation that would be normal among wild and weedy populations. It has also been difficult to understand temporal change in eastern North American maize using the fragmentary evidence available. For these reasons, it seems expedient to return now to the well preserved Ozark samples with hundreds of maize cobs, bags of seeds, and bundles of seed heads, in order to document distinguishing characteristics.

This study, therefore, concentrates on plant foods present in the desiccated assemblages curated by the University of Arkansas Museum.

Emphasis has been placed on dating key crop types and on putting them in cultural context as far as possible. The rockshelter evidence is used to reconstruct agricultural prehistory in the southwestern Ozarks.

Central problems are those surrounding the evolution of indigenous Eastern crops and the adoption of maize. Relative ubiquity of the various starchy and oily seed crops was unknown at the beginning of the project. The temporal sequence of their initial appearance, maximum importance, and possible decline was totally undocumented. The initial assumption that most plant caches were deposited during the Late Woodland and Mississippian periods proved to be mistaken. New radiocarbon dates on larger samples of chenopod, maygrass, ragweed, and sumpweed ranged from the Late Archaic (ca. 3000 B.P.), through the Early, Middle, and Late Woodland (until ca. 1100 B.P.), and into Mississippian times. Seed types from the Ozarks that correspond morphologically to those found elsewhere in eastern North America at certain time periods turned out to be contemporaneous with their counterparts. This has been interpreted as reflecting parallel developmental trends across a broad region. A coevolutionary perspective, following Rindos (1984) and Smith (1986b) is accepted as the best current conceptual orientation for understanding these changes.

Maize was incorporated into this system by A.D. 1000 if not earlier, but did not become a commonly stored plant food in the rockshelters until approximately A.D. 1200. Its arrival as a major crop, probably the most significant crop, is accompanied by a decrease in numbers of samples of the native starchy seed types. The mechanism for this shift to maize agriculture is not well understood, especially the initial stage or stages between its introduction and subsequent ascendancy. The timing of maize introduction across the Eastern Woodlands is a subject of much current debate, and interpretations hinge on tentative chronometry. Speculations based on inherent qualities of this early—but nobody knows really how early—maize type are similarly untested.

Ozark maize did not undergo any transition from a high row number Chapalote-like type to a low row number Eastern complex type. An early type with uniformly high row numbers was not present. Large 10 and 12 row cobs are typical of the developed Mississippian period, while the eight-row cobs in these late prehistoric samples tend to be smaller and to have narrower shanks. It is suggested that the presence of assemblages with higher average row numbers in the Central Lower Mississippi Valley is a similar reflection of a separate southern maize agricultural history rather than retention of an undocumented but hypothesized early high row number type.

This dissertation should be of interest to anthropologists, other archaeologists, agronomists, and botanists studying the evolution of agriculture in general, development of food production in North America, and husbandry of the specific plant species represented in these collections. My primary goal has been to contribute to the understanding of subsistence change in the southwestern Ozarks and of plant domestication in eastern North America.

PREVIOUS STUDIES OF THE ROCKSHELTER COLLECTIONS

Crews from the University of Arkansas Museum excavated more than 80 Ozark rockshelter sites during the late 1920's and 1930's (Davis 1969). Results of these excavations were never synthesized nor published. Samuel C. Dellinger, Curator of the Museum, and his colleagues prepared a few papers on topics of special interest (Dellinger 1936; Dellinger and Dickinson 1942; Wakefield and Dellinger 1936 and 1940; Wakefield, Dellinger, and Camp 1937). Later, major contributions were made by graduate students studying portions of the curated rockshelter collections for M.A. theses. Charles Cleland (1960 and 1965) analyzed the extensive assemblages of faunal remains. Sandra C. Scholtz (1975) presented a meticulous investigation of cordage, netting, basketry, and fabrics. Jerry Hilliard (1980) interpreted patterns of acorn exploitation in the Ozarks using the large nut and acorn caches.

Plant remains from most of the sites were examined by M. R. Gilmore between the years 1931 and 1934. Although he was unable to publish the results, Gilmore left notes divided into eight numbered reports (18, 21, 24, 25, 27, 69, 71A, and 72A). The first six reports include plant remains sent to Gilmore at his laboratory in Ann Arbor. Report No. 69 was written by Volney Jones, at that time Gilmore's assistant. The last two reports, 71A and 72A, consist of identifications made in person by Gilmore at the museum in Fayetteville. By 1934, the ethnobotanist had traveled to Arkansas to bathe in resort springs in either the Ozarks or Ouachitas, and he stopped at the University of Arkansas to inspect the collections (Michael P. Hoffman, personal communication). Far more material was examined during these visits to Arkansas than was ever shipped to Michigan, although some of the identifications duplicate items listed in previous reports as well.

Like the excavation field notes, the ethnobotanical laboratory notes are for the most part cryptic inventories. Items were rarely counted or measured and there is no indication that Gilmore examined specimens under a microscope. Each lot was assigned a University of Michigan Ethnobotanical Laboratory number, which is listed below the Arkansas field symbol and catalog number. The contents of individual samples vary in size from a single seed or gourd rind fragment to a quantity of mixed debris including more than a dozen species of domesticated and wild plants.

We know that Gilmore was given permission to retain some items of special interest to him at the Ethnobotanical Laboratory at the University of Michigan, but the agreement may have been informal. No records inventorying the samples involved have been located in my search of the documents on file at Fayetteville, and no inventory is available from Michigan (Richard I. Ford, personal communication). The samples in Ann Arbor have been put to good use over the years, helping ethnobotanists in their investigations into the prehistoric husbandry of sumpweed (Blake 1939; Black 1963; Yarnell 1972, 1978, and 1981; D. Asch and N. Asch 1978), chenopod (D. Asch and N. Asch 1977; Wilson 1981), and maygrass (Cowan 1978).

The collections curated at the University of Arkansas Museum in Fayetteville have also been drawn upon over the years by ethnobotanists, resulting in contributions to reports on ragweed (Payne and Jones 1962), sunflower and sumpweed (Yarnell 1978 and 1981), and providing Wilson (1981) with his convincing evidence for the cultigen status of Chenopodium.

I analyzed curated samples of plant food remains from three of these shelter groups in Crawford County (Beaver Pond, Swearingen, and Tidwell Hollow) in 1981 as part of the Arkansas Archaeological Survey's subsistence-settlement studies in the proposed Pine Mountain reservoir area (Fritz 1986). In 1982, I studied plant foods from 12 Madison County shelters, all originally excavated in the 1930's as part of the Dellinger-directed research (Fritz 1982 and 1983). Data from these studies of Beaver Pond (3CW11), Holman Shelter (3MA34), and Poole Shelter 2 (3MA44) are incorporated into the current volume.

Additional information was contributed by the tabulation of plant food taxa listed in the various Gilmore-Jones Ethnobotanical Laboratory Reports (Fritz and Yarnell 1985). Patterns reflected by frequency of taxa recorded during Gilmore's brief macroscopic examination will be used to strengthen interpretations presented in this report, which focuses on only 19 of the sites.

Table 1.1

Sites Analyzed in this Study (In Alphabetical Order, by Name)

	Name	State Site #	Catalog #
1.	Agnew	3BE2	32-1
2.	Alred	3BE1	32-4
3.	Beaver Pond	3CW11	34-2
4.	Brown Bluff	3WA10	32-10
5.	Buzzard Roost	3CR5	32-15
6.	Cob Cave	3NW6	31-15,31-71,31-72
7.	Cow Ford	3BE7	32-17
8.	Craddock	3CW2	34-6
9.	Edens Bluff	3BE6	32-3
10.	Gibson	3WA19	32-21
11.	Green Bluff	3BE10	33-7
12.	Holman	3MA34	32-22
13.	Marble	3SE1	34-23
14.	Montgomery 4	23BY-	32-34
15.	Poole 2	3MA44	32-42
16.	Putnam	3WA4	32-44
17.	Salts Bluff	3BE18	33-15
18.	White Bluff	3BE21	32-56
19.	Whitney	3BE20	32-57

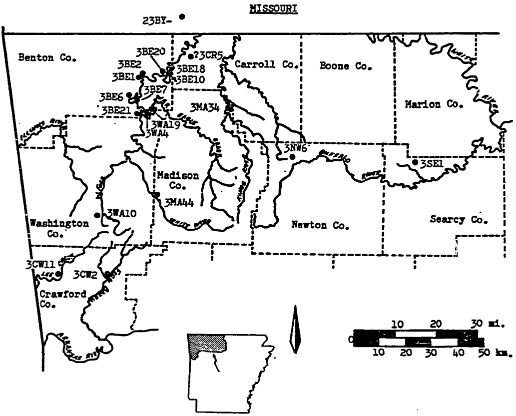
ROCKSHELTER SITES

The University of Arkansas Museum crews did not recover desiccated cultural material from all rockshelters excavated. A few sites contained perishable plant remains such as basketry, fiber, or wooden artifacts, but no plant foods. Gilmore's eight ethnobotanical laboratory reports dealing with these assemblages demonstrate that he observed plant foods from 46 shelters currently designated by separate site numbers. These sites are distributed across eight counties in northwest Arkansas and one southwest Missouri county. This study concentrates on the archaeobotanical subsistence remains from 19 sites in seven Arkansas counties and one Missouri county (Table 1.1 and Figure 1.1). The sites selected were those shelters yielding the greatest quantities of samples and, in addition, shelters where items of special interest had been found.

As mentioned above, the Beaver Pond samples were studied in 1981, and Holman Shelter and Poole Shelter assemblages were analyzed in 1982. Samples from all the other sites were brought to Chapel Hill for analysis in 1984 or else were studied at the University of Arkansas Museum during the months of September and October, 1984. Some inconsistency in data recording results from the fact that the Beaver Pond and Madison County site materials were analyzed several years earlier.

Most of the sites under consideration were excavated in 1932. The exceptions are Cob Cave (1929-1931), Green Bluff (1933), Salts Bluff (1933), Craddock (1934), Beaver Pond (1934), and Marble Bluff (1934). Edens Bluff was partly excavated in 1932 and again in 1934. More

Figure 1.1 Map of Northwest Arkansas



precise dates of excavation are included in Table 1.2 (Site Information) if that information was specified in the field notes.

Table 1.2 also lists the maximum depth at which artifacts were encountered, the number of items catalogued by the excavators, the number of burials, and the kinds of artifacts recovered. The maximum depth for artifacts found in the 1930's tends to correspond to the depth of dry deposits rather than of cultural debris in general. The University Musuem crews at the Breckenridge site (3CR2) catalogued no artifacts from depths greather than 30" in 1932, yet excavations in a different (damp) area of the same site in the 1960's encountered cultural strata to a depth of nearly three meters (Wood 1963). Maximum depths for artifacts ranged from 22" to 54" at the sites covered in this study.

Edens Bluff was by far the richest site in terms of total overall yield, with 1800 separately catalogued items or lots listed in the field notes (Table 1.2). The other big contributors were Beaver Pond with 933 catalog numbers, Craddock with 563, Green Bluff with 501, Putnam with 483, and Marble Bluff with 405. A few sites, such as Holman Shelter, did not yield a great number of objects, yet many of those lots recovered consisted of plant food remains. Only seven lots were collected from the Buzzard Roost site, but the site was included in the study due to the presence of maize with exceptionally high row numbers.

Artifact categories collected at most of the sites included lithics, bone tools, shell tools and/or ornaments, ceramics, basketry, matting, cordage, wooden artifacts, faunal remains, and plant food remains. The Cow Ford assemblage includes only wooden artifacts, basketry, grass, and plant food remains. Pottery was absent from the

Alred site and from Holman Shelter. The latter was notable for also lacking faunal remains.

INTERPRETING CONTEXT AND CHRONOLOGY

It is difficult to make generalizations concerning types of activities conducted at rockshelters in the southwestern Ozarks during the Woodland and Mississippian periods. Brown (1984b) finds little evidence for base camp occupation in the shelters, and stresses the scarcity of cultural debris after subtracting perishable items from the record. He sees a variety of specialized activities as responsible for the rockshelter material, namely human burial, food storage, food preparation, tool making, cane cutting, and bird (turkey) trap setting. Many of the plant food samples considered in this report were clearly placed in dry areas for storage, but the context of other samples is not evident.

The field notes left by the excavators during the 1930's were very different from those kept by professionally trained archaeologists today. The quality of the notes varies from site to site, especially in the amount of detail concerning the sites themselves. Sometimes there is a sketch of the shelter in cross section and a good description of the location and setting, but at other times, this type of information is lacking. Most of the space is given to listings of the artifacts, the trench and block number of their horizontal proveniences, and the depth from the surface at which the item was encountered. Features such as burials are customarily sketched and described in greater detail than other finds. Although the University of Arkansas Museum crews frequently labeled plant food remains as "caches", they rarely provided information that would have been helpful in verifying such an interpretation. The ubiquitous carefully prepared storage pits described in detail by Harrington (1960) in rockshelters excavated during the 1920's are not mentioned in the 1930's field notes.

The greatest disappointment in studying the old field records was that associations between key lots of plant remains and temporally diagnostic artifacts proved to be undocumented except in very rare instances. Most of the archaeobotanical remains must be treated provisionally as isolated in time from other material at the same site. Any given sample might have been deposited at the same time as projectile points or pot sherds found near it at a similar depth, but it might have been the product of a very different depositional event.

A few of the sites appear to contain primarily pre-Mississippian period artifacts, for example Alred and Edens Bluff. However, a pit for storage of plant foods or of seeds for planting could have been dug at any time, possibly long after most of the projectile points at the site had entered the archaeological record. Most of the shelters, especially the larger ones, are relatively narrow ledges where fallen slabs created spaces near the rear wall that were protected from rainfall and seepage (Figure 1.2). These dry pockets were evidently valued for food storage as well as for burial of the dead. Context for many samples will remain problematic, but there is currently agreement that we are not dealing with debris from typical habitation site occupation (Brown 1984b; Sabo et al 1982; Trubowitz 1983).

Harrington's (1924 and 1960) concept of an Ozark Bluff-dweller Culture fostered the lingering view that bands of xenophobic troglodytes inhabited the rockshelters and caves from preceramic times until an undetermined date in what we would now classify as the Late Woodland or Mississippian period. Traits associated with the "Bluff-dweller Culture" include infrequent use of pottery, a primarily foraging subsistence base in spite of the presence of cultigens, and general conservatism or resistance to cultural changes typifying the ranked, mound building societies of the late prehistoric Arkansas, Red, and Mississippi River valleys.

Ozark natives in the 1920's might have seemed conservative to a New Yorker. However, the prehistoric Mississippian period now appears to have developed in northwest Arkansas as elsewhere with regard to mound building and farming (Brown 1984b; Sabo et al 1982; Trubowitz 1983). In this sense, the Ozark Bluff-dweller concept has been laid to rest. For roughly the last 3000 years of prehistory, rockshelters of the southern Ozarks were primarily loci of specialized activities carried out by members of groups whose houses, gardens, and ceremonial centers were on the surrounding terraces and plateau surfaces.

BRIEF DESCRIPTIONS OF TARGETED SITES

Beaver Lake Area, Southern Cluster

1. Edens Bluff (3BE6). Edens Bluff was the most intensively excavated site, having been excavated in 1932 and again in 1934. Of the 1800 catalogued lots of cultural remains, many included plant foods. It is a south-facing shelter on the White River approximately 300 meters long and 22 meters deep. The concave bluff wall rises gradually from the sheltered floor area, creating a high, steep, semi-vaulted effect rather than a typical shelter roof (Figure 1.2). Originally 40' above the terrace elevation, the site is now inundated by Beaver Lake. The

Figure 1.2 The Edens Bluff Site, 3BE6. (Univ. of Arkansas Museum Photograph Negative # 320220)

White River Valley is less than 1500 meters wide at this point, but most of that is good terrace land.

Analysis of Edens Bluff archaeobotanical samples was incomplete. Many of the samples with catalog numbers in the 1700's consist of mixed plant remains, and few of these could be sorted in the time available.

2. "Cow Ford" (3BE7). The location of Cow Ford shelter could not be plotted with certainty by the staff of the Arkansas Archaeological Survey. The Field Notes are very confusing. Artifacts were not given a new field symbol and new catalog numbers, but were numbered consecutively along with samples from Butler Shelter (3BE3) and White Bluff (3BE21). Cow Ford currently starts with B-397. Inconsistencies in the data on file are more than slightly problematic. Cow Ford deposits are described as flood prone, but the items now accessioned as coming from this site are all desiccated archaeobotanical remains. When Gilmore went through the rockshelter collections, the specimens now having the accession number 32-17 and the site number 3BE7, for Cow Ford, were not distinguishable from Butler Shelter (3BE3) samples, which are now accessioned by the number 32-11.

After much examination of the files, I believe that the plant remains accessioned as Cow Ford site material actually came from Butler Shelter. The legal descriptions given in 1932 for the Butler Shelter group and for the White Bluff site indicate that surveying improvements since the 1930's have significantly altered the manner in which property locations were recorded at that time. (It has not been uncommon for mapping revisions to change the 1930's Ozark legal descriptions. The Poole Bluff Shelters (3MA42-44) were believed to be in Washington County until the U.S.G.S. 7 1/2' maps were issued in the late 1950's.) The crew evidently visited a new site, which they called Cow Ford, while working at the Butler Shelter group. Cow Ford is probably located within 2 km downstream of White Bluff, as far as can be determined by the Township-Range-Section numbers recorded in the field notes. These numbers are all off current legal descriptions by several miles, but they are are internally consistent. The Cow Ford site was wet and the lithic artifacts ("points") found there during the two "extremely hard" days of work did not become clearly catologued as a discrete unit. The desiccated plant remains listed as B-397 through-B-441 in the field notes (Field Book #1, pp. 44a-44c) after a reference to the Cow Ford site seem to be a continuation of Butler Shelter material, but were later mistakenly interpreted as having come from Cow Ford, so were separately boxed and accessioned.

The removal of true Butler Shelter plant remains from their proper assemblage as hypothesized left few plant foods in the Butler Shelter boxes. Therefore, that site was not included in the present analysis. Since all University of Arkansas Museum records currently treat the samples analyzed here as belonging with the Cow Ford site, I will provisionally treat them as such. Because of the uncertain origins, however, few "Cow Ford" samples were actually analyzed. The two samples with concentrations of Chenopodium and two samples of maize are the only items from the site included in this study.

3. White Bluff (3BE21). The White Bluff site is a long (ca. 100m) sheltered ledge facing east and overlooking a wide terrace at a bend of the White River (now Beaver Lake). The site itself is above lake level. Like Edens Bluff, this shelter is a narrow ledge with many breakdown slabs creating powder-dry crevices near the rear wall where

the bluff face rises steeply to form a high, protective concavity. Of the 70 catalogued samples, some of the most interesting were found with or near the burial numbered WB-300 (32-56-15). Six individuals were included in this burial group.

4. Putnam Shelter (3WA4). The south-facing Putnam Shelter overlooked a large expanse of terrace (now under water) on War Eagle Creek near its confluence with the White River. The sheltered ledge area is approximately 80 m long, with dry deposits between and behind fallen slabs, as at White Bluff and Edens Bluff. Although only 50-60 m of arable terrace occurred within 2 km, they were all within a 1 km radius. The field between the site and the river was found to be rich in lithic artifacts when the site was excavated in 1932. A total of 483 samples from the shelter were catalogued by the crew.

5. Gibson Shelter (3WA19). This site is located upstream from Putnam shelter at a distance of 2 km as the crow flies or 4 km following War Eagle Creek. Good terraces are located on both sides of the stream channel within 1 km of the shelter. The site is approximately 30 m long and 10 m deep. The total number of catalogued samples is relatively small—114—but many of the artifacts found are unusual. The collections include 16 beautiful marine shell beads (Oliva sayana, cf. Cleland 1965) from a burial, an example of finely twined fabric (G-66), compact red-slipped pottery, and other sherds that appeared to include grog-tempered, bone-tempered, and shell-tempered specimens.

Beaver Lake Area, Northern Cluster

6. Alred Shelter (3BE1). Alred is a southeast facing shelter approximately 70 m long and 12 m deep. The terraces across the White

River (now inundated) do not appear to have been very level, judging from contour lines on the original 7 1/2' topographic maps. The 150' drop from the shelter to the river channel would have been very steep. Harrington (1924 and 1960) had excavated this shelter in 1922. The Dellinger-directed crew removed 145 catalogued samples in 1932. Harrington (1960:82) remarked that "in all the tons of refuse examined, not one corn cob was found" and that "this great bulk of refuse contained no pottery whatever, only a few fragments being located in a superficial deposit on the top of a large rock at the west end of the shelter, entirely isolated from the main deposits." Corn and pottery were also absent from the University of Arkansas Museum collections from Alred.

7. Agnew Shelter (3BE2). Agnew is located approximately 0.5 km downstream from (northeast of) Alred, on the same (left) bank of the White River. An unusually level talus slope area is situated in front of this SSW-facing shelter, then there is a steep drop down to the original level of the river channel. Agnew is ca. 80 m long and has a deeper (ca. 15 m), flatter, dry sheltered floor area than most of the excavated rockshelters. Harrington had excavated the site in 1922, calling it Bushwhack. The Arkansas Museum crews managed to collect 169 samples in 1932, but plant foods were not well represented. The shelter was included in this analysis due to the presence of sunflower and sumpweed achenes.

8. Green Bluff (3BE10). This is an extremely long (ca. 400 m) and possibly not continuously sheltered ledge area facing northwest above the White River approximately 7 km downstream from Agnew Shelter. The topographic map does not indicate a great amount of level terrace

ground in the vicinity of the site, but some of the sloping land between the 1000' and 1100' contour intervals across the river from the site might have been favorable for gardens or small fields. The 1933 excavations resulted in the collection of 502 numbered samples.

9. Salts Bluff (3BE18). Salts Bluff is described by Harrington (1960:25) as "a series of great cliffs" with many caves and rockshelters, eight of which appeared to have been utilized. Aspect in general would be southwest. Three of these shelters were called Salts No. 1, No. 2, and No. 3. Shelter No. 1 was the largest (90 x 30') and richest in cultural deposits. The 1930's University of Arkansas Museum field notes do not specify shelter dimensions or locations along the bluff face. Near the end of the Salts Bluff field notes, however, at Sample No. S-150, the words "Fifth Shelter" were inserted. The first through fourth shelters were not specified previously, but it seems that the Salts Bluff assemblage came from more than one locality along the bluff face. An extensive terrace system existed along this stretch of the river due to the fact that Big Clifty Creek, a major tributary, joined the White River less than 1 km downstream from the bluff line. A letter to Dr. Dellinger shows that Salts Bluff was excavated while Wayne Henbest, who usually wrote the Field Notes, was on his honeymoon during late June and early July of 1933.

10. Whitney Bluff (3BE20). The exact location of Whitney Bluff is uncertain, but information available would place it approximately 5 km downstream from Agnew on the left bank of the White River. Only 65 samples from Whitney Shelter were catalogued, but they include a woven bag, basketry, string, mussel shells, stone tools, one potsherd, cane tools, a bundle of turkey bones, and plant food remains. The site was

included in this analysis due to the two samples of mixed Chenopodium and Polygonum seeds.

The Missouri Site

11. Montgomery Shelter #4. Five rockshelters were excavated along Dry Creek Hollow in Barry County, Missouri, six miles north of the Arkansas State line. The field notes state that the creek valley is approximately 200 yards wide, and the shelters are distributed across three one-mile Sections. Preservation of organic remains at these sites was exceptional even relative to other dry Ozark shelters. Plant foods were most abundant at shelter no. 4, the one included in this analysis.

Upper White River Site

12. Poole Shelter #2 (3MA44). The three Poole shelters are located in southwestern Madison County in a wide portion of the White River Valley. The sites are near the river, but the opposite bank has a broad terace ca. 700 m wide. Poole 2 is 38 m long and 11 m deep, and it faces south. Eighty-nine samples came from this site, which was included in the study due to the presence of two cultigen Chenopodium fruits and a sizeable number of maize cob segments.

Kings River Site

13. Holman Shelter (3MA34). Holman Shelter is on the much narrower Kings River in northeastern Madison County. It is a relatively small site, 17 m by 9 m, and has a sloping floor. Arable terraces are located on the opposite bank of the river and 600 m downstream from the shelter on the same bank, but they are narrow. No pottery, no

diagnostic lithic artifacts, and no animal bones were found. Henbest wrote in his field notes that a damp layer was encountered at a depth of 20 inches across the shelter. Plant food remains and basketry are well represented in the 68 catalogued samples.

Crawford County Sites

14. Craddock Shelter (3CW2). A long, curving bluff face exists at the north and west edge of a bend in Frog Bayou. A wide terrace is located directly across the stream. The bluff has a string of overhang areas called the Craddock Shelters which are now numbered as one group. When I visited the site in October, 1984, I could not determine which of the several sheltered areas along the bluff line had been the separately designated Cr, Cr-1, and Cr-2 of the 1934 excavations. Dry deposits exist only at the very rear of the site areas among breakdown slabs, but these dry pockets were heavily utilized, since the excavators removed 933 samples of cultural material from them. Shell-tempered potsherds and plant food remains, especially cultigens, are very common in the Craddock collections.

There were too many archaeobotanical samples from Craddock to be thoroughly analyzed at this time. Several of the larger lots with low catalog numbers were not sorted, and a cut-off point of 34-7-377, the end of archaeobotanical samples from shelter Cr-1, was arbitrarily chosen. None of the Cr-2 shelter material is included here, but a brief scan of those boxed samples did not reveal any new types of plant remains.

15. Beaver Pond (3CW11). The artifacts from three shelters beside Lee Creek are included in the Beaver Pond samples. The east-facing shelters range from 30 to 40 meters in length and from 2 to 8 meters in depth. Prime terrace land lies across Lee Creek from the site and up Larue Branch, a stream that flows into Lee Creek from the east at this location. Nine hundred and thirty-three samples from Beaver Pond were catalogued in 1934, second only to the number from Edens Bluff. Because it is located in the proposed Pine Mountain reservoir project area, the site was revisited by archaeologists in the 1970's, and the old collections were examined and described (Raab et al 1976; Trubowitz 1980).

Interior Boston Mountains Site

16. Brown Bluff (3WA10). This south-southeast facing shelter is in a localized bluff line in the narrow (200-300m) Winn Creek Valley in a rugged portion of southern Washington County. Size is not specified in the field notes. In spite of the seemingly remote location away from major stream valleys, deposits included shell and clay tempered potsherds, shell, bone and stone tools, basketry, a moccasin, remains of plant foods including cultigens, three human burials, and a desiccated dog burial. The 1932 excavators collected 172 samples.

17. Cob Cave (3NW6). Cob Cave was the first shelter investigated by workers from the University of Arkansas Museum. Excavations at this large southwest facing shelter at the head of intermittent Clark Creek began in 1929 and were continued in 1931. Terrain between the shelter

and the Buffalo River at a distance of 2.25 km, is extremely rugged. Stratigraphic interpretations were strongly influenced by Harrington's (1924) research. Dellinger (193?) described a "Top layer" about 8" thick lying beneath 4" of sterile material. Shell-tempered pottery and corn cobs were present in this upper layer. Separated from the "top layer" by a sterile layer 3-5" thick was a "culture layer" averaging 16-18" deep, containing no pottery and few lithics, but with cordage, basketry, nuts, and seeds. About 60 samples were catalogued. Unfortunately, most of the maize cobs were not saved.

18. Marble Bluff (3SE1). Marble Bluff is also on a stream in the Buffalo River drainage, but it is located approximately 50 km to the east of Cob Cave at a lower elevation, in a less rugged area. The shelter is approximatesly 120 x 7 m, and it probably faces west or southwest, just above Mill Creek. I could not estimate the number of hectares of arable land within a 2 km radius from information on the topographic map. The 1934 excavations resulted in the cataloguing of 405 samples. The plant remains from this site are unusual in that many of them came from a crevice where a fire had charred the items which apparently were placed there for storage.

Site of Unknown Location

19. Buzzard Roost (3CR5). The location and size of this shelter are uncertain. The crew worked there for only one day—July 18, 1932. Only seven samples were catalogued: a turkey down string, grass "weave", a projectile point, a "used stone", a crude flint "knife", a grass string with feather down attached, and a cache of corn cobs. The

plant foods, i.e., the cobs, were included in the analysis because of their high row numbers (14-20).

The combination of many factors prevented thorough analysis of the plants, with the sheer bulk of material being the primary reason. Numerous samples are no longer present in the Museum. Some are known to be in Ann Arbor; others are simply missing. The excavations were not systematic in the first place, and several of the shelters had been investigated by Harrington before the Dellinger-directed crews arrived.

In light of the series of sampling episodes, quantification was felt to be meaningless beyond a generalized frequency count. This study is biased toward samples in which crop plants could be recognized macroscopically. I want to increase understanding of the prehistoric crops, but have not attempted to relate the samples statistically to other archaeobotanical material.

Table 1.2: Site Information

	Approx. dimensions	Max. depth	#Cat. Nos.	# Burials	Date of Excav.	Artifact Types
I. Beaver Reservoir						
A. Southern Cluster						
3BE6	300x22m	48"	1800	13 or more	1932 & 1934	Full range
3BE7	not specified	30"	32	--	1932	Only plants
3BE21	100x15m	35"	70	4	1932	Full range
3WA4	75x20m	37"	483	15	5/24/32-6/13/32	Full range
3WA19	30x10m	22"	114	2	May,1932	Full range
B. Northern Cluster						
3BE1	70x12m	48"	145	0-UofA 3-Harr.	7/9/32-7/1232	Full range except ceramics
3BE2	80x15	30"	169	1-UofA 2-Harr.	7/5/32-7/8/32	Full range
3BE10	400mx?	37"	501	1	May-June 1933	Full range
3BE18	not spec.	24"	174	4-UofA 7-Harr	6/22/33 7/13/33	Full range
3BE20	not spec.	30"	65	--	9/19/32-9/21/32	Full range
3CR5	not spec.	47"	7	--	7/18/32	maize, string grass, knife, proj. pt.
II. Missouri Site						
23BY--	not spec.	31"	349	16 or more	April, 1932	Full range

Table 1.2, cont. Site Information

	Approx dimensions	Max. depth	# Cat. Nos.	# Burials	Date of Excav.	Artifact Types
III. Upper White River						
3MA44	12x3m	48"	89	2	Nov., 1932	Full range
IV. Kings River						
3MA34	17x9	27"	68	--	Aug. 1932	basketry, cordage; no pottery, no faunal remains
V. Lee Creek/Frog Bayou						
3CW2	200x1-6m	40"	563	--	1934	Full range
3CW11	3 shelters, 30-40x2-8mm	36"	933	5 or more	1934	Full range
VI. Boston Mountains						
3WA10	not spec.	36"	172	3	10/25/32-11/8/32	Full range
VII. Buffalo River						
3NW6	75x30	54"	60	--	1929, 1931	Full range
3SE1	120x7m	47"	405	3	Mar.-Apr. 1934	Full range

CHAPTER 2

REGIONAL OVERVIEW

THE GENERAL ENVIRONMENT

The Ozark Plateaus Province of the United States Interior Highlands is a dissected structural uplift. The three subdivisions in the Arkansas Ozarks, made on the basis of surface geology, are the Springfield Plateau, Salem Plateau, and Boston Mountains. The Springfield Plateau is dominated by Mississippian limestones and cherts; the Salem Plateau by Ordovician and older limestones and dolomites. The Boston Mountains section is higher and more rugged topographically than the Springfield and Salem Plateaus, with elevations in excess of 2000' (670 m). Rocks are predominantly Pennsylvanian-aged sandstones and shales (Thornbury 1964). At the southern edge of the Boston Mountains, the Ozark Highlands border the Arkansas Valley synclinorium. This transition is abrupt in places, but so gradual in others that an arbitrary line of separation at the 750' contour line has been established (Foti 1974:13).

Narrow, steep stream valleys do exist in the Salem and Springfield Plateaus as well as in the Boston Mountains, but the major rivers have broad alluvial terraces, and interfluvial areas can be gently sloping or even fairly level. Table 2.1 shows that most sites covered here are

Table 2.1 Topographic Setting of Sites

	Elev.	As-pect	# Ft. Above Terrace	# Ha. Alluv. w/in 2km	Nearest Stream	Horiz. Dist. to str.	Relief w/in 1 km	Comments
I. BEAVER RESERVOIR								
A. Southern Cluster								
3BE6	1100'	S	40'	ca.100	White R.	10 m	1050-1360'	
3BE7	1100'	S	20'?	75-100	White R.	10-25m	1060-1360'	Exact location uncertain; plants may be from 3BE3
3BE21	1150'	E	50'	ca. 50	White R.	25 m	1080-1360'	Steep drop to River; broad terraces to S. and E.
3WA4	1150'	S	50'	50-60	War Eagle	200 m	1090-1350'	Terrace is all within 1 km (directly across river)
3WA19	1180'	S	85'	75-100	War Eagle	70 m	1100-1400'	Overlooks very good terrace
B. Northern Cluster								
3BE1	1150'	SE	150'	30-50	White R.	100 m	1000-1320'	Steep drop at site; terraces all upstream & across river
3BE2	1150'	SSW	150'	30-50	White R.	200 m	1000-1320'	Best terrace is on opposite side of R.
3BE10	1120'	NW	150	30-50	White R.	100 m	980-1320'	Most good terrace is at least 1 km away
3BE18	1100-1200'	SW	100-200	125-150	White R.	20 m	940-1320'	Large terrace system; streams enter river
3BE20	1130'	?	75"?	25-50?	White R.	?	980-1350'	Location uncertain
3CR5	?	?	?	?	White R ?	?	?	Location unknown

Table 2.1, cont. Topographic settings

	Elev.	As-pect	# Ft. Above Terrace	# Ha Alluv. w/in 2km	Nearest Stream	Horiz. Dist. to str.	Relief w/in 1 km	Comments
II. MISSOURI SITE								
23BY-	1150'	?	40-60'	30 (ave.)	Dry Hollow Crk.	100 m	1080-1480'	5 shelters spread over 3 mi. of valley
III. UPPER WHITE RIVER								
3MA44	1380'	S	100'	150+	White R.	150 m	1250-1680'	At edge of very broad part of valley
IV. KINGS RIVER								
3MA34	1250'	S	50'	40-50	Kings R.	50 m	1160-1522'	
V. SOUTHERN OZARK EDGE								
3CW2	900'	S	100'	75-100	Frog Bayou	80 m	760-1320'	String of shelters in long bluff
3CW11	700'	E	50'	100-125	Lee Creek	35 m	640-1020'	3 shelters
VI. INTERIOR BOSTON MTS.								
3WA10	1500'	SE	10'	25-50	Winn Creek	50 m	1440-1900'	Ca. 5 km to West Fork of White River
VII. BUFFALO RIVER								
3NW6	1500-1600'	SW	500'	20-25	Clark Creek	15 m	1200-2100'	2.25 km to Buffalo R.; all alluvium over 1 km away
3SE1	?800-850'	?SW	?220-70	?ca. 30	Mill Creek	2 m	750-1240'	

situated at elevations of less than 1200' and are close to large streams. Nine of the shelters overlook the main White River channel, and two are on War Eagle Creek, a major tributary, within a few kilometers of its confluence with the White River. One, Holman Shelter, is on the Kings River, another major tributary of the White River. The southernmost sites, Beaver Pond and Craddock, are at the edges of wide valleys of streams—Lee Creek and Frog Bayou—that flow south into the Arkansas River. Only Brown Bluff, Montgomery Shelter #4, Cob Cave, and Marble Bluff are in narrower valleys. The location of Buzzard Roost is problematic, as discussed below.

Climate

James A. Brown has appropriately stressed the geographical commonalities between the southern Ozarks and the lowland areas of the south-central United States:

> In the first place, the climatic regime and the plant and animal life in the Ozarks are not unique to it, but are basically the same as in the surrounding regions and are a continuation of the latitudinal and longitudinal trends common to eastern North America [Brown 1984b:3].

The climate is humid and continental with warm to hot summers and cool winters. Precipitation is variable, averaging ca. 45 inches (ca. 100 cm) per year in northwest Arkansas. The mean annual frost-free season is 180 to 200 days. As Brown (1984b) points out, the climate is comparable from an agricultural perspective to conditions in the Mississippi River Lowlands at the same latitude except for the increased variability in summer rainfall, creating heightened suceptibility to drought. Local flooding is also a problem due to Ozark topography, but heavy rains are uncommon. Again, as Brown notes, other regions such as the Mississippi Alluvial Valley, where prehistoric agriculture flourished, also suffer from occasional devastating floods.

Arable soils extend along the large Ozark river valleys and are distributed in linear zones and patches along the secondary and tertiary streams. Pointing to the fast rate at which arable lands were appropriated by pioneer farmers in the early 19th century, Brown (1984b:5-6) argues that no barrier to prehistoric agricultural development was imposed by the restriction of fertile soils to circumscribed alluvial terraces. The rockshelter crop plants attest to a developed agricultural base.

Vegetation

The primary vegetation type across the Ozark Plateaus is oak-hickory forest, with shortleaf pine added as a common constituent in part of the Boston Mountains. Patches of prairie occur in the extreme western part of the area, especially in Benton and Washington Counties, Arkansas. Dominant prairie grasses are big bluestem (*Andropogon gerardii*) Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and little bluestem (*Andropogon scoparius*). According to the Arkansas Natural Area Plan (Foti 1974:26), these upland prairies are associated with "claypans or shallow rocky soils resulting in seasonally meager moisture resources that inhibit tree growth."

Bluffs, hills, barrens, bald knobs, and rocky glades frequently support the eastern redcedar (*Juniperus virginiana*). In the larger stream valleys, a more mesic vegetation type dominated by red maple (*Acer rubrum*), American elm (*Ulmus americana*), sycamore (*Plantanus occidentalis*), river birch (*Betula nigra*), and cottonwood (*Populus* deltoides) may be found. Otherwise, lowland areas are commonly covered by southern red oak (Quercus falcata), mockernut hickory (Carya tomentosa), and shagbark hickory (C. ovata). Northern red oak (Q. rubra) grows in high quality upland areas, and southern red oak grows in lower quality upland areas. Drier sites support shortleaf pine (Pinus echinata), black hickory (C. texana), and post oak (Q. stellata). Trees listed as "common associates" are black oak (Q. velutina), chinkapin oak (Q. muehlenbergii), black gum (Nyssa sylvatica), sugar maple (Acer saccharrum), and dogwood (Cornus florida) (Foti 1974:24-25).

The data presented later in this volume demonstrate that Woodland and Mississippian period groups who occupied the southwestern Ozarks did not rely only on resources from virgin forests or other purely "natural" plant communities. Gardens and agricultural fields had altered the vegetation of stream terraces, and the settlements of the prehistoric farmers would have caused further disturbance. In addition to clearing activities that created these openings, the suspected frequent burning to enhance mast production and to facilitate nut gathering, among other things, would have resulted in numerous places that departed, at least temporarily, from their "virgin" states. Acorns, nuts, and native fruits were frequently utilized, but their numbers may well have been increased by human management and by the creation of new forest edges, openings, and recently abandoned patches where the soil had been disturbed (see Yarnell 1981; Hammett 1986).

Geographic Subdivisions

Details concerning the topographic settings of the 19 targeted rockshelter sites are presented in Table 2.1. The sites have been grouped into seven subareas, one of which is subdivided further into two clusters.

1. Beaver Lake Area Sites. The first and largest group consists of sites on the main channel of the White River or on War Eagle Creek in the area now flooded by Beaver Lake. This group has a southern cluster of five sites—Edens Bluff, Cow Ford, White Bluff, Putnam Shelter, and Gibson Shelter—and a northern cluster also of five sites—Alred, Agnew, Green Bluff, Salts Bluff, and Whitney Shelter. Sites in the southern cluster are in the Springfield Plateau, but the northern cluster sites are within the confines of the Salem Plateau, since the White River has by this point cut its channel into the older strata, to an elevation of 1000' or lower.

Omitting Whitney Shelter, whose precise location is uncertain, the northern cluster sites are situated at greater vertical distances above the river terraces (100-200') than are the southern cluster sites which are located 50'-100' above the terraces. The northern cluster sites in general also have less available alluvial soil within 2 km, judging by terrace contours on the 7 1/2' U.S.G.S. topographic maps. Only one of the northern sites, Salts Bluff, has more that 50 ha of relatively level terrace soil within 2 km, while all of the southern cluster sites have between 50 and 100 ha.

Buzzard Roost can not be plotted since conflicting locational information exists in the site files. Legal descriptions, although differing from each other, would place the site near the northern Beaver Lake area cluster. I suspect Buzzard Roost is in the stretch of the White River in northwest Carroll County. It was excavated on July 18, 1932, and work at nearby sites was conducted July 9-12 (at Alred) and

July 20-23 (at Spiker Shelter, 3BE15). It is plotted on the Kings River in north central Carroll County, however on Figure 1 of Scholtz (1975:2).

2. The Site in Missouri. The Missouri site selected for study—Montgomery Shelter #4, is in the Dry Hollow Creek Valley, a tributary of the Roaring River which flows into the White River. It is within the Salem Plateau subdivision of the Ozarks. Its exact location is uncertain since archaeologists who later surveyed Dry Hollow Creek valley were unable to determine which of the many rockshelters were the ones excavated during the 1930's. Judging by the rather constant width of the valley, an estimate of 30 ha. of alluvial soil would have been available within 2 km of any Montgomery Farm shelter.

3. The Upper White River Site. Poole Shelter #2 is farther upstream in the White River Valley. It is situated at the edge of a very broad part of the valley, with more than 150 ha of alluvial soil located within 2 km. From the point of view of available resources, the site should be essentially like the southern Beaver Lake area shelters in spite of its distance from them and its slightly higher elevation.

4. The Kings River Site. The single site on the Kings River, Holman Shelter, is in a relatively narrow, rugged section of the valley. Still, 40-50 ha. of potentially arable terrace are presently located within 2 km of the shelter. Other rockshelters in the Kings River area were excavated by Dellinger's crews and are discussed in reports by Fritz (1982) and Fritz and Yarnell (1985). The occupied shelters and caves of this area are smaller, and most are situated at considerable heights above the terraces (200-400'), although Holman Shelter is only 50' above the terrace level.

5. The Interior Boston Mountains Site. Brown Bluff overlooks Winn Creek, a tributary of the West Fork of the White River. This site is in a rugged part of the Boston Mountains, off the major waterways. The West Fork is approximately 5 km from Brown Bluff. Only 25-30 hectares of terrace occur within 2 km of the shelter, but most of these are in a patch directly opposite the shelter, which is itself at the base of the low, localized bluff line.

6. The Southern Ozark Edge Sites. Craddock and Beaver Pond are in Crawford County near the southern edge of the Ozarks, on streams flowing south into the Arkansas River. Both valleys offer good terraces, the locations being in some respects transitional between Boston Mt. and Arkansas Valley topography.

7. Buffalo River Sites. Cob Cave and Marble Bluff are located in the Buffalo River drainage to the east of other targeted sites, and at a considerable distance from each other. Cob Cave is at the head of a small, intermittent drainage, Clark Creek, at a distance of 2.25 km from the Buffalo River. No alluvial soil is available within 1 km of the site, and only 20-25 ha could be mapped within 2 km. Just beyond the 2 km point, however, lie broad terraces of the Buffalo River. The numerous maize cobs that served as inspiration for the shelter's name may have been carried up the rugged valley for storage from fields on the Buffalo River.

Marble Bluff is within a few meters of Mill Creek, less than 0.5 km from a terrace formed by the intersection of Mill Creek and a pair of unnamed tributaries. The town of St. Joe, Arkansas presently occupies this favorable Springfield Plateau setting. The Missouri Pacific Railroad was built across Mill Creek near the south end of the bluff face, and the 1934 excavation field notes mention that the site was currently in use by "bums".

CULTURE HISTORY

An excellent review of Ozark culture history has recently been presented by Sabo et al (1982). Brown (1984b) has synthesized information relevant especially to subsistence, settlement patterning, and exchange systems in the Southern Ozarks during the Woodland and Mississippian periods. Perttula's (1983) report on the early Mississippian period Loftin phase of southwest Missouri is of special interest since Sabo (1986) has classified components at Madison County, Arkansas sites as Loftin phase manifestations. Recent papers by Bell (1984), Brown (1984a), and Rohrbaugh (1984) contain good data on late prehistoric phases of northeast Oklahoma that can be extended across the state line into northwest Arkansas. The seven publications cited above are exhaustive in their coverage of previous research, available literature, and current interpretive problems. Therefore, I will rely on them to briefly summarize the time and space systematics of Ozark prehistory.

Paleo-Indian

The Paleo-Indian period (12,000-10,500 B.P.) is manifested by isolated Clovis or Clovis-like projectile points and by lanceolate points associated with the Plano phase. Examples have been found in deep levels of excavated rockshelters as well as on elevated open surfaces. Climate and vegetation at this time would probably have been transitional between those of the waning Wisconsin glacial period and modern temperate conditions, as boreal forest and Pleistocene megafauna were replaced by deciduous forests and prairies and contemporary animal species (Sabo et al 1982:51-55).

Early and Middle Archaic

Sabo et al (1982:55-57) recognize a Dalton Period (10,500-9,500 B.P.), represented by diagnostic projectile points in stratigraphic context at several rockshelters and on river terraces. They consider this period a continuation of a flexible, foraging lifeway by small local groups in a transitional, terminal Pleistocene/early Holocene environment.

Technological change seems to have occurred during the Early and Middle Archaic periods (9500-5000 B.P.) judging by the proliferation of projectile point types. By 8000 B.P., warmer and drier climatic conditions associated with the Hypsithermal episode prevailed in the western Ozarks. Faunal assemblages dating to this time show a decline in the importance of deer and an increase in procurement of smaller mammals, especially rabbit and squirrel, along with birds, fish, and mussels. Artifacts for grinding and processing plant foods increase in numbers. In general, site locations point to a river valley (bottomland) focus for subsistence-settlement activities.

Late Archaic and Early Woodland

Pollen evidence from Oklahoma, Kansas, and Missouri indicates that available moisture had increased by 5000 B.P., and that oak-hickory forests were expanding at the expense of grassland. These post-Hypsithermal conditions coincided with the Late Archaic and Early

Woodland periods (5000-1800 B.P.). Except for the possible introduction of pottery during the Early Woodland, these two periods are characterized by a single pattern of continuous cultural development (Sabo et al 1982). Brown (1984b:26) thinks that pottery was probably not introduced until the Middle Woodland period.

Large bottomland sites are interpreted as multiseasonal, multiple activity base camps, while rockshelter components appear to become the loci for specialized activities for the groups living in open sites on the terraces of major waterways. Manifestations of change in social organization, however, have not been detected, leading Sabo et al (1982:64) to suggest that "local populations were largely autonomous, engaging in little more than reciprocal exchanges of utilitarian goods with their neighbors."

Middle and Late Woodland

The Middle and Late Woodland Periods (1800-1100 B.P.) can not currently be distinguished from each other on typological grounds at most northwest Arkansas sites due to the scarcity of ceramics. Several sites have, however, yielded distinctive Middle Woodland pottery (Brown 1984b:26; Sabo et al 1982:65). The bow and arrow had been adopted before 1100 B.P. A charred maize kernel was recovered by Don Dickson from the Late Woodland stratum at the Albertson site in Benton County, near the Oklahoma border (Sabo et al 1982:65).

In addition to these technological changes, sites in the Arkansas River valley at the southern edge of the Ozarks have revealed that sociopolitical and/or ideological changes had taken place by Late Woodland times. Hoffman's (1977) Gober Complex of the Ozark Reservoir project area in Franklin County, immediately south of the Ozark Plateaus, is seen as a local manifestation of the Fourche Maline phase of southwest Arkansas and eastern Oklahoma. Although mounds were no longer intact, there was convincing evidence for two former mounds and a plaza at the Spinach Patch site (3FR1), in addition to the sizeable midden. The characteristic artifact assemblage, including a chipped siltstone hoe type, have been found at numerous sites on large stream terraces in the southwest Ozarks. The Gober Complex of Franklin County has not been radiocarbon dated, and Brown (1984b:27) suspects on stylistic grounds that it is contemporaneous with the transitional Woodland/Mississippian Evans phase (1350-1050 B.P.) of eastcentral Oklahoma and the Coles Creek horizon of the lower Arkansas River Valley. Even at such a terminal Late Woodland or transitional Mississippian date, the demonstration of this heightened degree of community organization signals the development locally of greater social complexity. The same process occurred in surrounding areas at the same time and it seems to have been in progress within the southern Ozarks as well.

Mississippian

The Mississippian period (1100-300 B.P.) is divided into an earlier (1100-500 B.P.) and later (500-300 B.P.) complex. The earlier complex is now accepted by many researchers as a variant of the Arkansas Valley Caddoan settlement system, contemporaneous with the Harlan and Spiro phases of eastcentral and northeast Oklahoma (Brown 1984b; Sabo et al 1982; Trubowitz 1983; for opposition see Hoffman 1982). Excavations at two of the three mound groups in northwest Arkansas have resulted in discovery of mound construction sequences firmly dated to the early Mississippian period and have established the architectural patterns as being distinctly Caddoan (Kay 1982; Sabo 1982 and 1986). Other sites of the period are seen as the farmsteads, camps, and special activity loci of the populations supporting the civic-ceremonial centers.

Rockshelters, as stated before, were primarily storage areas and locations for certain burials and other activities. Sabo et al (1982:72) see settlement patterns in the southwestern Ozarks at this time as organized primarily according to the distribution of arable land and the location of civic-ceremonial centers. From a social perspective:

> Probably the most important cultural change reflected in the Ozarks during the Mississippi Period is the growing complexity of social organization and the unequivocal evidence of participation in panregional social and ceremonial systems. The construction of large mound centers implies a degree of organized labor tribute found ethnographically in societies wherein certain individuals are accorded positions of high rank by virtue of their hereditary lineage [Sabo et al 1982:75].

Those authors believe it is likely that the Ozark centers "were socially and ceremonially affiliated with the Spiro site Oklahoma" (Sabo et al 1982:75). Brown (1984b:30) seems to believe in such an affiliation as well: "Thus the occupation northwest of the Boston Mountains [this includes the three northwest Arkansas mound groups] appears to have a common political nexus, which would have Spiro as the principal center during the Spiro Phase."

The later Mississippian period complex has been referred to as the Neosho Focus or Neosho Phase based on similarities between artifact types in northwest Arkansas and northeast Oklahoma, where the Neosho Complex was originally defined (Freeman 1962; see Rohrbaugh 1984 for a recent discussion). Outside influences can be detected from both the southern Plains and from the Mississippi Valley. Sabo et al (1982:74) see this as an indication of expanding social networks, with an influx of new ideas and materials, but stress that "Neosho phase subsistence organization and settlement patterns, as reflected at Bontke and Albertson, show practically no change from earlier Caddoan patterns." The conclusion is that "a single ongoing subsistence-settlement system is reflected from ca. 1050 B.P. until the end of the prehistoric record as it is now known." At the extreme southern edge of the Ozarks, especially in Crawford County, Arkansas, it is probably more accurate to align the latest Mississippian components with the late Caddoan Ft. Coffee phase of eastcentral Oklahoma (cf. Trubowitz 1983; Brown 1984b:30).

Sabo (1986) has recently presented a new series of phases to accomodate components at the Huntsville Mounds and other Madison County sites (see Table 2.2). The Loftin phase is extended from southwest Missouri to cover the earliest Mississippian component, corresponding to the Harlan phase of eastcentral Oklahoma (A.D. 900 or 1000-1250). The succeeding component, designated the War Eagle phase, corresponds temporally to the Spiro phase (A.D. 1250-1400). Finally, the Huntsville phase (A.D. 1400-?) terminates the late prehistoric sequence.

In this dissertation, I will use general chronological terms for the most part. "Late Woodland" will include manifestations that correspond temporally with the later Fourche Maline Phase, including a terminal period when Coles Creek or Gober Complex style artifacts occur. "Early Mississippian" will cover both Harlan/Loftin Phase time slots and Spiro/War Eagle Phase contemporaries. The term will, in other words, apply to the centuries A.D. 900-1400. "Late Mississippian" will refer to the Neosho/Ft. Coffee phase years at the end of the prehistoric sequence.

Contact

Early European contact affected the southwestern Ozarks only indirectly, since recorded expeditions and settlement attempts did not penetrate the area. Disruption of the cultural fabric as a result of disease, death, and political breakdown of surrounding societies, however, must have had a profound effect. There are no ethnohistoric accounts of native settlements in the study area during the 17th and 18th centuries, although, as Sabo et al (1982:80) note, French trappers and traders "must certainly have ranged into the Ozarks" during those centuries.

Spain held sovereignty over the Louisiana Territory from 1763 to 1803, but no active settlements in the Ozarks are recorded (Sabo et al 1982:81). Subsequent American ownership of the Louisiana Territory resulted in the first documented exploration, description, mapping, and finally settlement by Whites. At the beginning of the 19th century, northwest Arkansas was described as virtually unpopulated (Scholtz 1969; Schoolcraft 1819). The Osage claimed the area and used it as hunting territory, but their permanent villages were located on the Osage River in Missouri and on tributaries of the Arkansas River in Oklahoma. Fear of Osage attack deterred other groups from occupying the area.

A treaty between the United States government and the Osage in 1808 was negotiated in order to relocate Cherokees from the east along the Arkansas and White Rivers, and a Cherokee Territory was formally established in 1817 in Arkansas and Missouri. The resulting Cherokee farms and villages were located to the south and east of the rockshelters studied here, with the exceptions of Cob Cave and Marble Bluff. The Osage did not desist from their hostilities, however, and White settlers competed with the resettled Indians for available resources:

> The federal government continually failed to live up to its treaty obligations, and for several years evaded payment of annuities due the Cherokee emigrants. In the end, the Cherokee were removed once again, this time in 1828 to the newly established Indian Territory in Oklahoma. With the removal of the Cherokee in 1828 significant occupation by Native North Americans in the region effectively ended" [Sabo et al 1982:80].

White settlements in the Ozark interior grew quickly in number between 1820 and 1840. The Arkansas Territory had been established in 1819. Agricultural settlers, as opposed to the early wave of hunter-herders, came primarily from the southern Appalachian or Upland South region of the states of Kentucky, Tennessee, the Carolinas, Alabama, and Georgia. The cultural and economic patterns established by these pioneers and the subsequent historical and social developments are summarized by Sabo et al (1982:81-117) and described in detail by Rafferty (1980) and other authors. Rockshelters were used by Whites as campsites, hideouts, and temporary living quarters while houses were being built, but the most common function of bluff overhangs in postaboriginal times has probably been for the sheltering of livestock and storage of feed.

Table 2.2
Regional Sequences and Time Periods

B.P.	A.D./B.C.	Ark. Valley Caddoan	Southwestern Ozarks: Sabo et al 1982	Southwestern Ozarks: Sabo 1986	Period
	1700				
300		Ft. Coffee Phase	Late Miss. (Neosho Phase)		
	1600				
400				Huntsville Phase	
	1500				
500					
	1400			War Eagle Phase	Mississippian
600		Spiro Phase			
	1300				
700			Early Miss.		
	1200				
800				Loftin Phase	
	1100	Harlan Phase			
900					
	1000				
1000					
	900				
1100					
	800	Evans Phase	Cultures of the Late and Middle Woodland		Late Woodland
1200					
	700				
1300					
	600				
1400					
	500				
1500		Fourche Maline Phase			Middle Woodland
	400				
1600					
	300				
1700					
	200				
1800					
	100				
1900			Cultures of the Early Woodland and Late Archaic		
	0				
2000					
	500 B.C.				
2500		Wister Phase			Early Woodland
	1000 B.C.				
3000					Late Archaic

CHAPTER 3

MODELS OF PREHISTORIC AGRICULTURAL GROWTH IN EASTERN NORTH AMERICA

Interpretations of agricultural development through time in eastern North America reflect assumptions of the researchers as applied to the available data base, as is of course the case with all types of archaeological inference. Prevailing perspectives have changed over the decades in the field of anthropological archaeology, and the data base itself has likewise altered considerably. The resulting interpretive blend has therefore gone through interesting phases. Attempts at reconstruction have at times concentrated on chronology, at times on documentation of the component parts of the agricultural system, and at other times on explanation of the processes involved in major episodes of subsistence change. Idealistically, we are now at the point of synthesizing these three aspects--history (the variations in time and space); internal pattern or structure (the plant types that were involved and their respective statuses in the food procurement systems), and process (why the changes occurred). In this chapter, I will briefly review the history of research into eastern North American plant husbandry and discuss current perspectives.

At least one anthropologist before Gilmore--Ralph Linton (1924)--speculated that a distinctly eastern North American type of plant husbandry had preceded maize agriculture. His suspicions were based on the observation that Eastern groups used different types of tools for gardening and food processing and had different culinary traditions than Southwestern groups that more closely resembled the Mesoamerican pattern. Other than a reference to wild rice, Linton's 1924 article did not specify which crops might have been grown before maize. Still, it was a strong and prophetic statement:

> . . . I believe that the Indians of the eastern United States were already in possession of the hoe and mortar at the time they acquired maize. The wild foods of the region were sufficient to support a considerable population, and it is not impossible that the eastern tribes had developed at least the beginnings of agriculture, for in historic times there were certain practices, such as the planting of wild rice in the north and of various small grains in the southeast, which bore litle resemblance to maize culture and may well have originated independently [Linton 1924:349].

Linton contrasted the diffusion of maize into the east with the arrival of agriculture in the Southwest, which he saw as adoption of the Mexican maize complex "more or less as a whole":

> In the east, on the other hand, maize probably arrived as a result of gradual diffusion, lost much of its cultural context in route, and was adopted into a preexisting cultural pattern which had grown up around some other food or foods [Linton 1924:349].

In 1955, after rockshelter collections from Arkansas and Kentucky had been analyzed, Linton was able to specify some of the crops that he believed preceded maize in the southeast Woodlands area:

> The archaic people of this region were seed-gatherers. . . . There was a gradual emergence of plant agriculture: amaranth, gourds, sunflowers (for seeds), and tobacco. None of these crops was desirable as a staple, but they served to develop techniques of farming, so that, when the corn-beans-squash complex was introduced from Mexico about the beginning of the Christian era, it was taken over rapidly. . . [Linton 1955:608].

Melvin Gilmore (1931) did not actually address the issue of primacy of indigenous eastern crops vs. Mesoamerican cultigens. In fact, the observations of professional agronomists who had examined Ozark chenopod samples were that it was closely related to the Mexican Chenopodium nuttalliae Safford (now C. berlandieri ssp. nuttalliae Wilson and Heiser), and Gilmore did not suggest that the chenopod was derived through independent domestication. Others of the suspected new aboriginal crops—sumpweed, maygrass, and ragweed—had no known "tropical" counterparts, but still Gilmore did not explicitly argue for autonomous domestication or for chronological precedence over maize. Maize was, of course, present in most of the shelters and not always in stratigraphically distinct contexts.

The Newt Kash shelter collections gave Volney Jones (1936) the opportunity to propose a premaize crop assemblage. Only two fragments of maize cobs and one "ear stalk" from Newt Kash were sent to Jones, leading him (1936:148) to suggest "that corn is not typical of the remains as a whole, and may represent a later occupation than the remainder of the material." Other tropical cultigens included "a few gourd seeds, two squash seeds, a number of fragments of gourd and squash shells, and three tobacco capsules". The presence of sumpweed, chenopod, ragweed, and sunflower enabled Jones to extend the range of "plants which may have been brought into cultivation in temperate North America" to Kentucky:

> In the Kentucky region they seem earlier than any of the tropical plants except possibly the gourd and the squash. We shall have to await further knowledge of stratigraphy in the bluff shelter cultures to determine priority of the various cultivated plants [Jones 1936:148].

George Carter (1945) wrote that the existence of agriculture across the southeast prior to the introduction of corn, squash, and beans "is well established". Aiming a well-deserved attack upon

Carter's incorrect statement, Quimby (1946) insisted that no evidence of the sort was available from either the Ozark or Kentucky sites. Pointing out that Webb and Funkhouser had not sent Jones all of the plant remains that they themselves could identify, Quimby placed in doubt the interpretation that native crops were older than tropical ones at Newt Kash. He was not totally convinced that the "eastern plant complex" represented cultigen varieties rather than carefully harvested wild ones or, if so, that they were brought into domestication in the Eastern Woodlands. Still, Quimby's main point was that evidence for temporal antecedence was lacking, and he agreed with Jones and Gilmore that Iva, Helianthus, Ambrosia, Chenopodium, and Phalaris were probably domesticates.

These early 20th century scholars, then, were primarily concerned with internal pattern or with placing crop complexes of different regional origins into temporal perspective. Linton (1924) had very little direct data. His earliest article appeared in the same issue of American Anthropologist as Harrington's (1924) preliminary description of Ozark bluffshelter excavations, and Gilmore had not yet analyzed the plants. Gilmore (1931) had no way of knowing how old the Ozark cultigens might be, and was therefore limited to a discussion of the component parts of the Ozark "Bluff Dweller" plant husbandry system. Jones (1936) had speculated about temporal order and was able to extend the geographical range of the seemingly indigenous eastern crop complex from the Ozarks to Kentucky. He also added a new ecological parameter with the suggestion that these species were indicators of a prairie ecosystem, and therefore of climatic change.

The first explanatory treatise putting subsistence change in the Eastern Woodlands into general cultural perspective came with Joseph R. Caldwell's Trend and Tradition in the Prehistory of the Eastern United States in 1958. Caldwell viewed the Archaic Period as a time of long and gradual development of "primary forest efficiency". When this was achieved in the Late Archaic, eastern groups were able to remain relatively sedentary and to exploit a broad range of natural resources, including many plant foods. Increase of food procurement effectiveness and efficiency was seen as the cumulative product of human intelligence. Over time, people discovered that new plants were edible, developed better tools with which to process the plants and the technology to become better hunters, and relied upon experience and innovation to flourish in the midst of the seemingly very rich Eastern forests and waters. The level of primary forest efficiency was a necessary step on the way to agriculturalism because people needed the settled way of life in order to make the transition, but that same efficiency had delayed the adoption of large-scale food production (it had not been necessary) and held down the importance of agriculture in this region even into Mississippian times.

Caldwell was interested in generalizing the significance of this process by applying it to the global level:

> Eastern North America provided innumerable sources of wild foods, and its population . . . was far from reaching the limits of its wild and cultivated resources. But the nuclear civilizations of southwest Asia and Mesoamerica are somehow associated with dryer lands of less natural abundance. Wild resources ought sooner to have reached their limits in portions of these regions so that some societies already "experimenting" with cultivated plants could turn gradually to food production as the older hunting-gathering activities became less and less fruitful [Caldwell 1962(1971):380].

Because he postulated that food production played a very limited role in Archaic and Woodland period economies, Caldwell was not interested in the question of whether or not native seed crops preceded maize agriculture. He did, however, accept the likelihood of an "independent development of food production in the Mississippi Valley", given the degree of settled life that forest efficiency afforded and the "considerable knowledge of wild plants" that would have provided an appropriate millieu for innovations by "generations of women with an empirical interest in wild plants and their properties":

> "It is possible that early plant cultivation in the East, whether actually indigenous or somehow stimulated by early cultigens from southward, facilitated the introduction of maize from Mesoamerica. It has already, however, become a matter of debate in North America whether the Adena and Hopewellian manifestations, which certainly practiced some planting, actually had an effective food production. My own view is that by and large they did not" [Caldwell 1962:379].

The 1950's and 1960's also brought the more purely historical treatment of James B. Griffin (1952, 1960, 1967). In his earliest article, Griffin (1952) was stymied by lack of direct subsistence data, but by 1960, he strongly favored the hypothesis that the Hopewellian "culture climax" had an agricultural base. Corn had been found in apparent Middle Woodland context at only a few sites, and Griffin (1960) clearly recognized the limitations of the data base. Citing evidence for the onset of a cooler climatic episode following the Hopewell climax, however, he stated:

> The gradual decline and demise of the Hopewell culture in the Ohio and northern Mississippi Valley appears to correlate well with the cold period from around A.D. 200 to A.D. 700.... It is suggested in this paper that a major contributing factor to the Hopewell decline in the north was the climatic deterioration which would have gradually affected their agricultural productivity.... [Griffin 1960:28].

The possibility of native seed crops was not mentioned. In his 1967 summary of eastern North American archaeology, Griffin (1967:183) wrote that Middle Woodland societies were primarily hunters and gatherers, but that maize in the midwest was first grown by these groups, and that "it is assumed that this addition to the diet was partly responsible for the strong cultural growth during Hopewellian times."

Melvin L. Fowler (1971) presented a paper in 1957 in which he paid attention to the possibility of indigenous plant domestication and placed the origins of this process in the Late Archaic. Citing Jones, Gilmore, and others, Fowler (1971:393) named sunflower, sumpweed, and amaranth as some of the native seed crops that provided a "local prelude to the introduction of the exotic cultigens from the south". While the paper is not heavily theoretical, Fowler did propose a "Dump Heap" mechanism, following Edgar Anderson (1952), for the development of native plant cultivation. He noted that late Archaic groups would have been in close association with seed plants when they occupied established base camps beside rivers and that "their extensive middens provided ideal open habitats for these nitrogen feeding plants (Fowler 1971:393).

Stuart Struever published a brief article in 1962 calling attention to the excavation of charred Chenopodium seeds from several Woodland period sites in the midwest and asking "whether a comparative study of the Chenopodium seeds from these Michigan, Ohio, Illinois, Kentucky, and Arkansas sites might not be useful" (Struever 1962:586). In addition to advocating botanical investigations that would have a bearing on the problem of whether or not these seeds were evidence for a local center of plant domestication, Struever introduced the flotation method for recovery of carbonized seeds and recommended that "particular attention should be paid to the contents of features in which ashes and charcoal are present" (Struever 1962:587). Given the paucity of plant food remains from Woodland period sites, Struever ascertained that the data base would have to be augmented before the controversy over the importance of food production in Hopewellian societies could be settled.

By implementing flotation recovery during subsequent excavations at numerous sites in the Lower Illinois River Valley, Struever (1964; 1968) demonstrated that Middle Woodland pits did contain quantities of charred Chenopodium and large-sized Iva seeds. He suggested that intensification of food production was an important factor in the development of the Hopewellian phenomenon, and provided detailed arguments against Caldwell's model of primary forest efficiency as an inhibition to agricultural growth.

Struever viewed mudflats adjacent to major streams as "a functional equivalent to Anderson's (1952) 'dump heap' situation": "It is here one might expect the early manipulation of commensal plants to have played an important role prehistorically in the development of higher levels of economic productivity" (Struever 1964:102-103). This subsistence shift was restricted to the broad river valleys and explained why centers of Hopewellian population and ceremonialism were limited to those zones.

Struever paid little attention to whether or not native seed crops anteceded tropical cultigens in these early papers, but in a later paper co-authored with Kent Vickery (Struever and Vickery 1973), the archaeological evidence for early members of both crop groups was carefully reviewed. The unprecedented emphasis on recovery and analysis of archaeobotanical data and interpretation of them in a processual, ecological framework resulted in a contribution to the study of North American agriculture that can hardly be overemphasized. Development of the Kampsville Archeological Center made possible the long-term residence there of ethnobotanists Nancy and David Asch, the excavation of many more sites, and the recovery of millions of seeds by students, professionals, and amateurs standing knee-deep in the Illinois River with screen-bottom buckets and tea strainers.

The Asches' first major report, coauthored with Richard I. Ford (Asch, Ford, and Asch 1972) held that Caldwell's ideas concerning primary forest efficiency could not be supported by the Archaic data base regardless of their implications for the evolution of agriculture. Rather than demonstrating an increasingly generalized use of wild plant foods with new items added through time, the archaeological remains from Archaic levels at the Koster site indicated a long-term concentration upon "first-line" foods, especially hickory nuts, in spite of the fact that other resources were known and available. Citing the newly published studies among hunter-gatherer societies which emphasized regulation of population size to levels below the carrying capacity of their environments, Asch, Ford, and Asch (1972) set forth a stress model in which the resource base would be widened as a result of population pressure rather than advancement of knowledge.

Although it influenced archaeologists throughout the 1970's and into the 1980's (cf. Ford 1977; Christenson 1980; Cowan 1985), the Asches themselves had largely abandoned the population stress model by 1980. In addition, their personal studies of vegetation communities in westcentral Illinois convinced them that Struever's mud-flat hypothesis was untenable. The major types of seeds recovered from Middle Woodland pits simply did not grow in harvestable stands in the river bottoms and were unlikely to have been abundant prehistorically without human cultivation.

The Asches' rigorous quantification of archaeobotanical data and sophisticated attention to phytogeography and plant systematics resulted in major advances in the understanding of prehistoric subsistence change and the role played by certain species, especially chenopod, sumpweed, knotweed, and maygrass (D. Asch and N. Asch 1977, 1978, 1980, 1982, 1985a and 1985b; N. Asch and D. Asch 1985a and 1985b). Despite a temporary set-back caused by the demonstration that archaeological Chenopodium seeds were no larger than modern wild ones, the research conducted at Kampsville helped pave the way to our current recognition of these species as crops and important Woodland period foods. The pertinent studies will be discussed in later chapters of this dissertation.

Reports by the Asches have sometimes stressed the chronological sequence, always with careful elucidation of the collections used as the basis for interpretation and their contexts (cf. D. and N. Asch 1982; 1985b). Their contributions to site reports include detailed analyses of paleoenvironmental indicators pertinent to subsistence. Recent chapters (N. Asch and D. Asch 1985a and 1985b) have focused on specific anthropogenic modifications to the environment.

Moving away from the Illinois River Valley, contemporaneous research projects in the midwest and midsouth began to concentrate on the development of eastern North American food production. One of the earliest and most important was implemented by Patty Jo Watson (1969 and

1974) in the Mammoth Cave system in Kentucky. By implementing flotation recovery and collaborating with ethnobotanist Richard A. Yarnell and botanist Robert B. Stewart, the Mammoth Cave area project produced an enormous data base. Because the flotation samples from Salts Cave vestibule midden deposits were compared with the contents of paleofeces left by prehistoric cavers, interpretations concerning diet could be firmly based.

Yarnell (1969 and 1974) perceived that products of plant husbandry were extremely important at Salts Cave. He estimated that the cultigens (gourd and squash seeds; sunflower and sumpweed seeds) contributed 42% of total food at Salts Cave and that weedy seed-food and greens from plants invading gardens and other clearings "accounted for perhaps as much as an additional 32%" (Yarnell 1974:122). Due to the abundance of Chenopodium (over 18,000 seeds), Yarnell perceived its status to be "a protected garden plant, if not intentionally propagated, and a harvested crop," and he thought that maygrass, amaranth, pokeweed, and purselane could be in that class, as well. This degree of dependence upon husbanded plant foods was unexpected for the Early Woodland period.

Another important aspect of the Salts Cave data was that cultigen sunflower and sumpweed occurred at greater depths that did remains of cucurbits, indicating that native eastern crops may have preceded tropical cultigens in central Kentucky (Yarnell 1974:117).

During the 1960's and 1970's, large-scale subsistence-oriented projects were conducted in eastern Tennessee on the Little Tennessee River (Chapman and Shea 1981), in central Tennessee on the Duck River (Crites 1978), in northern Alabama (Caddell 1982; Scarry 1981), in eastern Kentucky in the Red River Gorge (Cowan 1979 and 1985; Cowan et al 1981), in western Kentucky on the middle Green River (Crawford 1982), and in western Missouri on the Pomme de Terre River (Chomko and Crawford 1978; Kay et al 1980; King 1980 and 1985). Watson (1985) has recently summarized the contributions of these projects with the exceptions of the two in Alabama. Much attention was paid by the paleoethnobotanists to chronological problems. The question of whether or not cucurbits were introduced prior to development of the native starchy seed complex was of special concern, and it was resolved that pepo and bottle gourd came first in Illinois, Tennessee, and Missouri. This question will be reviewed in depth in Chapter 7. The economic significance of maygrass, chenopod, sunflower, and sumpweed, beginning at some sites in the late Archaic levels, was firmly documented during these projects. The native starchy seeds were especially abundant in Middle Woodland times when maize, if present at all, was a very minor item.

Most of the above studies concentrate on chronology and internal pattern. The discussion of mechanisms for the adoption of gourd crops by Kay et al (1980) and the stress model cited by Cowan (1985) are not well developed and seem peripheral to the descriptive, historical aspects.

Valuable regional syntheses of the Eastern North American archaeobotanical data have appeared at frequent intervals (Yarnell 1964, 1976, 1983, 1985; Ford 1978, 1981, 1985). Even so, it has been difficult to keep abreast of the rapidly mounting information. Yarnell and Ford agree in general that native oily and starchy seed crops evolved during the Archaic Period and had become important at some locations by the Early Woodland Period and at others by the Middle Woodland Period. As of the 1985 publications, they differ with respect to acceptance of Middle Woodland maize. Ford apparently accepted that maize from a number of midwestern sites could be trusted as dating to their Middle Woodland components, while Yarnell had become increasingly skeptical of the evidence, regarding most if not all specimens in question as contaminants from later occupation.

David Rindos has presented archaeologists with a fresh model for understanding the process of plant domestication, beginning with a paper in Current Anthropology (Rindos 1980) and followed in 1984 by the book, The Origins of Agriculture, an Evolutionary Perspective. With Sissel Johannessen, archaeobotanist for the FAI-270 project in the American Bottom (Rindos and Johannessen n.d.), Rindos applied his new conceptual approach to the development of native starchy seed husbandry in the eastern United States. More recently still, Bruce Smith (1986b) has used the same conceptual tool for explaining the subsistence shift reflected archaeologically in Late Archaic and Woodland period sites.

The Rindos model is based on Darwinian evolutionary theory and it hinges upon mutual, coevolutionary maximization of fitness by people and plants simultaneously as creating the symbiotic, obligate dispersal relationship that exists between crops and humans. Rindos (1984:138-139) summarizes the process as follows: "by virtue of a coevolutionary relationship with humans, certain plants will become relatively more fit. The ultimate expression of this evolutionary process is what we today call the domesticated plant."

Three stages of domestication as outlined by Rindos are incidental domestication, specialized domestication, and agricultural domestication. In the initial, incidental stage, nonagricultural people protect certain plants and disperse them as a direct result of their feeding behavior: "As a result of selective pressures placed upon the plants by this relationship, certain morphological traits in the plant will be at a selective advantage" (Rindos 1984:138). Examples of such traits are indehiscence and large fruit size, "traits that served as means by which the plant became obligately dispersed by humans" (Rindos 1984:154). Feedbacks created by incidental domestication "ultimately change the values humans place on the plants on which they feed" (Rindos 1984:158).

An increase in the proportion of husbanded plants in the diet accompanies the transition to specialized domestication. A new type of ecological system which Rindos calls "the agroecology" begins to develop during this "phase":

> Specialized domestication creates an increasingly obligate relationship between humans and plants and is mediated by specific human behaviors and also by evolutionary tendencies found in the developing agroecology [Rindos 1984:164].

Rindos makes it clear that "the agroecology" is an outgrowth of incidental domestication and that "the origin and subsequent development of the agroecology" is precisely what he is labeling by the term "specialized domestication" (Rindos 1984:165). Some of the pertinent human behaviors include alteration of the environment that would "increase the total amount of potentially habitable area for certain plants coevolved with humans" (Rindos 1984:159). Since many important crops were ruderal heliophytes, activities such as burning, cutting trees, and clearing land for long term settlements, would have this effect:

> These changes in behavior share a very important corollary: no longer is the plant population limited by intrinsic environmental parameters; instead effective niche space has been expanded as a result of the habits of the agent. As the productivity (here, localized biomass) of the coevolving plant

> increases, the potential also arises for increase in the agent's population. [Rindos 1984:160].

Other types of human behavior involved in increasingly specialized domestication are protecting, storing, and planting. Increased sedentism is correlated with these activities (Rindos 1984:160).

With agricultural domestication, further coevolution between people and crops "proceeds exclusively within the agroecology and is consequently subject to new potentials and limitations" (Rindos 1984:164). Selection pressures upon the crops are very different from those under natural conditions. The agricultural environment is more predictable, and the nature of competition changes. Selection toward increased productivity is heightened, and human populations rise as the carrying capacity increases (Rindos 1984:165-166). Local fluctuations in yield, however, are magnified with growing crop production and greater uniformity, so that stability decreases for any given agricultural community. Rindos (1980 and 1984) argues that this type of instability is inherent in agricultural systems and causes their geographical spread and sometimes their demise. In an appliction of the model to the American Bottoms area, Rindos and Johannessen (n.d.) suggest that maize agriculture brought about the ultimate disintegration of complex Mississippian society at Cahokia.

Bruce Smith's focus differs from that of Rindos in placing more emphasis on anthropogenic modifications to the environment from the beginning. During the Middle Holocene (8000-5000 B.P.) in eastern North America, there was an extension of base camp occupations on floodplains of major mid-latitude river systems. The development there of slackwater and shoal area aquatic habitats where fish and mussels were abundant created enriched, fixed place food resource concentrations.

Dry season base camps at these particularly favorable locations were occupied repeatedly and probably for longer periods, while time spent on trips for exploitation of the uplands may have been shortened. Shell mounds and midden mounds dating to the Middle Archaic attest to strong preference for proximity to these spatially limited, rich aquatic areas.

Disturbance of such site areas by their occupants would have created the first "domestilocalities", a term describing continually disturbed anthropogenic habitats (Smith 1986b). Applying a gradual coevolutionary process similar to that of Rindos, initial domestication is seen as having occurred in these localities where available sunlight and soil fertility were increased, the soil was disturbed, and harvested seeds were unintentionally dropped. Morphological changes in Iva annua and Chenopodium bushianum (or C. berlandieri, see Chapter 5) have been documented archaeologically by 3500 B.P., and alteration of Helianthus annuus is projected as having occurred at about the same time (Smith 1986b; Ford 1985; Yarnell 1983). Although pepo gourd and bottle gourd were present considerably before the native seed crops, they fit into the Middle Holocene coevolutionary trajectory simply as other plants having a mutualistic relationship within the protected, enriched anthropogenic habitat of the long-term riverine base camps. There is no reason to think of these early container crops as necessary models for the concept of agriculture, and there was no need for special garden plots to have been prepared for them.

This new model shares elements with the scenarios set forth by Fowler, Struever, and even Caldwell, but it has a much stronger foundation in evolutionary principles as specified by Rindos. The gradual spread of early plant husbandry across the east can be envisioned as follows:

> Different drainage systems and specific domestilocalities within drainage systems would have exhibited variation in terms of both the relative level of selective pressure and the timing of the developmental process. Against this backdrop of spatial and developmental variability, the "dispersal" of seed stock, information, and individuals between domestilocalities would have resulted in a complex mosaic of occasionally linked, generally parallel, but distinct co-evolutionary histories for different areas of the mid-latitude eastern woodlands [Smith 1986b].

While this scenario for local domestication of indigenous seed crops appears logical now, Smith (1986b) points out that the nature of the data base formerly impeded resolution of the question of whether or not an eastern North American center of plant husbandry had developed. Smith's own work with Chenopodium from curated museum collections and from wild plants contributed to the augmentation of the data base in no small way. By painstaking measurement of seed coat thickness and attention to other characters of the specimens using electron microscopy, Smith (1984; 1985a and 1985b) showed that stored fruits from Russell Cave, Alabama, and Ash Cave, Ohio, were clearly domesticated even though seed diameter had not increased. Although the Asches (1982) had previously noted the importance of the truncate-margin, smooth-coated forms, Smith's seed coat thickness studies were needed to clinch the case. Rounding out the botanical and theoretical aspects of his work, Smith has made context and chronology primary concerns and has acquired direct radiocarbon dates for critical specimens. Recent papers (Smith 1986a and 1986b) combine pattern, history, and process into grand overviews of agricultural origins and amplifications in eastern North America.

The coevolutionary framework for the domestication of the various native eastern North American seed crops and installation of these species as major subsistence items during the Woodland period makes excellent sense, and I will rely upon it for interpreting the Ozark plant remains. As Rindos and Smith both emphasize, initial domesticatory events are seen as taking place without human intentionality, and they were not triggered by population pressure.

The incorporation of maize into the apparently established Woodland gardening system, as Smith (1986b) notes, was a different type of process, and it has not been dealt with as systematically as the growth of early mutualism. Rindos (1984) would see an increase in human population as accompanying the rise in carrying capacity afforded by the indigenous crops. Selection pressures in agricultural systems favor means of increasing productivity. If the food yield of maize surpassed that of the extant crops, more and more energy would be invested in its production.

Speculations have been advanced concerning introductions of new, higher yielding maize (or maize that was different in some other way) which could be responsible for the seemingly rapid subsistence transformation at the onset of the Mississippian Period. At this time, however, the available data base is not adequate, or perhaps it has not been analyzed fully enough, for any of the proposed scenarios to be credible. We now have better information about when maize became important to eastern societies and what types of regional patterns the maize agricultural systems took, but we do not yet understand very well the processes involved in their development.

CHAPTER 4

DATING THE ROCKSHELTER PLANT REMAINS

THE DEPOSITS IN GENERAL

The major limitation in dealing with desiccated Ozark material has always been the unknown time factor. Harrington (1960) distinguished between a Bluff-dweller Culture and Post Bluff-dweller culture, conjecturing that the Bluff-dweller culture lasted until A.D. 500-600. Comparisons were based on traits shared with Basketmaker sites in the Southwest. He recommended radiocarbon dating to establish the antiquity of Bluff-dweller beginnings, stating that "some of the rockshelters had been occupied for a long, long time" (Harrington 1960:176). Shell-tempered pottery, larger corn cobs, "tiny" arrowpoints, and a few other specific types of artifacts were attributed to the Post Bluff-dweller culture (termed Top Layer Culture in 1924). Harrington (1960:178) had found manifestations of this type only near the surface of sites, overlying Bluff-dweller deposits. He thought it likely that the post Bluff-dwellers were ancestral to the Osage, who claimed the territory at the time of White settlement, but acknowledged the possibility that Siouan groups had moved in after the departure of the Post Bluff-dweller culture.

Dellinger and Dickinson (1942) had recognized that much of the rockshelter pottery was comparable stylistically to ceramic types found at other sites in Arkansas, Louisiana, and Oklahoma. The Yokena Incised, Troyville Stamped, and Coles Creek Incised sherds were thought to be affiliated with Harrington's (1924) Bluff-dweller occupation. Shell-tempered wares were aligned with the Top-Layer Culture, evidence of which was encountered with greater frequency by Dellinger's crews than had been the case during the Heye Foundation investigations. It was noted (Dellinger and Dickinson 1942:287) that preceramic bluffshelter site components must predate the "Marksville-Coles Creek horizons" (Middle to Late Woodland), which we would interpret today as referring to the Archaic or Early Woodland.

Sherds classified as "Caddo" and labeled as "intrusive" were found at three shelters. These "were well made, having grit temper, compact paste, and polished surfaces" (Dellinger and Dickinson 1942:287). One bore an engraved design, and some were fragments of the Caddoan bottle form. These were associated with shell tempered pottery and interpreted as pointing "toward a protohistoric horizon for the Top-Layer Culture" (Dellinger and Dickinson 1942:287).

In his overview of Northwest Arkansas prehistory, Jim Scholtz placed the desiccated artifacts from dry upper rockshelter levels generally into his Early Ceramic and Late Ceramic stages, remaining hopeful that:

> an intensive study of materials and records in the collections of the University of Arkansas Museum and further excavation of undisturbed shelter deposits may make it possible to determine which of these materials relate to the various cultural stages outlined here" [Scholtz 1969:56].

The first series of radiocarbon samples on curated rockshelter organic remains (Crane and Griffin 1968) was processed even as Scholtz's article was in press. The twelve dates on material excavated during the 1930's are presented in Table 4.1. The earliest date, on human bone from Edens Bluff, was A.D. 200 +/- 130. Another human burial from Red Bluff was dated at A.D. 370 +/- 30. Two other samples predated the second millenium A.D. The first, from Edens Bluff, was derived from "textile and plant remains" thought to be associated with Burial E-19. The second was on human "skeletal material" from Pine Creek Shelter (3MA2), yielding a date of A.D. 935 +/- 120. The seventh century A.D. Edens Bluff date is problematic since a sample of "grass" from the same burial yielded a determination of A.D. 1080 +/- 110. No corrections were made for isotopic fractionation at that time, of course.

Unauthored notes from the files of the University of Arkansas Museums entitled "Additional Commentary on this Series of C-14 Assays" state that "it is not known to what Sample M-1702 relates", since the two Edens Bluff samples submitted by the University of Arkansas Museum were covered by the determinations numbered M-1703 and M-1703A. The same notes confess that "the suffix A on sample M-1703A is not understood".

Seven other second millenium A.D. dates indicated that Scholtz was probably correct in assuming that most perishables from the Dellinger-directed excavations were relatively recent. Wolfman (1979), whose culture historical sequence for the Ozarks extended the Archaic Period to A.D. 1, acknowledges that "some of the great quantity of perishable material including bags, basketry, moccasins, cloth skins, etc. excavated by Harrington and Dellinger may date to the late Archaic substage." The bulk of the desiccated assemblages, however, "apparently dates to the following Woodland and Mississippian stages" (Wolfman 1979:22).

Table 4.1

The 1960's Radiocarbon Dates

RCYBP	Site	Material	Lab. #
(5570 Half life)			
1750+/-130	Edens Bluff	human bone	M-1703
1580+/-130	Red Bluff	human bone	M-1701
1320+/-120	Edens Bluff	textile & plants	M-1703A
1015+/-120	Pine Creek	human bone	M-1706
870+/-110	Edens Bluff	grass	M-1702
840+/-110	Brown Bluff	portions of cache	M-1711
820+/-110	Breckenridge	baby cradle	M-1687
790+/-110	Brown Bluff	gourd, fabric, and antler	M-1711A
720+/-100	Ricart	human bone	M-1705
630+/-110	Pine Creek	human bone	M-1707
600+/-110	Rock House	charred plants	M-1708
280+/-100	Ricart	human bone	M-1704

Dates on carbonized material from wet shelter levels demonstrate that some Ozark rockshelters (but not those excavated in the 1930's) were utilized at least as far back as the Early Archaic Period (Sabo et al 1982). The cultural sequence at Breckenridge Shelter (3CR2, Dellinger's Pine Hollow Shelter), was later found to extend to a depth of 280 cm (Wood 1963), with "nearly continuous" occupation throughout the Archaic Period, and up until the time that shell-tempered pottery was utilized. Brown (1984b:25) points to the well-represented Middle Archaic lithic assemblages at Breckenridge, but these tools came from strata excavated during the early 1960's, not the 1930's. The possibility remained, of course, that isolated dry pockets of Archaic period cultural material in certain shelters may have been encountered by Dellinger's crews.

Trubowitz (1980) provides an in-depth, overall analysis of artifact types in the context of their archaeological proveniences for two of the 1934-excavated rockshelter groups in the Pine Mountain Project area—Tidwell Hollow (3CW6) and Swearingen Farm Bluffs (3CW7). On the basis of pottery and projectile points, specific overhangs could be recognized as having been utilized during one or more time period, ranging from Fourche Maline phase through Ft. Coffee phase. Based on depths from the surface as recorded in the 1934 field notes, however, vertical separation could not be distinguished. At Tidwell Hollow, evidence pointed to a Mississippian period (Caddoan) episode during which pits were dug through earlier (Fourche Maline) debris, resulting in mixing of the cultural material (Trubowitz 1980:102). Insights such as this are important contributions, but they highlight the difficulty of dating individual specimens, especially small items such as loose seeds or other plant fragments.

THE PLANTS IN PARTICULAR

Researchers concerned with Ozark archaeobotanical remains have, by default, needed to regard the plant types in question as undated but most likely no more than 1000 years old, or less likely, between 1000 and 2000 years in age (Asch and Asch 1977; Wilson 1981; Fritz 1984b). Yarnell (1981) suggested that averaged sizes of sunflowers and sumpweed achenes could be used as temporal indicators based on hypothesized gradual size increase through time of these cultigens. This attempt at temporal placement of rockshelter material will be discussed in detail in Chapter 6. On a general level, without radiocarbon verification, it indicated that some of the plant remains were deposited during the Woodland Period and some during the Mississippian period, in accordance with prevailing interpretations.

Sandra Scholtz (1975:150) suggested that differences in age might have been responsible for the fact that coiled basketry tended to be concentrated in certain shelters, while interlaced cane basketry was found mainly in others. If so, "there is no evidence in the present analysis to indicate which of these two techniques was earlier in this area" (Scholtz 1975:150). Furthermore, interpretations other than temporal variation seemed equally plausible.

My own experience in examining the specimens, including samples of mixed cultural material accessioned as a "lot", and in studying the 1930's field notes for these lots and the artifacts found near them at similar depths from the surface, makes me believe that it is usually impossible to associate temporally diagnostic artifacts with specific items of plant remains. But because the well-preserved plants, especially certain cultigens, are so unusual, it was felt that determining their ages would make a contribution to the study of North American subsistence change even in the absence of clear cultural associations in the rockshelter deposits. Therefore, assistance was sought to acquire radiocarbon dates on key samples. The material submitted included 17 samples of maize, five of chenopod, one of amaranth, one of ragweed associated with chenopod, knotweed, and sunflower, one of gourd rind associated with chenopod and knotweed, three of maygrass, three of sumpweed, one of sunflower, and one of cucurbit peduncle. Table 4.2 presents the ages listed in numerical order by radiocarbon laboratory number. The dates in this table are not calibrated but are corrected for isotopic fractionation. Table 4.3 presents calibrated dates in chronological order together with the 95% confidence intervals.

Top research priority was to date the cultigen amaranth and chenopod. Amaranth stems from Holman Shelter were submitted for chronometric dating, as were stems of pale-seeded Chenopodium from Cow Ford and Montgomery Shelter. Black, thin-testa chenopod fruits from Edens Bluff and White Bluff were dated directly by the particle accelerator (AMS) method, as were small pieces of gourd rind from a Whitney Bluff sample which included mixed pale and black chenopod fruits together with cultigen Polygonum achenes. Two chenopod samples from Marble Bluff were dated: a clump of carbonized thin-testa fruits, and carbonized ragweed achenes from a sample mixed with slightly thicker-testa chenopod, sunflower, and several other seed types. The results are included in Tables 4.2 and 4.3 and are discussed in Chapter 5.

Second priority was to attempt to determine what changes in maize occurred during the centuries of farming represented by these assemblages. Seventeen samples of maize were submitted for dating. Two of these—a small cob from Salts Bluff and another from Edens Bluff—were dated by the accelerator method. One sample from Montgomery Farm #4 consisted of desiccated kernels. The remaining specimens were cobs or cob segments, with the rationale being to sample variation in row number, size, and shape. Specimens in addition to those mentioned above were selected from Beaver Pond, Brown Bluff, Buzzard Roost, Craddock, Cow Ford, Edens Bluff, Gibson, Putnam Shelter, and Whitney Bluff. Resulting dates are presented in Tables 4.2 and 4.3 and interpreted in Chapter 9.

Third priority was to date maygrass from sites where stored seed head bundles indicated heavy utilization of that suspected crop plant. Models of plant husbandry in other regions (e.g. Christenson 1980) suggest that more intensified maize husbandry during late prehistory reduced the importance of the small starchy seed crops that dominate Woodland period assemblages. Radiocarbon assays on maygrass were intended to test the hypothesis that a similar decline occurred in the Ozarks. Samples of stem, leaf, and panicle material from Salts Bluff, Gibson Shelter, and Putnam Shelter were submitted. These dates are discussed in Chapter 5.

Fourth priority was to date samples containing sunflower and sumpweed achenes that would be predicted as falling into a certain time period according to Yarnell's (1981) index of mean length times mean width. Yarnell suggested that relatively small-sized sumpweed achenes from Edens Bluff and Craddock might date to the Middle or early Late Woodland period, and that samples of large achenes from Craddock, Alred, and Edens Bluff would date to the Mississippian period. Very large sunflower achenes from Brown Bluff were from the same numbered lot as a sample submitted to the Michigan Radiocarbon lab in the 1960's, which had been dated A.D. 1110 +/- 110 (M-1711). In order to test the hypothesis of temporal predictability based on average achene size, specimens from the small-sized sumpweed samples from Craddock and Edens Bluff were dated by the accelerator method, as were achenes from the large-sized lot from Alred. A conventional date was run on the large sunflower achenes from the Brown Bluff sample that had been dated previously, since it was not known which of the species of plant remains present in that lot had been submitted to the University of Michigan radiocarbon laboratory. Smaller-sized sunflower achenes in association with the ragweed and chenopod in sample 34-23-327 from Marble Bluff would be dated by the assay on ragweed achenes mentioned above. Results are discussed in Chapter 6.

The last plant type singled out for age determination was a cucurbit. Four corky, bulbous peduncles from rockshelter sites excavated in the 1930's could be classified as *Cucurbita mixta*, a species not documented as present in eastern North America before the arrival of Europeans. Since these specimens came from deposits otherwise appearing to be prehistoric, a radiocarbon date on at least one of them was desired. A small chunk was cut out of the larger peduncle from Putnam Shelter and submitted for accelerator dating. This assay is discussed in Chapter 7.

Funding for chronometric study was provided by the National Science Foundation. Conventional dates were run at the Southern Methodist University Radiocarbon Laboratory in Dallas, Texas. Dr. Herbert Haas, director of that facility, granted ten free dates on maize in addition to the 15 assays whose cost was underwritten by the N.S.F. doctoral dissertation improvement grant. Particle accelerator dates were obtained through Beta Analytic of Coral Gables, Florida. The two assays on Chenopodium fruits from Edens Bluff and White Bluff, also processed through Beta Analytic, were furnished by Dr. Bruce Smith at the National Museum of Natural History, Smithsonian Institution.

Table 4.2. The New Radiocarbon Dates

Table 4.2
New Ozark Rockshelter Radiocarbon Dates

C-14 Lab #	Accession #	Site Name	Material Dated	Age (RCYBP) (uncalibrated; fractionation corrected)
I. Accelerator Dates				
B-13396	32-3-391	Edens Bluff	chenopod fruits	1930+/-100
B-13397	32-56-17a	White Bluff	chenopod fruits	1960+/-105
B-14586	32-3-16f	Edens Bluff	12-row maize	1120+/-85
B-14587	32-57-3	Whitney Bluff	gourd rind	785+/-75
B-14588	33-15-5	Salts Bluff	8-row maize	650+/-80
B-14589	32-44-217	Putnam Shelter	*Cucurbita mixta*	520+/-75
B-14590	32-4-103B	Alred	*Iva annua*	1600+/-75
B-14591	34-7-377	Craddock	*Iva annua*	460+/-90
B-14592	32-3-1706	Edens Bluff	*Iva annua*	360+/-80
II. Standard Dates				
SMU-1553	32-15-22	Buzzard Roost	16-row maize	70+/-55
SMU-1554	32-10-69	Brown Bluff	10-row maize	322+/-47
SMU-1555	32-17-2	Cow Ford	8-row maize	680+/-62
SMU-1556	34-7-19	Craddock	10-row maize	660+/-70
SMU-1557	32-3-711	Edens Bluff	8 & 10 row maize	976+/-77
SMU-1558	32-44-38	Putnam Shelter	12-row maize	526+/-103
SMU-1559	32-57-45	Whitney Bluff	8-row maize	536+/-102
SMU-1560	32-21-76	Gibson Shelter	10-row maize	702+/-105
SMU-1561	34-2-647	Beaver Pond	14-row maize	547+/-46
SMU-1578	32-34-19p	Montgomery 4	maize kernels	1468+/-250
SMU-1630	32-34-19A	Montgomery 4	chenopod stems	1419+/-78
SMU-1631	32-17-22	Cow Ford	chenopod stems	1620+/-70
SMU-1632	32-22-4	Holman Shelter	amaranth stems	920+/-109
SMU-1678	32-56-17c	White Bluff	bark	2165+/-47
SMU-1679	32-10-78a	Brown Bluff	sunflower achenes	450+/-42
SMU-1681	34-23-327	Marble Bluff	ragweed achenes	2843+/-44
SMU-1682	34-23-341	Marble Bluff	chenopod fruits	2926+/-40
SMU-1683	32-44-186	Putnam Shelter	maygrass stems	2042+/-61
SMU-1684	33-15-156	Salts Bluff	maygrass stems	1310+/-49
SMU-1685	32-21-58a	Gibson Shelter	maygrass stems	970+/-48
SMU-1686	32-17-21	Cow Ford	12-row maize	581+/-34
SMU-1688	32-44-283	Putnam Shelter	16-row maize	69+/-42
SMU-1689	32-44-479	Putnam Shelter	12-row maize	877+/-40
SMU-1690	34-7-93	Craddock	12-row maize	518+/-60
SMU-1691	32-3-1774	Edens Bluff	12-row maize	856+/-68

Table 4.3. Calibrated Dates and Intervals

C-14 Lab No.	Uncalibrated Date	* Calibrated Date	* 95% Confidence Interval
SMU-1553	A.D.1880+/-55	A.D.1905+/-92	A.D. 1668-1961
SMU-1554	A.D.1628+/-47	1576+/-77	1444-1661
SMU-1555	A.D.1270+/-62	1298+/-50	1227-1393
SMU-1556	A.D.1292+/-67	1315+/-57	1238-1408
SMU-1557	A.D. 974+/-77	1043+/-73	883-1225
SMU-1558	A.D.1424+/-103	1410+/-77	1249-1608
SMU-1559	A.D.1414+/-102	1402+/-76	1254-1567
SMU-1560	A.D.1248+/-105	1287+/-81	1050-1424
SMU-1561	A.D.1403+/-46	1402+/-38	1280-1449
SMU-1578	A.D. 482+/-250	572+/-252	10-1011
SMU-1630	A.D. 531+/-78	627+/-56	465-737
SMU-1631	A.D. 330+/-70	432+/-82	231-596
SMU-1632	A.D.1030+/-109	1106+/-109	883-1268
SMU-1678	215+/-47 B.C...	210+/-76 B.C.	394-92 B.C.
SMU-1679	A.D.1500+/-42	A.D.1451+/-32	A.D.1396-1471
SMU-1681	893+/-44 B.C	1016+/-70 B.C.	1147-913 B.C.
SMU-1682	976+/-40 B.C.	1152+/-72 B.C.	1274-1022 B.C.
SMU-1683	92+/-61 B.C.	39+/-84 B.C.	A.D. 89-204 B.C.
SMU-1684	A.D. 640+/-49	A.D. 696+/-48	A.D.631-816
SMU-1685	A.D. 980+/-48	1044+/-47	972-1165
SMU-1686	A.D.1369+/-34	1366+/-41	1276-1409
SMU-1688	A.D.1881+/-42	1888+/-95	1676-1949
SMU-1689	A.D.1073+/-40	1156+/-62	1019-1243
SMU-1690	A.D.1432+/-60	1411+/-43	1289-1464
SMU-1691	A.D.1094+/-68	1175+/-80	1013-1267

* Calibrated Dates are Weighted Averages (Centroids) of Calibrated Distributions, furnished by the S.M.U. Radiocarbon Laboratory. Printouts furnished with the dates state that the Calibration Curve Data are based on: `Data table of G.W. Pearson (1985), Stuiver (82) after 1800 A.D.' They also state: "Calibration algorithm of S.W. Robinson (1984)".

CHAPTER 5

THE STARCHY SEED CROPS

CHENOPODIUM

Background

Melvin R. Gilmore's suspicions that certain rockshelter chenopod samples represented a cultigen variety were apparently based on context, ubiquity, and the observations of specialists W. E. Safford and O. M. Freeman at the Bureau of Plant Industry (U.S.D.A.). In 1924, Safford had examined a sample of _Chenopodium_ fruits from an unspecified shelter excavated by Harrington. His conclusion was that the specimens were "very closely allied" to the Mexican cultigen species _C. nuttalliae_ Safford (letter cited in Asch and Asch 1977:12). Freeman made further comments on a second packet of Ozark chenopod in 1926. He concurred with Safford that the Ozark specimens were much like the Mexican crop, adding the important observation that the rockshelter fruits were black, whereas the Mexican cultigen could be either "horn-color, dark brown, or black" (letter cited in Asch and Asch 1977:12-13). It appears, therefore, that Freeman was dealing with a truncate-margin, thin-testa sample. Pale color is not mentioned by Gilmore in the 1931 article or anywhere in his notes on the assemblages excavated by Dellinger in the 1930's.

Gilmore (1931:85) appreciated the repeated association of chenopod with "the selected seed of corn, beans, sunflowers, squashes, and pumpkins" in apparent storage context. Carefully cleaned fruits filling a drawstring bag from Edens Bluff and two gourds full of Chenopodium from White Bluff, both found in 1932, must have strengthened Gilmore's opinion that a cultigen chenopod was in evidence. Again, these two samples are exclusively the dark, thin-testa variety.

Hugh D. Wilson seems to deserve credit for first recognizing the presence of pale, "no-testa", "huauzontli-like" Chenopodium in North America north of Mexico. He observed that the Harrington sample with Michigan Laboratory #13011 contained well-preserved horn-colored fruits complete with pericarp. Wilson (1981:234) stressed that "any percentage of light-colored fruits in an archaeological sample would constitute positive evidence that a domesticated form was being utilized." The Asches seem to have taken the pale fruits in this sample for seeds missing their testas. They described the sample as consisting of 39 specimens having seed coats and 51 specimens lacking seed coats (D. Asch and N. Asch 1977:36).

The discovery of pale cultigen chenopod in sample 13011 at Ann Arbor led Wilson to the stacks of Vol Walker Hall at Fayetteville, Arkansas, where the bulk of the University of Arkansas Museum rockshelter collections were curated. There he found the dense Holman Shelter inflorescence with numerous pale Chenopodium fruits, sample 32-22-3 (Wilson 1981). Wilson believed that the Arkansas chenopod was most likely the taxon C. berlandieri ssp. nuttalliae (Safford) Wilson and Heiser, which would have been introduced from Mesoamerica. There was no convincing taxonomic evidence to rule out independent North American domestication, however.

When I first encountered the Holman Shelter chenopod in 1982 and needed to write about it in conjunction with cultigen amaranth from the same location (Fritz 1984b), it seemed most reasonable to follow Hugh Wilson's suggested identification of the pale chenopod as Mesoamerican huauzontli. In fact, the association of this chenopod with Amaranthus hypochondriacus L., another Mexican crop, seemed to strengthen the interpretation that diffusion was responsible for its presence in Arkansas, rather than independent domestication. I had not yet seen the samples of dark, thin-testa Ozark chenopod, and Bruce Smith had not yet published his work with the Russell Cave and Ash Cave specimens in which he demonstrated that a truncate margin, thin-testa crop variety of Chenopodium had been present in Eastern North America as early as 2000 B.P (Smith 1984; 1985 a and b). The prevailing opinion was that most if not all "perishable" Ozark material was probably late prehistoric, so that an introduction after A.D. 1000 of huauzontli, perhaps along with amaranth and chia, the black-seeded Mexican chenopod cultivar, could have been independent from the Woodland Period husbandry of Chenopodium proposed by Yarnell (1974 and 1976) and Asch and Asch (1978 and 1982), and finally validated by Smith.

New radiocarbon dates of ca. 3000 B.P. on thin-testa chenopod from Marble Bluff and ca. 2000 B.P. on chenopod from both Edens Bluff and White Bluff force a reassessment of the issue by demonstrating contemporaneity between the dark Ozark chenopod and similar fruits from Newt Kash and Cloudsplitter Rockshelters in Kentucky and Russell Cave in Alabama (Smith and Cowan 1986). Another significant development is the proposal by the Asches (N. Asch and D.Asch 1985b; D. Asch and N. Asch 1985b) that carbonized specimens recovered from the Newbridge site (A.D. 480-660) and Hill Creek site (A.D. 1260) are examples of a no-testa chenopod form in Illinois that would have been pale in color prior to carbonization, like huauzontli. Radiocarbon dates predating the Mississippian period have now been obtained on two of the samples of pale-seeded chenopod from these Ozark shelters as well (see below).

The combined lines of evidence indicate that there was a long sequence of chenopod domestication in the eastern United States and that Ozark plants and people were involved in the process. Therefore, the pale specimens need to be seriously considered as potentially the products of this local development. As it is now known, the sequence includes the following evidence:

1. Some Late Archaic Titterington Phase (ca. 4000 B.P.) components in Illinois, including Napoleon Hollow, Lagoon, and Koster, have yielded higher frequencies of chenopod seeds—over 60% of identifiable seeds—than would be expected under natural conditions. The specimens are biconvex and have thick seed coats.

2. Thin-testa chenopod seeds from two rockshelter sites have now been dated to the fourth millennium B.P. Specimens from both Newt Kash and Cloudsplitter rockshelters were directly dated, yielding ages of 3400 +/- 150 and 3450 +/- 150 B.P., respectively (Smith and Cowan 1986). Thin-testa Marble Bluff Chenopodium, discussed below, has been dated to the early 3rd millennium B.P.

3. By the Early Woodland Period in Kentucky (ca. 2300 B.P.), at Salts Cave, and the Middle Woodland Period in Illinois (ca. 1800 B.P.), at Smiling Dan, changes in gene frequencies had resulted in populations

of mixed seed types--some with thin, smooth seed coats and some still resembling the wild form (D. Asch and N. Asch 1985b).

4. By about the time of Christ, the Russell Cave and Ozark rockshelter samples of cleaned fruits in specialized storage contexts, such as the contents of woven bags and filled gourds, show strong selection in favor of the thin-testa cultigen. Middle Woodland samples from Ash Cave, Ohio, and the John Roy site in Illinois, are also dominated by this "chia-like" type.

5. Two pale-seeded Ozark samples (from Cow Ford and from Montgomery Shelter 4) have now been dated to Middle or Late Woodland (ca. 1600-1300 B.P.) times, and some specimens from two Late Woodland (ca. 1500-1300) components in westcentral Illinois (Newbridge and Smiling Dan) are viewed as lacking outer epiderms and therefore representing a huauzontli-like crop.

6. Husbandry of this pale-seeded variety continued into the Mississippian period in the Ozarks (at Holman Shelter and Whitney Bluff), in Illinois (at the Hill Creek Site), and probably other areas.

The Nomenclatural Problem

Smith and Funk (1985) have formally designated a new subspecies, *C. berlandieri* ssp. *jonesianum*, to "allow easier reference to the prehistoric domesticated taxon of the eastern United States" (Smith 1985b:446). This circumscription accepts Wilson's (1980) evidence that *C. bushianum* and *C. berlandieri* are conspecific. As Heiser (1985:69) notes, no formal revision to that effect has yet been made. The Asches, following Smith's lead, have stopped referring to their Illinois specimens as *C. bushianum* and now refer to them as *C. berlandieri*. The new subspecific designation of Smith and Funk connotes the likelihood that the "chia-like" archaeological specimens in question are the result of independent domestication and are not populations of C. berlandieri ssp. nuttalliae cv. 'chia', the Mesoamerican crop.

This circumscription creates problems for classifying the Ozark chenopod samples. To label the pale fruits as C. berlandieri ssp. nuttalliae would infer that they are of Mesoamerican origin. To refer to them as C. berlandieri ssp. jonesianum would equate them with thin-testa chenopods, suspected as being products of an indigenous husbandry process. Classification of the dark Ozark chenopod fruits as C. berlandieri ssp. jonesianum would carry with it the connotation that they are different from the Mesoamerican chia cultivar. Even though I suspect that the Ozark chenopods, both dark and pale, are native temperate North American crops, the means of distinguishing them botanically from Mesoamerican chenopods have not yet been discovered. Therefore, I feel compelled to stop short of subspecific designation.

Descriptions of the Larger Ozark Chenopod Samples

Cultigen Chenopodium has been identified in samples from 13 Ozark rockshelter sites excavated by the University of Arkansas Museum and at two additional sites excavated by Harrington for the Museum of the American Indian. Eight of the "Dellinger" sites and one Harrington site had at least one substantial sample of chenopod—i.e., a concentration of numerous fruits and/or a bundle of longer stems with inflorescences still attached. These are itemized in Table 5.1. The smaller samples which consist of only a few loose fruits or short segments are tabulated in Table 5.2.

A. Samples with Black Seeds.

Sites excavated by the University of Arkansas Museum yielding only the thin-testa, truncate-margin form of cultigen chenopod are Marble Bluff, Edens Bluff, and White Bluff.

1. Marble Bluff. Two samples from the Marble Bluff site include sizeable amounts of *Chenopodium*. Both were buried in a large crevice at the rear wall of the shelter along with numerous other types of plant remains and bone tools. A fire had started in the crevice at some point after deposition, and all the organic contents were charred. Sample 34-23-327 consists of a large volume (the excavators estimated one gallon) of mixed seeds. The fraction of sample 34-23-327 brought to Chapel Hill for analysis weighed approximately 300 g. Stone, bone, and mussel shell larger than 2.0 mm weighed 127 g, and particles smaller than 0.71 mm comprised another 78.5 g. Most of the organic content of the ca. 95 g of other material consists of seeds, with ragweed and chenopod dominating. Extrapolating from a 10% subsampling of items between 0.71 and 2.0 mm in size, more than 30,000 *Chenopodium* seeds are present in the material placed on loan. This compares to approx. 1000 ragweed achenes, 189 four-seeded capsules suspected of belonging to the mint family (Lamiaceae), 122 sunflower achenes, 97 *Polygonum*, 104 amaranth, three *Cucurbita* seeds, and two sumpweed achenes.

Two hundred *Chenopodium* fruits from the subsample placed on loan were measured. Diameters ranged from 1.1 to 2.0 mm (mean = 1.60 mm, std. dev. = 0.17). Seed coats of all well preserved fruits in this sample are noticeably thicker than those of other chenopod seen in the rockshelter collections (Figure 5.1) One specimen was sectioned, and its seed coat measured using the Etec Autoscan Scanning Electron

Microscope at the Dental Research Center, School of Dentistry, University of North Carolina at Chapel Hill. The thickness of the measured specimen is 25 microns. In comparison, mean testa thickness for 20 measured specimens from Russell Cave, Alabama, is 11 microns, and that for 20 Ash Cave, Ohio, specimens is 14.9 microns. Wild Chenopodium seed coats were found to range between 40 and 80 microns in thickness (Smith 1985b). Seed coats of Marble Bluff sample 34-23-327 in general also exhibit more distinct pitting than is typical of the thin-testa North American crop (cf. Smith 1985b).

Many of these fruits had split along the horizontal axis and popped open to some degree, so that original seed shape was difficult to ascertain. They appeared different, however, from the truncate-margin form of the Edens Bluff, White Bluff, Russell Cave and Ash Cave specimens. The relatively thick seed coats are more uniformly curved, indicating rounded rather than truncate sides. Many are attached at one edge, reminiscent of open bivalves.

The thicker, more pitted seed coats and the apparent absence of truncate margins place the Chenopodium in this Marble Bluff sample closer to wild or weedy forms. Remnants of alveolate pericarp demonstrate that subsection Cellulata of section Chenopodia of the genus is still the taxon involved. The fact that such a large quantity of chenopod was buried in this location, along with the other types of seeds, would indicate that some degree of husbandry is likely, as does the 25 micron-thick seed coat.

A radiocarbon date of 2843 +/- 44 B.P.: 893 B.C. (S.M.U. 1681) was obtained on ragweed achenes from this sample.

The second Marble Bluff chenopod concentration has accession number 34-23-341. It consists of carbonized clumps of fruits, some of which exhibit an outer surface of woven fiber that looks like the remnants of a bag. The excavation field notes describe this sample as a "Bag with seed", sketched as lying beside the one-gallon cache 34-23-327, just described. One clump is largely plant (grass?) stems. Remnants of fiber can be seen on one side, with a few chenopod seeds adhering. It appears as if the woven bag full of Chenopodium was laid next to a grass lining.

Seed coats of fruits in this sample are thinner and smoother than those in sample 34-23-327. Shapes are difficult to determine due to puffing (Figure 5.2), but an original truncate-margin form is believed likely. Only those specimens that had become detached from clumps were measured. The 26 measurable fruits range in diameter from 1.0 mm to 1.7 mm. Mean diameter is 1.48 mm, with a standard deviation of 0.17. Testa thickness was measured as varying from 16-20 microns.

Clumps from 34-23-341 were dated to 2926 +/- 40 B.P.: 976 B.C. (S.M.U. 1682). There is a one-year overlap with sample 34-23-327 at the 66% confidence interval. The two samples overlap considerably at the 95% confidence interval, and may well have been deposited at the same time. The 95% confidence interval overlap after calibration is 125 years.

Two other bags filled with seeds are sketched as lying near the sample 34-23-341 in the excavation field notes. They are numbered 34-23-340 and 34-23-344, and both samples currently consist of carbonized thin-testa chenopod clumps with twined fabric remnants on one side. The fruits in these samples were not measured, but they seem the same in general as those in the 34-23-341 sample. Neither sample currently holds enough seeds to have filled a bag the size of those indicated in the field book sketch.

2. Edens Bluff. The largest lot from Edens Bluff was found inside a remarkably well preserved drawstring fiber bag, 32-3-391 (Figure 5.5). The volume of fruits present is estimated to be approximately 1 liter. Fruits examined at the University of North Carolina consist of specimens which had fallen to the bottom of the plastic bag protecting the artifact at the University of Arkansas Museum. These were found to be mixed with an unidentified species of Asteraceae achene (Figure 5.3). A total of 844 *Chenopodium* fruits and 94 composite achenes were among the material from this sample placed on loan. This may not reflect the ratio of chenopod to composite fruits in the bag itself since the narrow composite achenes could slip through the bag more easily than the chenopod fruits. Still, the abundance of this Asteraceae type indicates that it may have been intentionally harvested and stored together with the chenopod, rather than being a weedy contaminant.

A sample of 125 of these *Chenopodium* fruits was measured. Diameters ranged from 1.2 to 1.9 mm, with a mean diameter of 1.66 mm and standard deviation of 0.11 mm. Most specimens are truncate on the side of the embryonic leaves and rounded or banded on the radicle side (Figure 5.4). Seventeen fruits in the measured group of 125 had round rather than truncate margins, and eight had broken seed coats that made determination of original margin shape impossible.

Using scanning electron microscopy, seed coat thickness was measured as 12-15 microns for a typical truncate margin specimen

(Figure 5.7) and 30 microns for a fruit with round rather than truncate margins. Measurements were made from micrographs of cross sectioned specimens using the Etec Autoscan Scanning Electron Microscope at the Dental Research Center, School of Dentistry, University of North Carolina at Chapel Hill.

The 1932 excavation field notes supply only the Trench and Block numbers, a depth of 35" below the surface, and the brief description: "Cache (bag of seed) Unique." Gilmore's Laboratory Report 71a lists the specimen as no. 923a: "Finely woven bag. Eryngium. Woof strands Eryngium, walnut dyed. Bag filled with seeds of Chenopodium sp., large size, 1 mm. diameter. Cultivated?"

Chenopod fruits from this bag have been dated directly by the particle accelerator method to yield a radiocarbon date of 1930+/-100 RCYBP: A.D. 20 (Beta 13396).

3. White Bluff. Sample 32-56-17a consists of Chenopodium fruits from the White Bluff site. The excavators found two gourd bowls full of black chenopod fruits that had been placed in a prepared storage pit at this site. Only one of the gourds was still intact when encountered in the field, and it has fallen apart since 1932, but University of Arkansas Museum photographs (Figure 5.6) indicate that the volume of fruits inside each container was at least one liter and probably closer to two liters.

The subsample placed on loan for study at U.N.C.-Chapel Hill consisted of the contents of three small packets that had previously been loaned out for study elsewhere by the Museum . Each gram of this sample contained slightly less than 4500 fruits, and the sorted

Chenopodium weighed slightly more than 7.5 g, so that the small subsample alone held almost 50,000 fruits.

One hundred fruits were measured. Diameter range was 1.1 to 1.8 mm. Mean diameter was 1.58 mm, with a standard deviation of 0.10. Specimens in this sample are not preserved as well as those in the Edens Bluff drawstring bag. The White Bluff fruits tend to be hollow or to contain only powdery remnants of perisperm, whereas many of the Edens Bluff fruits are still filled with hard perisperm. The predominant shape is the same for the two samples, however: truncate on one side and banded on the other, with a distinct point opposite the beak where the truncate portion ends (Figure 5.8). Testa thickness of a "typical" cross-sectioned specimen was measured as 17 microns.

The 1932 excavation field notes give only the Trench and Block numbers and the depth of 10" below surface for the tops of the gourds. A description of the context, however, is included in Gilmore's Ethnobotanical Laboratory Report 25. Gilmore received a quantity of these seeds for analysis, and his information was presumably supplied by Dellinger:

> The cache was a hole about ten (10) inches below the surface, lined with grass and leaves. In the cache were two large gourds, each with a capacity of three or four pints, filled with these seeds. One of the gourds had been crushed, but the other was intact. In its top were two small slits through which the seeds had evidently been poured. The cache was enveloped with bark, and outside of that were flat slabs of sandstone.

A radiocarbon date of 1960+/-105 RCYBP: 10 B.C. (Beta 13397) was obtained from these chenopod fruits using the accelerator method. This determination places them as approximately the same age as the thin-testa chenopod from both Edens Bluff, Arkansas, discussed above, and Russell Cave, Alabama (Smith 1985a). The accelerator date on Russell

Cave chenopod fruits is 1975 B.P, while grass from the basket containing the fruits was dated by the standard method to 2340 +/- 120 B.P. A paired date for the White Bluff specimens was obtained by submission of a piece of the bark which had "enveloped" the gourd cache. The age of the bark was determined to be 2165 +/- 47 B.P.:215 B.C. (S.M.U. 1678). The overlap of the uncalibrated dates using two standard deviations indicates that these chenopod-filled gourds were in fact buried at White Bluff about 2000 years ago.

B. Samples with Pale Chenopod Seeds

Five Ozark rockshelters excavated during the 1930's were depositories of pale-fruited chenopod caches. At only one of these sites, Whitney Bluff, did the samples consist of stored, winnowed fruits devoid of fruiting stems--the pattern presented by the black, thin-testa chenopod samples discussed above. Pale chenopod at the other four sites included stem segments and inflorescences in various degrees of completeness.

1. Cow Ford. Two samples from the Cow Ford site consist of stems and fruit-bearing inflorescences of pale-seeded chenopod mixed with numerous twisted pods of the wild bean, *Strophostyles helvola*. One of the samples, 32-17-1, was not sorted so that the integrity of this interesting conglomeration of food types would be preserved for the benefit of future researchers. The second, 32-17-22, was separated, sieved, and sorted.

All mature, complete chenopod fruits loose in this sample were measured. The number of measurable fruits was 155. They ranged in diameter from 0.9 mm to 1.6 mm, with a mean of 1.25 mm and standard deviation of 0.16, the smallest in size among the cultigen chenopod populations from the Ozarks. The fruits in this sample are in an excellent state of preservation, with hard, dense perisperm tissue. The Cow Ford "huauzontli-like" seeds are fully truncate and golden in color, much like the Holman Shelter chenopod, described below.

Dark colored, thin-testa chenopod is also present in sample 32-17-22. Ten fruits have thin, black seed coats and fully truncate margins, and one has a thin seed coat with a rounded radicle side and truncate embryonic leaf side. These "chia-like" fruits range in diameter from 1.2 to 1.6 mm (mean = 1.45 mm, std. dev. = 0.13). Six fruits have thin, reddish seed coats and fully truncate margins, ranging in diameter from 1.2 to 1.6 mm (mean = 1.38, std. dev. = 0.13). There are also 10 immature (?), shriveled red fruits, all flattish and less than 1.2 mm in diameter. Finally, the sample includes three chenopod fruits with thick black seed coats and rounded (not truncate) margins. The two complete specimens of this type measure 1.7 mm and 1.5 mm in diameter. The larger has a much thicker pericarp than is found on the fruits with reduced seed coats.

Larger-sized plant remains in the Cow Ford sample 32-17-22 consist of 40.29 g of twisted Strophostyles helvola pods, approximately 20 g of chenopod stems with inflorescences (Figure 5.13), 21.47 g of wood, including a few carbonized chunks, 8.29 g of non-chenopod stems and leaves, 2.89 g of acorn shell, 0.17 g of acorn meat, and 0.32 g of hickory nutshell. Other seeds include one Iva annua var. macrocarpa pericarp fragment, 5.3 mm wide, seven Strophostyles helvola (5.6 - 8.4 mm in length), two sumac, four grape, and 26 unidentified composite achenes. A single pale-colored amaranth seed was found in a packet of chenopod stem and flower head material that had been placed on loan in 1976. This, then, is one of the three instances of mixed cultigen amaranth and chenopod from the Ozarks.

The 1932 field notes state only that the Cow Ford chenopod material in this sample came from Trench 16, Block 4, at a depth of 12" below the surface. A sample of these chenopod stem segments was submitted for conventional radiocarbon dating, with a resulting date of 1620 +/- 70 RCYBP: A.D. 330 (SMU 1631). This date becomes A.D. 432 +/- 82 after calibration.

2. Holman Shelter. The Holman Shelter sample consisting of a relatively large quantity of chenopod is 32-22-3. In addition to the compact inflorescence shown by Wilson (1981:325), the sample consists of small sized particles including 108 measurable pale, brownish-yellow chenopod fruits, as well as others attached to their calyxes and immature fruits. Diameters range from 0.8 mm to 1.8 mm (mean = 1.48, std. dev. = 0.22). Side margins are fully truncate.

Much of the loose debris in this sample consists of chenopod flower parts. In addition, one carbonized maize kernel fragment, one tiny piece of carbonized pepo rind, small fragments of hazelnut shell, hickory nutshell, walnut shell and acorn shell, one sunflower pericarp fragment, two whole plus two fragmentary sumac seeds, one grape seed, one ragweed achene, 12 flat black amaranth seeds, seven Poaceae caryopses representing three types of grasses, and small amounts of wood, cane, and juniper leaf were present.

The sample was encountered at a depth of 8" below the surface in Trench 10, Block 4. It is described by the excavators as "Pigweed seeds". None of this material was submitted for dating, but it is assumed to be contemporary with the amaranth from sample 32-22-4, recovered from the same trench, block, and depth. The latter sample contained seven Chenopodium calyxes, indicating that the two were buried in close proximity. The conventional date on amaranth stems is 920 +/- 109 RCYPB: A.D. 1030 (SMU 1632). The calibrated date is A.D. 1106 +/- 109.

3. Whitney Bluff. Two samples from Whitney Bluff include quantities of chenopod fruits along with other plant foods. They have accession numbers 32-57-3a and 32-57-5c. The fruits in these two smples are so similar, and they were located so close to each other, that a considerable degree of mixing is suspected.

Pale fruits and dark fruits are present in both of the Whitney Bluff chenopod samples. The black fruits are considerably larger than the pale fruits, and are less abundant. Sample 32-57-3a contained a total of 270 dark, thin-testa fruits, but only 73 were complete enough to be measured. Diameters range from 1.5 to 2.2 mm, with a mean of 1.90 mm and a standard deviation of 0.13. Margins in general are more fully truncate (Figure 5.9) than exhibited by the Edens Bluff and White Bluff specimens, but some are truncate only on the side of the embryonic leaves as are typical fruits from Edens Bluff and White Bluff. A few fruits have fully rounded rather than truncate margins. The typical fruit chosen for sectioning has a outer epiderm approximately 15 microns thick.

Approximately 1,100 pale chenopod fruits were present in sample 32-57-3a. In most cases, pericarps remain as filmy shields around seeds that have for the most part disintegrated. Diameters range from 1.1 mm to 1.9 mm (mean = 1.55, std. dev. = 0.17), for 125 measured specimens.

Scanning electron micrographs of the dark and pale forms of chenopod from Whitney Bluff illustrate the similarity of these fruits when color is eliminated as a character (Figures 5.9 and 5.10).

The field notes describe sample 32-57-3a as "Gourd in cache, contained seeds." It was located in Trench 11, Block 3, at a depth of 8". A photograph of the sample prior to being removed from its context shows fragments of gourd, indicating that it was already broken when encountered. Only the outer skin of the gourd fragments remain. They are paler in color than the typical Ozark bottle gourd and may be pepo gourd. The interpretation that this was a gourd container for small seeds seems questionable to me.

A fragment of this gourd rind was submitted to Beta Analytic for radiocarbon dating by the accelerator method. The resulting date (B-14587) is 785 +/- 75 RCYBP: A.D. 1165.

The second Whitney Bluff seed sample, 32-57-5c, consisted of 275 g of mixed debris. A subsample of 100 g of this material was sorted. Chenopodium present in this subsample included 328 pale fruits and 133 dark, thin-testa fruits. Only 55 of the dark specimens were measurable. Those ranged in diameter from 1.3 to 2.1 mm, with a mean of 1.82 mm and standard deviation of 0.16. Pale fruits varied from 1.1 to 1.8 mm, with a mean of 1.56 and standard deviation of 0.15 for the 108 specimens measured.

Light and dark chenopod fruits in this sample are seemingly identical to their counterparts in 32-57-3a. Both samples were found in Trench 11, Block 3, at a depth of 8" below the surface, as was a fiber bag given the number 32-57-4b. The bag is described in the field notes as "Grass bag in cache. Contained seeds". Sample 32-57-5c is labeled

"Seeds in bag and loose in cache". I suspect that the chenopod seeds in 32-57-3a and those in 32-57-5c came from the same population and were deposited at the same time: 785 +/- 75 B.P. as indicated by the accelerator date on gourd rind from 32-57-3a.

4. Montgomery Farm #4. Two bundles of long chenopod stems with portions of remaining inflorescences came from separate Ozark rockshelters. One bundle is from Montgomery Farm Shelter #4 in Barry County, Missouri (sample 32-34-19a), and it consists of five larger stems and three smaller ones tied together by the prehistoric handlers with a strip of leatherwood (Dirca palustris) bark (Figure 5.15). The bundle weighed 23.27 g. The longest stem is 31 cm long. Nine pale (brownish-yellow) chenopod fruits had fallen loose in the plastic bag used to store the specimen. These ranged from 1.0 mm to 1.4 mm in diameter (mean = 1.16; std. dev. = 0.16). Also present were 23 incompletely developed fruits, all pale in color. The inflorescenses are relatively diffuse, but central distal stems are missing, giving the impression that more compact seed heads may have been removed. Except for the smaller average size and higher percentage of shriveled fruits, this Chenopodium appears identical to fruits from Holman Shelter and Cow Ford.

The excavators in 1932 considered this chenopod bundle to be associated with a burial placed in a crevice in Trench 36, Block 3. The recorded depth of 19" below surface could be the depth at which the burial was first encountered, not necessarily the depth of the chenopod itself. The burial was surrounded by leaves and grass and covered by six rocks. Other associations include gourd rind, a sunflower seed head, three ears of corn, and fiber, rope, bag, and basketry material.

A radiocarbon date on stem material is 1419 +/- 78 B.P.: A.D. 531 (SMU 1630). The calibrated date is A.D. 627 +/- 56.

5. Cob Cave. The second chenopod bundle (31-72-1) came from Cob Cave in Newton County. It consists of 18.02 g of long stems with a very few short axillary clusters (Figure 5.14). The longest stem segment measures 470 mm in length. The only fruits in evidence were three small, shriveled, yellow specimens that appear identical to the immature fruits from Montgomery Shelter #4.

A manuscript entitled "Data on Cob Cave by S. C. Dellinger" includes a sketch map of an apparent pit in which these stems were found. Notes listing the samples by number describe the material as "Mature stalks of the weed *Chenopodium leptophyllum*. A large number of them were found against the face of the large limestone rock. They were side by side as if they had been place there for a lining of the cache" (Dellinger n.d.). More chenopod stems are depicted in the sketch than were present in the curated sample. Dellinger's assumption that the chenopod plants were weeds rather than crops probably influenced his interpretations that they had served as lining for the pit rather than as stored seed or food. It is possible, however, that the robust stems of domesticated *Chenopodium* were used for other purposes after threshing or removal of the larger seed heads. Other items listed as being present in the cache included long cane stems ("2 1/2 feet" long) lashed together, two large pieces of woven basketry at the base of the pit, and "the bottom half of a small beanbag". Dellinger's final note on this feature is interesting: "This cache (?) which had probably contained small bags of some kind of seeds, had been greatly disordered by the rats and therefore some of the contents of it had been destroyed or misplaced."

No portion of this sample was submitted for chronometric dating.

C. Large Sample of Cultigen Chenopod from Harrington's Excavations. The largest Ozark chenopod sample among the Harrington collections in storage at the Research Branch of the Museum of the American Indian in the Bronx, N.Y. is catalogued as #11/5813. It was found at the Blowing Springs site (3BE189) in Benton County, Arkansas. Clean, well-winnowed chenopod seeds were wrapped in deerskin and tied up to form an oblong bundle. The provenience is described by Harrington (1960:37) as a grass-lined pit about 1 ft. 10 in. in depth:

> There was no inner lining of basketry, but near the top of the larger lobe, about 3 in. from the surface, lay an oblong package wrapped in a piece of a woven fiber bag or blanket, tied with strings within which was an inner wrapper of deerskin containing shelled corn, dark colored beans, and some small black seeds. Below it was a piece of twined bag or mat of bark fiber.

Like the Whitney Bluff samples, both pale and dark fruits are represented. The sample was observed only briefly. No measurements or counts were made, since this project did not include analysis of the Harrington collections.

Smaller Samples of Chenopod from Dellinger's Excavations

In addition to the large samples from the nine sites described above, cultigen chenopod has been observed in seven samples from five new sites and in two other samples from Holman Shelter. The data are summarized in Table 5.2.

1. Poole Shelter #2. Two pale fruits were found while screening debris from a bag described as "corn cobs" from "all over shelter", from depths ranging from 12" to 35". Each fruit is 1.6 mm in diameter, and they look essentially the same as the Holman, Cow Ford, and Montgomery Farm specimens.

2. Green Bluff. Three Green Bluff samples were found to contain cultigen or likely chenopod fruits, all in very small numbers. The lot with accession # 33-7-263, consisting of more than 220 g of mixed plant remains, included a few chenopod stem segments among the larger items. Four uncarbonized *Chenopodium* fruits and eight carbonized seed fragments were sorted from the fine debris. One of these, measuring 1.6 mm in diameter, is pale. Two are red, with very thin seed coats, but both are broken and could not be used to attain diameter measurements. The fourth uncarbonized fruit has a smooth, black truncate seed coat. It, too, is incomplete and not measureable.

Green Bluff sample 33-7-302 contained a single loose, thin-testa *Chenopodium* fruit, red in color and 1.2 mm in diameter. Another single red fruit was present in sample 33-7-330, measuring 1.5 mm in diameter.

A large, sulcate cheno-am type of stem measuring 170 mm in length is present in sample 33-7-250, but no fruits were found during careful sieving of the fine debris.

3. Putnam Shelter. One pale-colored (yellowish) chenopod fruit with a diameter of 1.3 mm was noted while fine-screening 50 g (approximately 50%) of the smaller sized particles from sample 32-44-479 from Putnam Shelter. This sample is especially noteworthy due to the presence of pale-seeded amaranth—one of only three samples with cultigen amaranth other than the Holman Shelter material found during

analysis of the 1930's University of Arkansas Museum collections. Three carbonized seed fragments appear to be chenopod, judging by their puffed perisperm remnants.

4. Craddock Shelter. A stem 85 mm long with *Chenopodium* fruiting clusters attached is part of sample 34-7-326 from the Craddock site, and the debris smaller than 1.0 mm in size consists primarily of chenopod flower parts and shale. The 87 g of screened debris includes 13 pale chenopod fruits, 14 red ones, and approximately 50 black fruits with rounded margins and seed coats that appear to be relatively thick, probably thicker than 30 microns. The black fruits also have seed coats more pitted than those of the definite cultigen forms. The only two pale fruits that were mature and could be measured had diameters of 1.6 and 1.9 mm. The seven measurable red fruits ranged from 1.4 to 2.1 mm in diameter (mean = 1.84; std. dev. = 0.19).

This sample is recorded in the field notes as a "Cache of pigweed", located in Trench 43, Block 23, at a depth of 16". Different species within samples of mixed plant remains such as this cannot be viewed with confidence as tightly associated due to the likelihood of postdepositional disturbance. With that caveat, it can be noted that a common bean (*Phaseolus vulgaris*) was present in sample 34-7-326. Since most of the cultural material at Craddock is late prehistoric, and since all radiocarbon dates from the site postdate A.D. 1290, it seems likely that the chenopod in this sample is also relatively recent. If so, the fact that most of the seeds are black and apparently thick-coated could reflect relaxation of selection for thin seed coats or contamination from a weed variety that was well established by this time, or a combination of the two processes.

The only tobacco seed (Nicotiana sp.) in the Ozark rockshelter assemblages was found in fine-screened debris from this Craddock sample. Tobacco had not been reported previously from these sites, and it appears to have been deposited in the shelters very rarely, probably a reflection of the specialized activities performed here. The single seed encountered is broken and missing its hilum, and therefore of limited taxonomic value.

5. Gibson Shelter Chenopod. A large sample (32-21-62a) of mixed desiccated plant remains from Gibson Shelter was found to have small clumps of carbonized chenopod seeds in the loose debris. Upon screening 29.90 g of the debris, an estimated 150 to 200 clumped chenopod seeds weighing a total of 0.14 g were sorted out. The specimens are very distorted and fragmented. Very little pericarp can be seen, and seed coats tend to be missing as well. Where seed coat is visible, it is clearly very thin. One incompletely carbonized specimen has a patch of reddish testa. Three different shapes could be discerned: (1) fully truncate (a specimen 1.3 mm in diameter); (2) truncate on one side and round on the other (1.8 mm diameter); (3) truncate on one side with a sharp ridge on the other (1.7 mm diameter). Thirteen seeds were measured for diameter (mean = 1.55 mm; standard deviation = 0.14 mm).

My preliminary impression of this sample is that it might have come from a mixed population of pale, red, and black fruits, like Craddock sample 34-7-326, above. Without electron microscope analysis, however no firm interpretation can be offered. The larger sample consists of a 10-row maize cob, two maygrass panicles, one hickory nut, a grape stem cluster, hazelnut bracts, leaves, stems, and bark.

6. Holman Shelter, the Small Chenopod Samples. Sample 32-22-4 from Holman Shelter was predominantly cultigen amaranth, but it included seven chenopod calyxes, one bearing its pale fruit with a diameter of 1.2 mm. Sample 32-22-26 from Holman Shelter yielded two immature pale chenopod fruits among many other types of plant foods.

7. White Bluff Chenopod, Small Sample. Sample 32-56-79 from the White Bluff site is a small bag of debris which included 3 to 4 broken thin-testa chenopod fruits that appear similar to those from the gourds, described above.

Small Chenopod Sample from Harrington's Excavations

One other small sample of cultigen chenopod was observed in storage at the Museum of the American Indian in New York City. This sample, numbered 11/8630, came from the Scenic Bluff Rockshelter in McDonald County, Missouri. It consists of a few short chenopod stems with attached flower parts. One pale fruit was visible inside its calyx. The most likely provenience is Pit 1, near the middle of the rockshelter, described by Harrington (1960:95) as 2 ft., 1 in. in diameter and 16 inches deep. It was lined with grass and weeds and "contained a small piece of coarse textile, several native strings, deer hair, feathers, two bones from a human foot, and the seed heads of several plants, some black walnut hulls, flint chips, and the bones of food animals."

Table 5.1

Ozark Rockshelter Chenopodium (The Larger Samples)

Site & Sample #	Color	Outer epiderm (microns)	Diameter range (mm)	Mean diam. (mm)	Std. dev. (mm)	Measured # (diam)	Uncal. C-14
Edens Bluff							
32-3-391	dark	12-15	1.2-1.9	1.66	0.11	125	A.D. 20
White Bluff							
32-56-17a	dark	17	1.1-1.8	1.58	0.10	100	10 B.C.
Marble Bluff							
34-23-327	dark	25	1.1-2.0	1.60	0.17	200	893 B.C.
34-23-341	dark	16-20	1.0-1.7	1.48	0.17	26	976 B.C.
Whitney Bluff							
32-57-3	dark	15	1.5-2.2	1.90	0.13	73	A.D. 1165
	pale	--	1.1-1.9	1.55	0.17	125	"
32-57-5	dark		1.3-2.1	1.82	0.16	55	"
	pale	--	1.1-1.8	1.56	0.15	108	"
Cow Ford							
32-17-1	not sorted						
32-17-22	pale	--	0.9-1.6	1.25	0.16	155	A.D. 330
"	dark	--	1.2-1.6	1.45	0.13	11	
"	red	--	1.2-1.6	1.38	0.13	6	
Montgomery #4							
32-34-19a	pale	--	1.0-1.4	1.16	0.16	9	A.D. 530
Holman Shelter							
32-22-3	pale	--	0.8-1.8	1.48	0.22	108	A.D. 1030
Cob Cave							
31-72-1	pale	--	(3 immature fruits)		0		not dated

Table 5.2
Smaller Samples of Chenopodium

Site & Sample #	Color	Diam. Range	Mean Diam.	Std. Dev.	# Meas. for Diam.	# Present
Green Bluff						
33-7-263	1 pale	1.6			1	1 (also stems
	2 red	inc.				2 and flower
	1 black	inc.				1 parts)
33-7-302	red	1.2			1	1
33-7-330	red	1.5			1	1
Putnam						
32-44-479	pale	1.3			1	1 (also a few flower parts)
Poole 2						
32-44-43	pale	1.6	1.6		2	2
Holman						
32-22-4	pale	1.2				1 (also 7 calyxes)
32-22-26	pale					2 immature
Craddock						
34-7-326	pale	1.6-1.9	1.75	0.15	2	13 (also stems
	red	1.4-2.1	1.84	0.23	7	14 & flower
	* black	1.3-1.9	1.54	0.19	17	50 parts)
Gibson						
32-21-62a	carb.	1.3-1.8	1.55	0.14	13	several hundred in clumps
Marble						
34-23-340	carb.	not measured				clump
34-23-344	carb.	not measured				clump
White Bluff						
32-56-79	dark	indeterminate				3-4

* round margins, evidently thick testa (more than 30 microns)

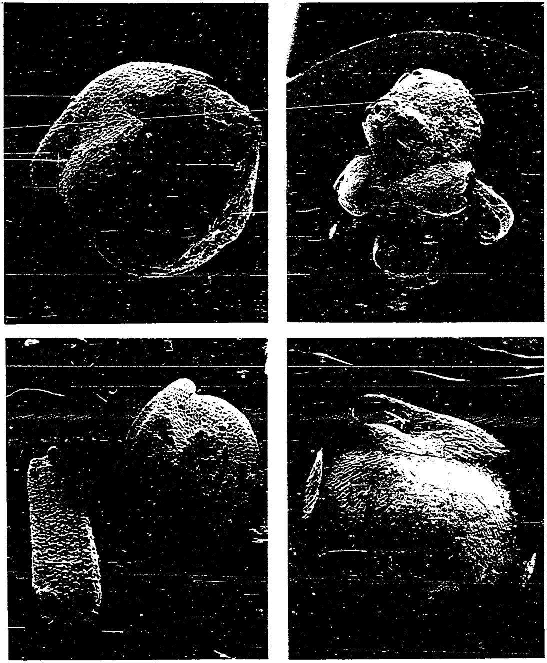
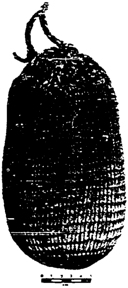


Figure 5.1 (Top left) Chenopodium from Marble Bluff, 34-23-327. 36X magnification.

Figure 5.2 (Top right) Marble Bluff, 34-23-341. 13.5X

Figure 5.3 (Bottom left) Chenopodium (right) and Asteraceae (left) from Edens Bluff 32-3-391. 20X magnification.

Figure 5.4 (Bottom right) Edens Bluff 32-3-391. 40X.



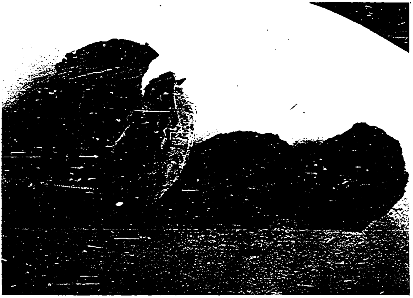
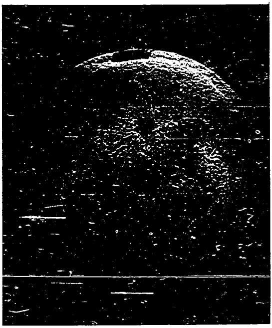
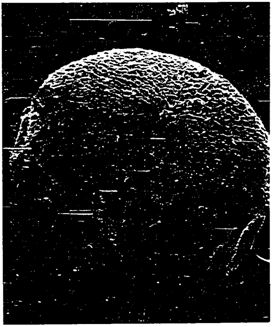


Figure 5.5 (Top) Bag full of Chenopodium from Edens Bluff, 32-3-391.

Figure 5.6 (Bottom) Gourd and Chenopodium from White Bluff, 32-56-17a

(Univ. of Arkansas Museum Photograph Neg. #'s 320220 and 320115)





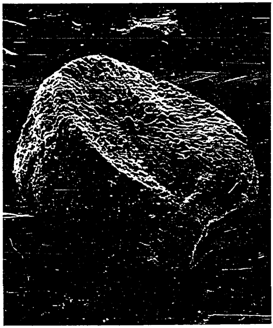
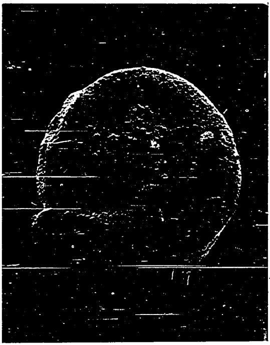


Figure 5.7 (Top left) Chenopod seed coat, Edens Bluff 32-3-391. 1200X

Figure 5.8 Chenopodium from White Bluff 32-56-17a. 40X

Figure 5.9 (Bottom left) Thin-testa chenopod, Whitney Bluff 32-57-3. 40X

Figure 5.10 Pale chenopod from Whitney Bluff 32-57-3. 40X



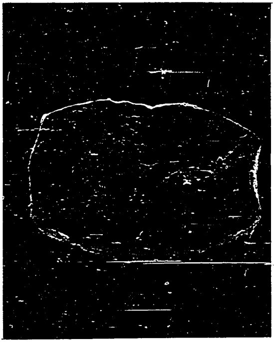


Figure 5.11 (Top left) Cow Ford chenopod 32-17-22. 42X

Figure 5.12 Cow Ford chenopod, x-section. 45X

Figure 5.13 (Bottom) Cow Ford sample 32-17-22, stems.

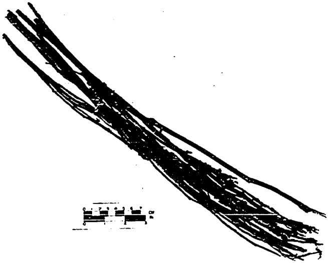


Figure 5.14 (Top) Cob Cave chenopod stems, sample 31-72-1.

Figure 5.15 (Bottom) Montgomery #4 chenopod stems, 32-34-19a.

POLYGONUM

Knotweed is generally accepted as one of the important crops in the pre-maize starchy grain complex of westcentral Illinois (D. Asch and N. Asch 1985) and in the American Bottoms (Johannessen 1984). *Polygonum erectum* L. is thought to be the species represented by the thousands of seeds in Woodland period pits. Recently, a new morphological type of *Polygonum* has been described from the Mississippian period (A.D. 1260) Hill Creek site in Pike County, Illinois (N. Asch and D. Asch 1985b). The Hill Creek site achenes are much longer than specimens in Woodland Period samples, with an average length of 4.2 mm after applying a 20% correction factor to adjust for shrinkage during carbonization. Pericarps are uniformly smooth and thin, unlike Woodland Period samples which include both a smooth, thin morph and a shorter, wider type with a thick, reticulate pericarp. Even the long, smooth knotweed morph from earlier components is shorter than the Hill Creek specimens, with lengths averaging between 3.1 and 3.6 mm after correction for carbonization (D. Asch and N. Asch 1985b:186).

Whitney Bluff Polygonum

Two samples from Whitney Bluff contain achenes that appear to be like the Hill Creek site *Polygonum*. These are the same two Whitney Bluff samples described earlier in the discussion of cultigen chenopod, with both pale and dark *Chenopodium* fruits represented, 32-57-3a and 32-57-5c. The excavators believed that the 32-57-3a seeds had been contents of a gourd bowl and that the 32-57-5c seeds had come from a drawstring bag or had been loose in the pit prepared for both the gourd and the string bag. The similarity of the small seeds in the two samples, however, indicates that they may not have been distinct originally.

Sample 32-57-3a contained approximately 830 loose Polygonum achenes. They range in length from 2.9 mm to 4.7 mm, with a mean of 3.99 mm and standard deviation of 0.31 for the 100 specimens measured. I subtracted 0.2 mm from actual specimen lengths to eliminate the perianth base, if present. Most specimens are partially covered by a five-lobed calyx element that appears to account for approximately 0.2 mm of the visible basal length (Figures 5.16 and 5.17). This leafy perianth covers most achenes at the shoulder or widest part, making it impossible to see or to estimate achene width for those specimens. In sample 32-57-3a, the 42 measurable achenes ranged in width from 1.4 to 2.5 mm (mean = 2.06; std. dev. = 0.27), but average width would be greater if all specimens could be measured, since this figure includes a disproportionately high number of smaller achenes.

The 100 g subsample from 32-57-5c contained approximately 850 Polygonum achenes, ranging in length from 3.3 to 4.5 mm (mean = 3.94; std. dev. = 0.29) for a sample of 101. Visible widths range from 1.2 mm to 2.5 mm (n = 49; mean = 2.04; std. dev. = 0.23), again with the larger specimens being under-represented since their shoulders tend to be covered with tepal tissue more frequently. In addition to loose achenes, both samples include chunks of soft, yellowish, starchy-looking material inside of which Polygonum achenes can be seen.

The Polygonum in these two Whitney Bluff samples appears to have come from the same population in all regards. Pericarps are smooth, thin, and light brown in color. Pericarp thickness was measured as 23-25 microns (see cross-sectioned specimen in Figure 5.18). The true seed has an even thinner, layered, papery coat that is dark red in color with the starchy yellowish endosperm inside contrasting greatly. Most achenes are faintly trigonous, but rounded except at the distal tip where three angles are manifested. Others have one or more sharp edges running from base to tip. A few specimens have a narrower, concave side as does wild P. erectum.

As stated above, gourd rind fragments from sample 32-57-3a were dated by the accelerator method to 785 +/- 75 B.P.

Marble Bluff Polygonum

The second rockshelter site with Polygonum suspected of being involved in the husbandry system is Marble Bluff. Sample 34-23-327 was a charred "cache" of mixed seeds--primarily ragweed and chenopod, but including a number of Polygonum achenes. Ninety-seven knotweed achenes and seeds were sorted from the analyzed portion of the sample. These Polygonum achenes, very different in form from the Whitney Bluff knotweed specimens, were determined by radiocarbon dating to be 2000 years older. Most are distorted from carbonization, having split at one or more points and with seed tissue extruding. The 17 measurable achenes range in length from 2.4 to 3.5 mm, with a mean of 2.82 and standard deviation of 0.30. Adding 20% to the mean, corrected length would be 3.38 mm. All pericarps are smooth.

Although there is obvious variation in length-to-width ratios and pericarp thickness, the achenes could not be divided into two distinct morphs as described by D. Asch and N. Asch (1985b). Compared to the Whitney Bluff knotweed, these carbonized Marble Bluff fruits are wider with respect to length, have much thicker pericarps, and are more distinctly trigonous. A specimen with a relatively thin fruit coat was measured using the scanning electron microscope, and the pericarp was found to be approximately 67 microns thick. Pericarp thickness of an exceptionally thick-coated specimen was measured as 132 microns.

The radiocarbon date of 2843 +/- 44 B.P. on ragweed achenes from this sample establishes that Polygonum was a component of this relatively early husbandry system, although distinct morphological changes in the archaeological achenes are not yet recognized.

Green Bluff Polygonum

Ten knotweed achenes or pericarp fragments similar in form to the Marble Bluff speimens in sample 34-23-327 were found in sample 33-7-263 from the Green Bluff site. Only three of these desiccated achenes were complete enough to be measured, and their lengths are 3.8, 4.2, and 4.3 mm, respectively. Although these lengths are more typical of the very thin-coated knotweed samples from Whitney Bluff, pericarps of the Green Bluff achenes are considerably thicker. In shape, also, they correspond much more closely to the thicker, earlier Marble Bluff morph. The colors of the ten Green Bluff knotweed fruits vary considerably, from black, to dark red, to reddish-brown, to light brown.

The sample containing these specimens weighed a total of 225 g and was recorded as including material from between the depths of 4" and 20", so the species represented may not have been associated during deposition. Several of the other seed types present in Marble Bluff 34-23-327 occur in the Green Bluff sample as well, including at least four cultigen Chenopodium fruits, 10 ragweed achenes, and two of the four-seeded, possibly Lamiaceae, capsules.

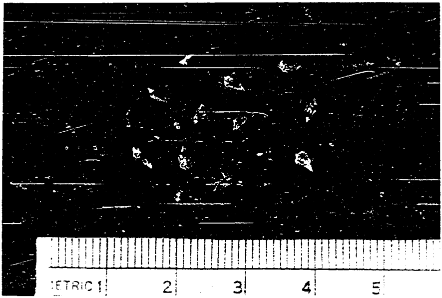


Figure 5.16 (Top) Whitney Bluff Polygonum, Sample 32-57-3.

Figure 5.17 (Bottom left) Sample 32-57-3, Polygonum, 20X.

Figure 5.18 (Bottom right) Sample 32-57-3, Polygonum, 19.6X.

AMARANTH

Pale-seeded amaranth from the Ozarks was first noticed in 1982 and sent to Jonathan Sauer, who identified it as <u>Amaranthus hypochondriacus</u>, a Mesoamerican cultigen. The close association of this Holman shelter amaranth with cultigen <u>Chenopodium</u> was initially interpreted as possible evidence for diffusion of the Mesoamerican <u>huautli-huauzontli</u> complex (cf. Sauer 1950) into the Trans-Mississippi South (Fritz 1984b). Examination of a wider range of Ozark rockshelter samples, however, failed to verify a general correlation between the two crops. While <u>Chenopodium</u> was widely distributed across Ozark rockshelter sites, pale-seeded amaranth was found in very small numbers in only three additional samples excavated during the 1929-1934 Dellinger-directed excavations and in one sample donated to the museum by amateur archaeologists in 1945. My brief search through Museum of the American Indian collections failed to locate cultigen amaranth, although inflorescence clusters with black seeds were present in two samples from the Alum Cave Site.

<u>Holman Shelter Amaranth</u>

The four Holman Shelter samples containing pale-seeded amaranth are described in detail elsewhere (Fritz 1984b). To briefly summarize, sample 32-22-4 consists of 9.0 g of larger stems with axillary inflorescences and 3.5 g of loose stem segments and flower parts larger than 0.7 mm. Diameters of the 125 mature seeds range from 0.7 to 1.1 mm (mean = 0.89 mm; std. dev. = 0.11). Seed color is pale yellow to brownish-yellow, with a rust-colored tinge characterizing a few specimens. The location of this sample as recorded in the 1932 field notes is the same as that of sample 32-22-3, (Trench 10, Block 4, 8"), the largest concentration of pale-fruited Chenopodium from Holman Shelter. Seven chenopod calyxes, one with pale fruit attached, were found during the sorting of 32-22-4. Proximity of the two samples is inferred by this evidence of mixing of the two species.

The standard radiocarbon date obtained from amaranth stems from this sample is 920 +/- 109 B.P., calibrated to A.D. 1106 +/- 109.

Two larger amaranth or chenopod stems were present in sample 32-22-26 along with small amaranth stem segments and loose flower clusters weighing 0.23 g. Only 10 of the 39 loose seeds were mature and measurable. Diameters are 0.8 to 1.1 mm (mean = 0.90 mm; std. dev. = 0.11). A small Chenopodium inflorescence retaining two immature, pale fruits was also present in this sample. Location within the shelter was given merely as Trench 10, Block 15, 11-14" deep, and the material was recorded as "Bot. specimens".

Sample 32-22-28 includes 1.24 g of larger stem segments and 0.13 g of smaller stem and flower parts. Of the 72 loose seeds, some enclosed in utricle tissues, 39 are mature and measurable. Diameters range from 0.7 mm to 1.2 mm (mean = 0.89; std. dev. = 0.13). These seeds were softer, yellower rather than brownish yellow, and more shriveled than those in the previous two samples. The sample came from Trench 9, Block 5, under a rock, 16" deep. It is described in the field notes as a "cache of acorns, sunflower, hickory, walnut, pigweed."

Two pale, immature amaranth seeds were discovered during the fine screening and sorting of sample 32-22-60. Two flat, dark brown amaranth seeds were also present in this sample. The 1932 field notes and the Gilmore laboratory notes (Report 72A) both indicate that additional, larger-sized, amaranth plant material was once a part of this sample.

It was found in Trench 15, Block 8, at a depth of 14" and recorded as a "cache of persimmon, grape, etc". A sketch of this "cache" shows the plant foods covered with a layer of shale and ashes, and a caption under the sketch describes it as "a distinct layer of vegetal remains."

Putnam Shelter Amaranth

Three pale amaranth seeds were among the screened debris of sample 32-44-479 from Putnam Shelter. Approximately one-half (50 g) of the smaller-sized objects in this sample were put through the graduated geological sieves. Sulcate stems weighing 4.98 g that may be from either chenopod or amaranth plants were present in the larger, unscreened part of the sample. One pale Chenopodium fruit was also found during screening, as were three carbonized chenopod seed fragments.

Two of the pale Putnam Shelter amaranth seeds could be measured, and the third is shriveled and immature. Diameters are 1.0 and 0.9 mm. Five flat black amaranth seeds were loose in the sorted portion of the sample, and an uncounted number of black seeds were observed in inflorescence clusters that were common in the residue.

Cultigen amaranth, including A. hypochondriacus is supposed to be distinguishable from undomesticated species by bracts that are shorter than tepals (Robertson 1981), but none of the flowers in this sample could be recognized as having short bracts. Part of the problem may stem from the deposition and desiccation processes, resulting in many bent and broken bracts. However, the Holman Shelter amaranth flowers with pale seeds still attached also seemed to have bracts longer than their tepals. I am not prepared at this point to interpret the taxonomic significance of this phenomenon. Ford (1985) suggests that possible independent domestication of amaranth in the American Southwest should not be discounted, but the evidence is exceedingly meager. Future researchers concentrating on this problem may be able to use the Ozark amaranth plant parts to help answer these questions.

Archaeological provenience of this sample within the shelter is given as Trench 15, Block 4, 13" deep, and it is recorded in the field notes simply as a "Bot. specimen".

Cow Ford Amaranth

One pale amaranth seed 0.9 mm in diameter was found in sample 32-17-22 from the "Cow Ford" site material. It was in a packet of chenopod stem and flower cluster material that had been placed on loan in 1976. As described above, most of this sample consisted of *Chenopodium* inflorescences mixed with wild bean (*Strophostyles helvola*) pods. The radiocarbon date on chenopod stems is 1620 +/- 70 B.P.

Gibson Shelter Amaranth

Sample 32-21-30 from Gibson Shelter consists primarily of hazelnut bracts and nutshell fragments. The loose debris, however, contained a few amaranth flower clusters and two seeds. One is a plump red seed, shaped like the pale ones from Holman Shelter, measuring 1.1 mm in diameter. The second is pale and was still enclosed in utricle membrane and surrounded by tepals. It is an immature specimen, flat and shriveled. A few pieces of corn husk, part of a maygrass panicle, a grape fruiting stem cluster, and a hickory nut fragment were also present in this sample.

Alum Creek Shelter

Holman, Putnam, Cow Ford, and Gibson Shelters were the only four sites from which recognizably domesticated amaranth was recovered during the Dellinger-directed excavations. The largest concentration of pale amaranth seeds in the University of Arkansas Museum, however, was found in 1945, in Cleburne County, Arkansas on the eastern edge of the Ozarks, by local amateur archaeologists. The site is unrecorded and should not be confused with Harrington's Alum Cave site on the White River in Benton County, Arkansas. The specimen is a twined fabric bag that was originally filled with pale amaranth seeds and dark red corn kernels. Scholtz (1975:128) states that "A bundle of loose, shredded hard plant fiber is stuffed into the top, probably to prevent spillage." By 1984, the fiber and most of the seeds had been removed from the bag and it had been placed on display in the University of Arkansas Museum.

The seeds from this sample are remarkably clean, although utricle membranes still enclose a few seeds. Flower parts are very rare, and bract length could not be ascertained. A higher proportion of red amaranth seeds is present in the Alum Creek bag than in the Holman Shelter samples. The Cleburne County material was not quantified or dated.

MAYGRASS

Background

Maygrass (Phalaris caroliniana Walt.) appears to have been an important food plant in the Ozarks, judging by its ubiquity in the rockshelter samples. Gilmore listed maygrass in 24 samples from eight of the shelters he examined. It was present in 62 samples from 12 of the 19 sites analyzed during this study.

Cowan (1978:278) notes that "actual bundles of tied maygrass inflorescences were discovered at the Gibson, Putnam, Indian Bluff, and Edens Bluff shelters". The bundle from Indian Bluff was excavated by Harrington (see Figure 1 of Cowan 1978). In addition to bundles from those four sites, two large bunches of maygrass stems with panicles were also found in the Salts Bluff collection. This apparent storage of seed heads has been interpreted as an indication of husbandry—the seeds seem to have been put away for future planting.

The most persuasive evidence for the crop status of prehistoric maygrass is that its archaeological range extends far beyond its modern range as a wild plant. No signs of genetic alteration resulting from husbandry have been recognized. Cowan (1978:282) checked for possible increase in panicle length among rockshelter specimens and found them to "exhibit a range of variability that can be duplicated by modern populations". Inflorescence length range for the species <u>Phalaris caroliniana</u> is 1.0 - 7.0 cm (Anderson 1961:78). Cowan (1978:282) also failed to find signs of a shift to more simultaneous rather than sequential ripening of fruits in the desiccated remains available to him. Archaeological seed size is likewise within wild, modern boundaries. Caryopsis length is given as 2.0 - 2.3 mm by Anderson (1961:78), and a mean mature grain length of about 2.1 mm resulted from the Asches' measurements of modern caryopses. Archaeological grains from westcentral Illinois and the American Bottom area turned out to be "if anything slightly smaller than expected if they were grown from populations like those of modern wild plants" (D. Asch and N. Asch 1985b:190).

It is curious that no concentrations such as containers filled with threshed maygrass florets or caryopses were encountered in the rockshelters. The quantities of carbonized maygrass seeds in association with Chenopodium and Polygonum in Midwestern sites (D. Asch and N. Asch 1985b; Johannessen 1984) indicate that the grains may have at times been stored and processed together. If the rockshelter maygrass bundles represent seed stock for planting, it would appear that the mature florets and spikelets were persistent and that shattering did not leave the plants devoid of seeds. The panicles currently lack florets for the most part, but the grains could have been devoured by insects or rodents in the shelters after deposition, as seems to have been the fate of most maize kernels.

David and Nancy Asch (1985b:190) do state that maygrass "florets fall free as soon as the grain is ripe", and they are the only known researchers to have conducted modern harvesting experiments with this species. The sample submitted for nutritive analysis by Crites and Terry (1984) was collected by the Asches in Chicot Co., Arkansas. If dehiscence was also the case for the archaeological variety, it seems inconsistent that bundles of seed heads would have been stored outside of containers.

Harlan, de Wet, and Price (1973) have published a comparative study of cereal evolution under domestication. They state that "the establishment of nonshattering traits is, genetically, one of the easiest and simplest steps in the entire process " (Harlan, de Wet and Price 1973:315), being controlled by one or two genes in the major Old

World grass species which have been studied. Harlan successfully obtained a nonshattering population of sand bluestem (Andropodon bellii) in a single generation by harvesting seed after the normal period of dehiscence was past. The authors note that "many other grasses behave in a similar way, and improvement in seed retention was obtained in every species seriously studied in this respect" (Harlan, de Wet and Price 1973:315). Furthermore, the trait of determinate growth (simultaneous seed maturation) reinforces the nonshattering trait.

Archaeological evidence clearly indicates that maygrass was harvested in quantity by prehistoric native eastern North Americans and that it was common at sites outside the plant's modern range. It was repeatedly deposited at sites where the domesticates Chenopodium and Polygonum were also present, and therefore appears to have been a component of the agroecology. It was stored in rockshelters in the form of seed head bundles. A nonshattering habit would have increased the fitness of maygrass in early domestilocalities by making it more likely that people would become primary dispersal agents. Simultaneous ripening of fruit could have accompanied the transition to indehiscence. The argument is weakened considerably by the fact that few florets remain attached to their inflorescences this long after deposition, but the mere presence of these bundles makes it seem likely that genetic change in favor of indehiscence had occurred.

Gibson Shelter Maygrass Bundles

Bundles of maygrass stems and panicles that were actually tied up together were found only among the Edens Bluff and Gibson Shelter collections at the University of Arkansas Museum. These are summarized in Table 5.3 along with information about other samples consisting primarily of numerous maygrass stem and inflorescences bunches. Gibson Shelter was clearly the site where most of the maygrass concentrations were found. Only four of the eight bundles found at this shelter were placed on loan. Sample 32-21-37 consisted of five bundles, found in Trench 14, Block 3, at a depth of 11". A sketch of the sheaths as encountered is provided in the field notes, and a photograph was taken of them in situ. The bundles vary in thickness, but all were tied with what appears to be maygrass stem material. Two of these bundles were studied. The thicker bundle weighs approximately 20 g (precise weights of these samples are not meaningful because dirt is continually falling out) and has stems up to 370 mm long. Panicles range from 15 mm to 40 mm in length, and no florets were noticed. The smaller bundle weighs slightly less than 5 g, has stems up to 290 mm long and panicles ranging from 20 to 45 mm in length. Most panicles in this bunch are short, ca. 30 mm long. Eleven loose florets were present in the bag. The stems of both of these bundles from 32-21-37 are loosely tied together with maygrass stems.

Sample 32-21-58 was described by the excavators as a "Cache of canary in 3 sheaths or bundles. One sheath 4" wide". The sample came from a depth of 11" in Trench 15, Block 4. One of these bunches was left at the Museum. The other two are not actually bound together into bundles as are the stems in 32-21-37. The largest (32-21-58a) weighed 50 g, with stems approximately 450 mm long and panicles 25-55 mm in length. A five gram sample of stems and inflorescences was removed from this bunch and submitted for standard radiocarbon dating, with the resulting date of 970 +/- 48 B.P.: A.D. 980 (S.M.U. 1685). The smaller bunch (32-21-58b), weighs 27g, with stems approximately 400 mm long and panicles 33-57 mm in length. The stems were folded over rather than tied together. The field notes state that the cache also included a corn cob, hickory nuts, and bean hulls.

A third Gibson Shelter sample, 32-21-50, may have contained a quantity of maygrass, but it is missing from the collections. The sample is described in the field notes as "Cache about 12" in diameter--Canary grass, hazel nuts."

Salts Bluff Maygrass Concentrations

Direct dates were obtained on maygrass samples from two of the other sites. Salts Bluff yielded two maygrass bunches. The largest (33-15-156) weighed 24 g, had stems 300-350 mm long, and panicles 30-50 mm in length. It was rolled up into a pillow-like bunch, and seven florets had fallen free. Stems from this sample were radiocarbon dated to 1310 +/- 49 B.P.:A.D. 640 (S.M.U. 1684).

The second Salts Bluff sample (33-15-155) weighs about 10 g, with stems 200-300 mm long and panicles 20-53 mm long. The stems were folded over once. One loose floret was observed.

Putnam Shelter Maygrass Concentration

One large maygrass sample came from Putnam Shelter. Inflorescence-bearing stems were bunched up and mixed with leaves and cane stem segments. The maygrass weight was approximately 28 g. Stem lengths could not be determined. Panicles were 20-45 mm long. The radiocarbon determination on this sample is 2042 +/- 61 B.P.:92 B.C. (S.M.U. 1683).

Edens Bluff Maygrass Concentrations

Maygrass was very ubiquitous at Edens Bluff. The collections contained four concentrations of seed heads that appear to have been put away for safe keeping. Sample 32-3-935b is a small bundle with stems tied together by more maygrass stems. It weighs approximately 8 g, has stems 300-350 mm long and panicles 25-50 mm in length. Sample 32-3-1550 is a deteriorated small clump that appears to be the remnants of a bundle. The material weighs 5.5 g, with stems up to 150 mm long and panicles 25-50 mm in length. The other two samples (32-3-1737 and 32-3-1738) are large lots of mixed plant remains that were not weighed or measured.

Table 5.3
The Larger Maygrass Concentrations

Site	Wt. (g)	Stem Length	Panicle Lengths	C-14 Date
Gibson				
32-21-37a*	19.8	370 mm	15-40 mm	
32-21-37b	4.7	290	20-45	
32-21-58a**	49.9	ca. 450	25-55	A.D. 980
"	27.3	ca. 400	33-57	
Salts Bluff				
33-15-155	9.7	200-300	20-53	
33-15-156	23.7	300-350	30-50	A.D. 640
Putnam				
32-44-186	28.4	indet.	20-45	92 B.C.
Edens Bluff				
32-3-935b	7.9	300-350	25-50	
32-3-1550	5.5	ca. 150	45	
32-3-1737	not weighed			
32-3-1738	not weighed			

* Three additional maygrass bundles from this sample not analyzed. 32-21-37c is much like 32-21-37b. 32-21-37d is much like 32-21-37a. 32-21-37e not seen.

** One additional maygrass bundle from this sample not analyzed.

LITTLE BARLEY

Little barley (Hordeum pusillum Nuttall), like maygrass, is a cool season grass that fruits early in the summer. Its likely status as another starchy seed crop in prehistoric eastern North America was recently suggested after analysis of plant remains from Middle and Late Woodland components at five westcentral Illinois sites demonstrated that little barley constituted between 15% and 40% of identifiable seeds (D. Asch and N. Asch 1985b), co-occurring with chenopod, knotweed, and maygrass. Unlike maygrass, a range extension argument can not be made for little barley, which grows today across most of the southeast, midwest, southwest, and northwest regions of the United States (Fernald 1950:138). Noting that dense stands of this grass can be found in the midwest, D. Asch and N. Asch (1985b:194) remark that "Ecological/economic arguments for cultivation of little barley are not as strong as those developed for knotweed."

Since the possibility of genetic alteration of little barley through husbandry had been raised in the Southwest (Bohrer, cited in Gasser 1982), it was hoped that well-preserved desiccated specimens would be found among the Ozark collections. The importance of little barley at the nearby Spiro site at ca. A.D. 1200 (Fritz 1984a) seemed to increase the likelihood of finding stored caryopses or fruiting stems among the rockshelter material. Unfortunately, this was not the case. Its absence does not necessarily mean that this grass was not an important prehistoric food in northwest Arkansas, but it raises the possibility that the seeds were not stored as frequently as those of the other known and suspected crops. One reason for not storing little barley might have been that it was not sown but rather allowed to reseed itself. A variation would be that some seeds were scattered about after harvesting to augment the succeeding crop.

Rindos (1984) notes that plants in different stages of the domestication process are likely to be found when the agroecology is developing. Little barley might have been one of those plants taking advantage of the maintained clearings and/or gardens but not becoming dependent upon people for dispersal, at least not to the same degree as chenopod, knotweed, and perhaps also maygrass.

SUMMARY AND DISCUSSION

The thin-testa and no-testa chenopods have been given the most attention in this study due to the recent work of other researchers, especially the Asches and Bruce Smith, that has established the cultigen status and antiquity of this genus in eastern North America after more than 50 years of uncertainty and debate. Reduced-testa chenopod seeds were found at 13 rockshelter sites covered by this analysis, more than any of the other small starchy seed crops. Maygrass, however, was present in far more individual samples--62 samples from 12 of the sites (see Table 5.4). Most of the maygrass was represented by only one or a few caryopses or by a small number of seed heads. Cultigen amaranth was found in abundance only at Holman Shelter and at the Alum Creek Bluff Shelter which was not among the Dellinger-directed excavations. Polygonum was recovered only from Marble Bluff, Green Bluff, and Whitney Bluff. Little barley was not represented at all.

The radiocarbon dates on major samples indicate that heavy utilization of these species may not have extended beyond the early Mississippian Period. All four samples of the thin-testa chenopod type were dated to between ca. 1000 B.C. and A.D. 100. Pale-seeded chenopod smples all date between ca. AD. 300 and 1200. The latest of these dates—from Whitney Bluff—is on a sample of mixed pale and dark fruits. Samples of chenopod from Craddock Shelter, a site that appears to be uniformly late prehistoric, are likewise mixtures of pale and dark fruits. It appears that Late Archaic and Woodland gardeners placed more emphasis on husbandry of distinct Chenopodium varieties. During the full Mississippian period, as maize became the dominant crop, chenopod appears as a minor crop with a mixture of types of varying seed coat thicknesses.

Maygrass is totally absent from the primarily late sites, Craddock, Beaver Pond, and Brown Bluff. The three uncalibrted radiocarbon dates range from 92 B.C. to A.D. 980. A single caryopsis was found in the large cache of mixed seed types from Marble Bluff (34-23-327) which dated to 1000 B.C. This evidence indicates that maygrass may have become important as a stored food later than chenopod, but that it declined in significance after A.D. 1200, as did chenoppod.

Polygonum is relatively uncommon in the Ozark shelters, but the four Ozark samples can be added to evidence from westcentral Illinois showing utilization and modification in the East that resulted in a variety with very thin fruit coats and paper-thin seed coats. This type is dated to A.D. 1165 +/- 75 at Whitney Bluff.

Cultigen amaranth could have been introduced from the Southwest. The single pale seed in a chenopod sample (32-17-22) with a radiocarabon date of A.D. 330 from Cow Ford indicates a Middle Woodland presence for amaranth, but single seeds in mixed rockshelter samples are always potential contaminants from later deposits. Seeds from the Alum Creek amaranth bag need to be dated directly. The early Mississippian period assay on amaranth from Holman Shelter stands alone as a direct date on this crop type in the eastern United States. Although the seeds from Holman, Putnam, and Cow Ford were in samples that also contained cultigen Chenopodium, most chenopod caches contained no pale-seeded amaranth. Chenopodium was obviously a more important crop in the Ozarks, and was evidently a much older one. The poor representation of amaranth from open sites in the Eastern Woodlands where extensive flotation recovery has been conducted, together with its relative scarcity in Ozark rockshelters, indicates that it was added as a minor crop to an agricultural system in which Chenopodium was an established crop.

The 3000 year old concentration of ragweed seeds mixed with Chenopodium found at Marble Bluff meshes with evidence from other eastern sites, where ragweed has been found in abundance only during the Late Archaic and Early Woodland (Yarnell 1986; D. Asch and N. Asch 1982). It appears that ragweed was a tolerated or encouraged colonizer of early domestilocalities or even an intentionally propagated garden plant. The arguments used by Payne and Jones (1962) to discount Ambrosia trifida as a cultivated plant could be turned around and used in support of a case for its status as a husbanded plant at one time during prehistory. The species displays a polymorphism in the wild that is mirrored in archaeological specimens, but frequencies of the husbanded morph—in this case probably somewhat longer achenes with thinner fruit coats and/or seed coats—may be higher in archaeological deposits than in the wild. Quantifications to test this have not been conducted. Achenes collected from wild plants will not germinate if kept warm and dry indoors throughout the winter, but reduction of the pericarp might have eliminated this dormancy mechanism. Heiser (1985:60) notes that the armor layer of the wild sunflower acheane is generally not present in cultivated Helianthus, and speculates that freezing and thawing is necessary to allow water to reach the wild-type seed. This could be true of Iva and Ambrosia as well. In any event, ragweed evidently did not become one of the established cultigens in the Ozarks or elsewhere in eastern North America. As a weed in anthropogenic habitats, however, it has enjoyed long-term success.

Table 5.4

Frequency of Starchy Seed Crops from Dellinger-Directed Excavations Examined in this Project

	# Sites	# Samples
All Crop Chenopodium	13	23
Thin-testa (black)	3	7
No-testa (pale)	6	9
Mixed black/pale	3	4
Red morph only	1	2
Indeterminate	1	1
All Crop Polygonum	3	4
Shorter; thicker coats	1	1
Intermediate	1	1
Paper-thin testa	1	2
Crop Amaranth	4 *	7
Maygrass	12	62

* Alum Creek Shelter, Cleburne County, not included (not excavated by University of Arkansas Museum crews).

CHAPTER 6

SUMPWEED AND SUNFLOWER

SUMPWEED

Sumpweed (Iva annua var. macrocarpa) achenes from Ozark rockshelters have been a source of fascination to archaeobotanists since Gilmore (1931) first recognized that the exceptionally large fruits most likely evolved through domestication. Further attention by Jones (1936), Blake (1939), Black (1963), Yarnell (1972; 1978; 1981), and the Asches (D. Asch and N. Asch 1978; 1985a; 1985b) has resulted in an unusually thorough understanding of the role played by this plant in the prehistoric plant husbandry sequence. Many questions, of course remain unanswered.

Background

To briefly review the history of research, Gilmore correctly assessed that the large Iva achenes in rockshelter storage context were cultigens. He first (1931) referred to the Ozark sumpweed as Iva xanthifolia (Fresen.) Nutt. and later changed it to Iva ciliata Willd. At that time there was no evidence to indicate that sumpweed had been used as food for people, but its presence in human paleofeces from Newt Kash rockshelter in Kentucky brought about enlightenment on that front

(Jones 1936). S. F. Blake (1939) formally designated rockshelter sumpweed from the Ozarks and from Newt Kash as a distinct variety--*Iva ciliata* Willd. var *macrocarpa* Blake. The type specimen (Type no. 37413, Nat. Arboretum Herb.) came from one of the Montgomery Farm shelters in Barry Co., Missouri, and was furnished by Dellinger. Other Ozark samples covered in Blake's article came from Worley (3MA11), Alred (3BE1), Agnew (3BE2), and Alum Cave (3BE?). The Alum Cave sample and one from Alred were from Museum of the American Indian excavations, and the others were from University of Arkansas Museum investigations. Blake (1939:84) regarded the new variety as most likely "an ancient cultivated strain obtained by selection, and now extinct", the view accepted by most botanists and archaeologists today.

R. C. Jackson's (1960) revision of the entire genus *Iva* resulted in the nomenclatural shift of the archaeological taxon to *Iva annua* var. *macrocarpa* (Blake) Jackson. An unfortunate typographical error in that paper changed the maximum length of these specimens from 9.3 mm (Blake 1939:84) to 13 mm, but there is no indication that Jackson personally studied any of the archaeological material.

Later researchers have documented the temporal and spatial distributions of archaeological sumpweed and have concentrated on understanding its autecological parameters, nutritional potential, and morphological variation. The undated Ozark material, as usual, remained enigmatic. Yarnell (1981) attempted to ameliorate the situation by comparing the mean sizes of several Ozark samples with those of dated samples. The underlying assumption was that *Iva annua* achenes increased in size gradually through time and that the mean length x mean width index in mm for cultural periods in general could be expected to be approximately as follows:

L X W Index	Time Period
8 - 12	Terminal Archaic
12 - 16	Early Woodland
16 - 20	Middle Late Woodland
20 - 26	Early Late Woodland
25 - 40	Mississippian

These values are adjusted for shrinkage due to carbonization, based on a correction factor of kernel length x 1.10 + 0.07 mm and kernel width x 1.10 + 0.04 mm.

With mean Length x Width indices of 21 each, a sample from Edens Bluff (32-3-1706) and one from Craddock Shelter (34-7-377) were projected as possibly being early Late Woodland in age. Four Ozark samples with mean sizes between 35 and 38 were hypothesized as dating to the Mississippian Period. Two of these came from Alred Shelter, one from Craddock, and one from Edens Bluff.

In order to test the hypothesis that Ozark samples with the determined mean achene sizes would date to the corresponding time periods, three sumpweed samples measured by Yarnell were directly dated by the accelerator method, yielding the following determinations:

L X W	Sample #	C-14 Age
35	Alred 32-4-103B	1600+/-75 B.P. (B-14590)
21	Craddock 34-7-377	460+/-90 B.P. (B-14591)
21	Edens 32-3-1706	360+/-80 B.P. (B-14592)

Obviously, the results are the reverse of the projected sequence. The large achenes from Alred were dated to the Middle Woodland period, and the small achenes from Craddock and Edens Bluff were dated to the late Mississippian. Before discussing the various implications of these dates, an overview of Ozark rockshelter sumpweed is in order.

Ozark Rockshelter Sumpweed Samples

Gilmore's laboratory notes list sumpweed as present in 20 samples from 11 rockshelters. During my own analyses, Iva achenes were found in 28 samples from 13 sites. These are summarized in Table 6.1, which includes three sites (Indian Bluff, Butler Creek, and Worley) not among the 19 rockshelters covered in this report. Only one seed was listed as coming from the Indian Bluff site (3BE9), but Butler Creek Bluff Shelter and Worley Shelter evidently yielded considerable quantities.

The Butler Creek Shelter sample is described in Laboratory Report #24 as "a parcel of seeds" which had "filled a large gourd, in volume about one (1) gallon". The artifact is described as having been found by a local collector named Wyrick in August, 1925, at a site nine miles southeast of Seligman, Missouri. This location does not match the Butler Shelter group (3BE3, 3BE5, 3BE205, and 3BE206), and could either be in southern Barry Co., Missouri or in extreme northern Benton Co. or Carroll Co., Arkansas.

The Worley Shelter (3MA11) sample is described in Laboratory Report #72a as "a mass of Iva ciliata seeds (marshelder)" together with a "Fragment of something woven out of Phalaris caroliniana (canary grass)". I could not find this sample (cat. #32-58-1) among the University of Arkansas Museum collections in 1984, presumably because it was sent away for analysis. As mentioned above, a Worley Shelter sample is included in the Blake (1939) designation of Iva ciliata var. macrocarpa.

The largest sumpweed sample that could be located in the Museum stacks in 1984 was labeled as material from Montgomery Farm in Barry Co., Missouri, but for an unknown reason was accessioned under the number 32-146 and was separated from the rest of the Montgomery Farm samples (32-30 through 32-34). The sample matches the description of 32-34-154 (originally Field No. M4-332), from Montgomery Shelter #4, listed in the excavation Field Notes as "Iva seed in gourd". and in Gilmore's Laboratory Report 71A as "a considerable quantity of seed (cleaned) of Iva ciliata." The box for sample 32-34-154 was empty except for a card reporting the sample missing as of 5/11/70. It is possible that the plastic bag full of Iva achenes now numbered as 32-146 was the original M4-332.

The type collection for Iva annua var. macrocarpa is published as coming from Montgomery Shelter (Blake 1939), and M4-332 is the only sample from any of the Montgomery Farm shelters listed in Gilmore's laboratory notes or in the Field Notes as containing sumpweed. No other sumpweed was found in the samples from Montgomery Shelter #4 examined during the current analysis. One problem, however, prevents the conclusion that the sample now labeled 32-146 was originally M4-332 and is furthermore the source of the extinct cultigen's holotype.

In February of 1932, before the Montgomery Farm Shelters had been excavated, Dellinger sent Gilmore the sample of Iva achenes mentioned above that had been collected in August, 1925, by Mr. Wyrick in a rockshelter called Butler Creek Bluff Shelter, said to be nine miles southeast of Seligman, Missouri. Since the Butler Shelter group excavated in 1932 by the Arkansas Museum crew is more than 20 miles SSW of Seligman, Wyrick's Butler Creek shelter must be a different site. Gilmore's Ethnobotanical Laboratory Report No. 24, cited above, is devoted to a discussion of this one sample, but the report is only one page long. The Laboratory number assigned at Michigan is 317, and the space on the form for "Orig. No." is blank.

In Blake's list of large-seeded Iva samples, the year "1925" is given as the collection date of the Montgomery Farm type sample. The Montgomery shelters were not excavated until 1932, however. The 1925 Wyrick sample from Butler Creek, therefore, may have become mistakenly labeled as Montgomery Shelter material at some point in time. The 1925 date on the taxon holotype at the U.S. National Herbarium suspiciously connects that sample with the Wyrick sumpweed. The large sample now accessioned as 32-146 could be from the same source rather than from the Montgomery Farm sites excavated in 1932. Sample 32-146 was excluded from my analysis due to the questionable provenience.

Sumpweed Size and Age

The Ozark sumpweed samples measured in the past by Yarnell (1981) had fallen into two size categories, a pair of samples with mean L x W values of 21 and a group of four samples with mean L x W values between 35 and 38. Table 6.1 shows that newly measured samples from Agnew and Whitney Bluff have mean values of 27 and 28, respectively, and that the sample from Marble Bluff has an index of 30. A gap still exists between 21 and 27, but this could easily be a function of the limited number of samples available.

It should be noted that the sample 32-1-52 from Agnew is only the remnant left at Fayetteville after an unknown number of Iva fruits were transferred to Michigan and from there to Washington for examination by S. F. Blake. Only five sumpweed achenes were left in sample 32-4-45, and none were present in sample 32-4-90, the two Alred Bluff samples removed for study during the 1930's. The Worley shelter material is missing entirely, as is the Montgomery Shelter sumpweed unless it was recatalogued as 32-146.

Returning to the problematic radiocarbon accelerator dates, it can be seen that the two small-sized achene samples (LxW = 21), both of which were dated to very late in prehistory or protohistory, are the only two lots with mean length x width indices less than 25, the minimum value suggested by Yarnell for Mississippian period sumpweed collections. A crop resembling sumpweed was not noticed by early Europeans in the eastern United States, so presumably it began the decline leading to extinction during the Mississippian Period. Adair (1984) suggests that Iva on the Plains reached its maximum importance as a crop before the Mississippian Period, and the same could be true for the Ozarks. This does not mean that achene sizes elsewhere in the eastern U.S. will have dropped off after the Late Woodland or early Mississippian.

Craddock sample 34-7-555, however, contains much larger sumpweed achenes than the ones in 34-7-377. The higher-numbered sample was beyond the cut-off point for analysis in this report, but 56 achenes from 34-7-555 were measured and reported by Yarnell (1981). The mean LxW index was 36. Specimens from this sample need to be dated directly, since rank speculation about the age of an individual rockshelter plant sample is risky. At this point, it would seem that the Craddock site assemblages are entirely Mississippian, but the large sumpweed achenes could still be centuries older than the small, very late, ones in 34-7-377.

The late radiocarbon dates on small sumpweed achenes from Edens Bluff sample 32-3-1706 and Craddock sample 34-7-377 are consistent with the presence of relatively large sunflower achenes in both of these samples. A garden bean (*Phaseolus vulgaris*) in the Craddock sample further attests to its late prehistoric deposition. Craddock sample 34-7-555, however, contains much larger sumpweed achenes than the ones in 34-7-377. The higher-numbered sample was beyond the cut-off point for analysis in this report, but 56 achenes from 34-7-555 were measured and reported by Yarnell (1981). The mean LxW index was 36. Specimens from this sample need to be dated directly, since rank speculation about the age of an individual rockshelter plant sample is risky. At this point, it would seem that the Craddock site assemblages are entirely Mississippian, but the large sumpweed achenes could still be centuries older than the small, very late ones in 34-7-377.

The early (A.D. 350 +/- 75) radiocarbon date on very large sumpweed from Alred sample 32-4-103 is more difficult to reconcile. No known pre-Mississippian sample of *Iva* has had a mean LxW value exceeding 30. Part of the discrepancy may be due to our inability to determine the best correction factor for converting carbonized seed and achene sizes to projected uncarbonized achene sizes. Experiments by the Asches (D. Asch and N. Asch 1985a) could of necessity be conducted only on modern wild-sized *Iva annua* populations with maximum achene lengths of 4.6 mm and maximum widths of 3.7 mm. The linear regression equation derived from these experiments in order to adjust for shrikage due to carbonization can not be tested against cultigen sumpweed and may underestimate the original size of larger specimens.

Another possible explanation for the presence of such large achenes is that these rockshelter samples, as seed stock, would represent the largest specimens available. Midden debris might be argued to reflect the smaller end of the size range, as fruits discarded during processing. A third, and not mutually exclusive, possibility is that sumpweed domestication in the Ozarks had resulted in larger achenes at an earlier date than elsewhere.

A 5 g sample of clumped carbonized sumpweed and fiber from Marble Bluff sample 34-23-347 was submitted for radiocarbon dating in order to determine whether or not it was deposited at the sme time as the two dated samples found in the same crevice, 34-23-327 and 34-23-341. If these Iva specimens are also 3000 years old, they will continue the Ozark rockshelter trend by being of unprecented size (LxW=30) for their time. The carbonized Iva from sample 34-23-347 was sent to S.M.U. too late for the results to be available at this time.

Table 6.1
Ozark Rockshelter Sumpweed Achenes

Site	# Meas.	Length Range (mm)	Width Range (mm)	Mean LxW	LxW Index	C-14 Date
Alred						
32-4-45	5	6.5-7.9	4.5-5.7	7.2x5.2	37	
32-4-62	4	6.9-8.5	3.8-5.5	7.6x4.8	36	
32-4-98	3	8.6-8.8	4.9-6.2	8.7x5.5	48	
32-4-103b	18-	5.5-8.7	3.4-5.8	7.0x4.4	31	A.D. 350
	91-Yarnell			7.3x4.8	35	
34-4-156	250			7.4x4.8	36	
Agnew						
32-1-52	50	5.1-9.4	3.0-5.2	6.6x4.3	28	
Edens						
32-3-1643	45-Yarnell			7.5x5.1	38	
32-3-1706	300-Y	4.0x7.8	3.0x5.1	5.5x3.9	21	A.D.1590
Putnam						
32-44-68	1	7.1	4.6			
Craddock						
34-7-208	2	6.7-7.1	3.6-4.0	6.9-3.8	26	
34-7-321	1	6.2	4.1			
34-7-326	1	5.4	3.7			
34-7-377	27	4.2-7.0	3.2-5.1	5.4x3.9	21	A.D.1490
	300-Y			5.5x3.9	21	
34-7-555	56-Y			7.1x5.0	36	
Green Bluff						
33-7-1	15	5.3-8.5	3.6-5.9	7.2-5.0	36	
33-7-20	1	6.8	5.0			
33-7-60	1	5.7	5.7			
Whitney						
32-57-3	1	6.4	4.5			
32-57-27	1	6.0	3.6			
32-57-33	10	5.2-7.2	3.0-5.2	6.4x4.2	27	
Marble						
34-23-327	1					
34-23-347	19L,18W	5.9-9.1	4.3-6.2	6.5x4.6	30	

Table 6.1, cont.

	# Meas.	Length range mm	Width range mm	Mean LxW mm	LxW Index
Beaver Pond					
34-2-94	3	7.0-8.2	4.8-5.2	7.4x5.0	37
34-2-279	1	10.0	5.3		
Holman					
32-22-26	1 frag.				
Poole 2					
32-42-43	1	3.4	2.8		10 (wild-sized)
Cow Ford					
32-17-22	1 frag.		5.3		

Montgomery 4
32-34-154 Sample described as "Iva seed in gourd". Missing
32-156 Large sample of Iva achenes and gourd rind. Not measured.

Indian Bluff (3BE9)
32-24-62 1 "seed" listed by Gilmore

Worley (3MA11)
32-58-1 "a mass of Iva ciliata seeds" listed by Gilmore

Butler Creek "a parcel of Iva seeds". Collected by Mr. Wyrick, 1925.

SUNFLOWER

Sunflower (Helianthus annuus var. macrocarpus Ckll.)seems to have been a very important prehistoric crop in the Ozarks. Excluding the cucurbits, which are represented primarily by rind fragments that are probably the remnants of containers rather than food, sunflower is second in frequency only to maize among the rockshelter plant food remains. Gilmore listed sunflower as present in 68 samples from 16 sites, and I observed the species in 78 samples distributed among 15 of the 19 shelters targeted here (Table 6.2). One additional site, Gibson Shelter, yielded a sunflower seed head fragment according to both the excavation field notes and Gilmore's laboratory notes. The sample in question, 32-21-88, was either no longer present in the University of Arkansas Museum collections or was overlooked when I pulled the samples to be studied.

Sunflower Size, Age, and Color

Table 6.2 demonstrates the size and color variation among the achenes. Sites with the smallest fruits are Marble Bluff, Green Bluff, and Edens Bluff. The Marble Bluff specimens are carbonized and have been corrected by multiplying kernel length by 1.30, kernel width by 1.45, achene length by 1.111, and achene width by 1.27. The resulting LxW index for the achenes in sample 34-23-327 is 34, and that for the seeds is 39. This sample has been radiocarbon dated to 2843 +/- 44 B.P., as discussed in Chapter 5. The material submitted for dating consisted of carbonized ragweed achenes from the one-gallon cache of mixed seed types described in the discussion of Chenopodium.

The sunflower achenes in this sample are very similar in size and shape to those in Marble Bluff sample 34-23-345, described in the Field Notes as a "Bag of large seeds". It was probably burned at the same time as 34-23-327, but may or may not have been deposited at the same time. Sample 34-23-345 consisted of a clump of Helianthus achenes and Cucurbita seeds weighing approximately 18.5 g.

Three-thousand-year-old sunflower achenes with mean LxW values of 34 and higher have never before been reported. The Higgs site in eastern Tennessee is credited with yielding the earliest cultigen sunflower, "securely dated to about 900 B.C." (Yarnell 1978:296). The mean length (7.8 mm) by mean width (3.1 mm) product for 24 Higgs site sunflower specimens produced a LW value of 24. Marble Bluff sample 34-23-327 is approximately the same age (893 +/- 44 B.C.), yet the reconstructed mean achene length is at least 1 mm longer than that of the Higgs specimens, and the LW values of 34-39 exceed those of any sample studied by Yarnell (1978) that could be confidently assigned to a pre-Middle Woodland date.

None of the Green Bluff samples contain enough sunflower fruit specimens to give a good mean sample size. Only one of the fragments in 33-7-1 could be actually measured for width, but the projected mean LxW value of this sample would be slightly higher than 40. All the Green Bluff samples are relatively dark in color compared to the larger specimens from other sites. Three samples have only dark red achenes, while those in 33-7-9 vary from light brown, to brown-with-dark-red-stripes, to black.

Fourteen of the analyzed samples from Edens Bluff include sunflower disk or achene specimens. Only two samples contain more than 10 measurable achenes. Those in 32-3-1706 differ from all other sunflower fruits at the Edens Bluff site by being larger (mean LxW = 50) and consisting primarily of white or gray-and-white-striped fruits, although one mottled brown-and-black pericarp is present. Sumpweed achenes from the same sample were small (mean LxW = 21), and the A.M.S. radiocarbon date on sumpweed pericarp is late (360+/- 80 B.P.). This is interpreted as evidence for a relaxation in selection pressures for large-sized sumpweed fruits that was not evidently correlated with a decrease in sunflower achene size.

Since pre-Mississippian utilization of the Edens Bluff site is well documented, it seems likely that the smaller-sized, darker-colored sunflower fruits are earlier in age than those in sample 32-3-1706. For example, the mean LxW value for 10 measurable achenes in sample 32-3-1712 is 28, and mature fruits are reddish-brown in color. The four measurable fruits in sample 32-3-1698 are also dark-colored (dark red), and also have a mean LxW value of 28. Other samples have immature fruits that are not as diagnostic, but they appear to fall into the smaller, darker category which I speculate would date in the early or middle centuries of the first millenium A.D. Yarnell's (1981) suggested index for eastern North American sunflower predicts that Middle Woodland mean LxW values in general range from 25 to 35, that the range for early Late Woodland samples is 35 to 60, and that Mississippian mean values would be expected to fall within the 50 to 100 range.

Two very large caches of desiccated sunflower achenes were excavated during the 1930's rockshelter investigations. Sample 32-10-78 from Brown Bluff was described by the excavators as a "cache of sunflower seeds--over 1 gal." Material from this sample had been dated at the Michigan Radiocarbon Laboratory, as described in Chapter 4, but it was not specified whether or not sunflower achenes themselves were submitted. Since the large sample includes wood charcoal and other plant remains that could have been mixed in with the sunflower achenes after deposition, it was felt that a new direct date on sunflower material would be illuminating. This date turned out to be 450 +/- 42 B.P.: A.D. 1500 (S.M.U. 1679). The Brown Bluff achenes are white or white-with-gray stripes and are very large. The 56 fruits measured by Yarnell (1981) yielded a mean LxW value of 96. The 56 fruits that I measured were somewhat smaller, with a mean LxW value of 75. The discrepancy may be due to size sorting and subsequent removal of subsamples from different parts of the pile. The longest achene among those brought to North Carolina for analysis is 13.6 mm long. Maximum width is 8.5 mm.

The second very large sunflower cache came from Montgomery Shelter #3, which is not one of the 19 sites targeted in this study. A subsample from the thousands of sunflower fruit coats present in sample 32-33-1 was measured, however, and included in Table 6.2. Lengths range from 8.4 to 12.2 mm; widths range from 4.0 to 7.0 mm. The mean LxW value is 56. Colors include solid gray, solid white, and gray-and-white striped.

The Montgomery Shelter #4 assemblage included six samples with sunflower plant parts, but few mature fruits were present. Two measurable seed heads show that the disks were very large--180 mm and 185 mm in diameter.

Sunflower achenes from Salts Bluff, Putnam, Beaver Pond, and Craddock are predominanty large, white, or white-and-gray-striped, and presumably Mississippian (or only slightly earlier) in age. The Craddock assemblage appears to be a uniform late prehistoric manifestation. Sunflower fruits from 24 samples were examined, and all had mean LxW values exceeding 50. A few brown achenes came from Craddock, but most are the white and white/gray striped colors typical of the large Ozark specimens.

Craddock sample 34-7-377 (Cr-380), with a mean sunflower LxW value of 61, also contained sumpweed achenes with a mean LxW value of 21 (N=300 measured by Yarnell). Sumpweed pericarps were dated by the A.M.S. technique to 460 +/- 90 B.P. This supports the evidence from Edens bluff sample 32-3-1706 that a decrease in sumpweed size occurred in the Ozarks during the Mississippian period, but that sunflower fruits remained relatively large.

Regional Comparison and Discussion

Adair's (1984) data from the Central Plains are very different than these from the Ozark rockshelters. Sunflower seeds and achenes are relatively uncommon from Plains sites, and sample sizes are small. With the exception of one sample from the Steed-Kisker site in Missouri with a mean LxW product of 58, the specimens are quite small in size. Even Mississippian-aged samples have mean LxW values less than 30. The scarcity of seeds from archaeological sites is difficult to reconcile with ethnographic descriptions of Plains Indians gardens, in which sunflower was a highly valued oil seed crop. Adair speculates that introgression with small-seeded prairie sunflowers (H. petiolaris) may be a factor in the low LxW values. She also cites an ethnographic description of Hidatsa agriculture which documents the high value placed on smaller-headed "baby sunflowers".

Sunflowers are ubiquitous in the Ozark rockshelter collections, and large achenes are well represented. The earliest dated specimens, with mean LxW of 34-39, come from the 2900-year-old charred cache of mixed seed types found in the Marble Bluff crevice. Other samples of small achenes (mean LxW value of less than 30) were present in samples from Edens Bluff and Green Bluff, and a few relatively small specimens were included in samples from other sites as well. There is a consistent correlation between small achenes and dark pericarp color. This may represent an early variety. Large striped or white achenes dominate the assemblages known or suspected as being Mississippian in age.

Before the Ozark specimens were directly dated, Yarnell (1981:59) interpreted the rockshelter data and other evidence from eastern North America as indicating "that continuing increase in size of achenes took place more uniformly for sumpweed and that this species should be a better chronological indicator than sunflower." The five new radiocarbon dates for Ozark rockshelter sunflower and sumpweed, however, demonstrate that it is sunflower rather than sumpweed that increased continuously throughout the prehistoric sequence in this region.

Table 6.2
Ozark Rockshelter Sunflower

Site	# Achenes Measured/ Present	Mean L x W (mm)	LxW Index	Achene color	Disk Diam. (mm)	Chaff Ht. (mm)
Marble						
34-23-327	35/64	8.8x3.9	34(achenes)	carbonized		
		9.3x4.2	39 (seeds)	"		
34-23-345	22/?	9.3x4.2	39	"		
Brown Bluff						
32-10-78	56/100's	10.9x6.9	75	white & wh/gray striped		
	56-Y*	11.9x8.1	96			
Alred						
32-4-98					19 frags	7.0-8.0
32-4-103b	5 imm.					7.0-8.5
32-4-159					a) 40 mm	
					b) 35 mm	5.5-7.0
					c) 34 mm	
Agnew						
32-1-168b	1 imm.	8.0x?		brown	2 frags	7.0-8.0
Salts Bluff						
33-15-51	1/1	12.1x6.2		white		
33-15-96	1/1	11.4x5.4		eroded		
33-15-125	3L/4W	8.6x5.2	45	1 eroded, 2 white, 1 wh/brown striped		
White Bluff						
32-56-79	10L/ 0W	8.3-10.3 mm long		brown & black		
Cob Cave						
31-15-57					1 frag.	7.0-8.0

* measured by Yarnell (1978 and 1981)

Table 6.2, continued

	# Achenes Measured	Mean LxW (mm)	LxW Index	Achene Color	Disk Diam. (mm)	Chaff Ht. (mm)
Green Bluff						
33-7-1	3L/3 1W	8.4x4.6	39	red		
33-7-9	5L/5 0W	9.8x?		1 black; 2 lt. brown 2 br/dark red striped		
33-7-20	1L/2	7.3x?		dark red		
33-7-154					2 frags	6.5-7.5
33-7-182	1/1	8.0x4.6	37	dark red		
33-7-302	1L/1	4.2x?				
Edens Bluff						
32-3-27					1 frag.	7.5
32-3-95a	1/1	7.5x4.2		brown	95 mm	7.0
32-3-95b	1/1	7.8x4.7		lt. brown		6.0-7.0
32-3-247					a) 70 mm	7.0
					b)1 frag	7.0-8.0
	1/1	8.0x3.5		brown	c)2 frags	6.0-7.0
32-3-752b						6.5-8.0
32-3-1694						7.5-8.0
32-3-1695					110+ mm	9.0-10.0
32-3-1696					a) 75 mm	6.0-9.0
"					b) frags	7.0-8.0
32-3-1698	4/6	7.2x3.9	28	dk.red		7.0
32-3-1699	1 imm.	7.5x2.7		lt. brn.	a) 70 mm	6.0-8.0
"	1/1	7.5x2.6		lt. brn.	b) frags	6.0-8.0
32-3-1701	3 imm.	7.3x3.2	23	ruddy	10 frags	6.0-8.0
32-3-1702	6 imm.	8.1x3.1	25	brown	100 mm	7.0
32-3-1706	12-Y	9.7x5.2	50	1 br & blk.; 3 white; 8 wh/gray		
32-3-1712	10/20	8.0x3.5	28	red-brn.	120 mm	7.0-8.0
32-3-1754	2 imm.	7.9x3.4	27	brown	1 frag	5.5-8.0
Putnam Shelter						
32-44-120	1 imm.	8.4x3.8		white		9.0-10.0
32-44-132	imm.			brown	folded	7.5-8.0
32-44-156	6L/7 5W	10.2x5.6	57	white		
32-44-197	20L/ 8W (many frags)	10.8x6.3	68	gr/wh str. a few dark		
32-44-257	2 imm.	8.7x3.5		tan	75 mm	7.0
32-44-380	1L/1	10.4x?		wh/brown striped		
32-44-479					1 frag.	7.0-8.0
32-44-483	1 imm.	9.5x3.5		tan	frags	7.0-8.5

Table 6.2, continued

	# Achenes Measured	Mean LxW (mm)	LxW Index	Achene Color	Disk Diam. (mm)	Chaff Ht. (mm)
Gibson						
32-1-88	Field Notes say "Part of a sunflower head"					
Montgomery 3						
32-33-1	127/ 1000's	10.2x5.5	56	gray & gr./white striped		
Montgomery 4						
32-34-19j	imm.				130+ mm	7.0-9.0
32-34-59					185 mm	8.0-9.0
32-34-60b	1/10	9.3x4.8		tan/br. stripes		6.0-8.0
32-34-160	1	8.0x4.7		red/brn striped	180 mm	6.0-7.0
32-34-167	0/1 imm					7.5-8.0
32-34-173	1/sev.	9.5x6.4		red-black		9.0-10.0
Holman						
32-22-3	0/1					
32-22-28					1 frag.	not rec.
Poole 2						
32-42-31	1/1	9.4x4.7			1 frag.	not rec.
32-42-43	0/1 tip of a possible kernel					
Beaver Pond						
34-2-221	2/3	8.6x4.5	39	not recorded		
34-2-248	1/1	10.0x5.5		white		
34-2-279	5L/15 4W	9.5x5.7	54	not recorded		
34-2-637	1/1	10.0x7.0		not recorded		
34-2-677	1/1	10.0x5.7		not recorded		
34-2-703	1L/1	13.0 x ?		not recorded		
34-2-753	0/1					
34-2-768	2/6	10.6x6.7	71	not recorded		

Table 6.2, continued

	# Achenes Measured	Mean LxW (mm)	LxW Index	Achene Color	Disk Diam. (mm)	Chaff Ht. (mm)
Craddock						
34-7-15	1/2	9.8x5.4		brown		
34-7-33					1 frag.	6.0-8.0
34-7-84	0/1	11+x5+		wh/gr str.		
34-7-86	6/6	11.2x6.4	72	wh/gr str.		
34-7-87	2L/3 3W	11.7x5.9	69	br. & cream str.; gr. & wh. str.		
34-7-88	3/3	11.7x7.0	82	1 white; 2 wh/gray str.		
34-7-104	2L/3 1W	11.0x6.4	70	white		
34-7-128	1/1	9.6x7.0		gr./wh.str.		
34-7-132	0/1			gr./wh. str.		7.0-9.0
34-7-139	1/1	12.6x6.8		gr./wh. str.		
34-7-141	1/1	11.5x6.5		gr./wh. str.		
34-7-146	1L/1	11.1x?		eroded		
34-7-155	5/5	11.6x5.9	68	1 white; 4 gr/wh str.		
34-7-169	2L/2 1W	10.5x6.1	64	wh/gr str.		
34-7-183	32-Y	10.7x6.3	67			
34-7-186	7L/14 5W	10.2x6.1	62	white; wh/gray str.		
34-7-190	1/1	9.3x5.9		white		
34-7-232	1/1	11.0x6.4		white		
34-7-249	2/2	11.1x5.5	61	1 white; 1 wh/gr str.		
34-7-267	1/1	10.8x7.3		wh/gr. str.		
34-7-274	4/4	10.8x6.0	65	2 white; 2 wh/gr. str.		
34-7-306	1/1	12.9x7.8		white		
34-7-318	4/5	10.8x5.7	62	1 white; 2 wh/gr. str.		
34-7-321	4/4	10.8x5.6	56	3 white; 1 wh/gr. str.		
34-7-345	1/1	10.9x6.2		white		
34-7-346	1/1	10.7x5.7		cream		
34-7-377	17-Y	10.3x5.9	61	brown;gray		
34-7-381	150-Y	10.9x6.3	69	not recorded		
34-7-545	14-Y	11.3x7.2	82	not recorded		

CHAPTER 7

THE CUCURBITS

CUCURBITA Spp.

Cucurbita is the most abundant domesticated plant type in the rockshelter assemblages. Although my analysis (Table 7.1) lists no specimens from Buzzard Roost, Cow Ford, Poole 2, or White Bluff, it should be remembered that the "Cow Ford" assemblage was not fully analyzed due to the suspected provenience problem, that the only plant food type from Buzzard Roost was maize, and that many of the archaeobotanical samples from White Bluff are housed at the University of Michigan. Table 7.1, which itemizes Cucurbita rind and seeds, is also an incomplete listing in that it omits many specimens in samples from Edens Bluff and Craddock with catalog numbers higher than the cut-off points for this analysis (see Chapter 1). Gilmore listed Cucurbita as present in 167 samples from 28 of the Ozark rockshelter sites (Fritz and Yarnell 1985). His reports include three references to Cucurbita from White Bluff. The nutritious oily seeds were probably highly valued food items, but most Cucurbita remains are rind fragments likely brought to the Ozark shelters as containers or as some type of utensil. A thorough study of the rockshelter cucurbits would be a thesis in itself, and this chapter barely skims the surface of the topic. It might serve as an inventory to the collections, however, and demonstrate the richness of the material available.

Regional Background

The antiquity of Cucurbita pepo L.in North America has been the focus of much attention and has greatly influenced explanations of regional agricultural origins. Now that rind fragments from westcentral Illinois have been directly dated to 7000 B.P. (Conard et al 1984; D. Asch and N. Asch 1985b), it no longer seems likely that pepo could have served as a model inspiring Archaic hunter-gatherers to embark upon the path to agriculture. Smith (1986b) has convincingly detailed the arguments against accepting the Middle Archaic rind fragments as tropical cultigen "pepo squash". The physical evidence itself is so meager that both the cultigen status and the taxonomic status of the early North American archaeological cucurbits must be viewed as less than certain. Heiser (1985:65-66) discusses the possibility that C. pepo was domesticated independently in eastern North America from an ancestral native wild gourd. Even if early pepo came from Mexico, fruits could have been carried northward by Gulf currents, and feral gourds might have grown along rivers just as they do today (Cutler and Blake 1971:374; D. Asch and N. Asch 1985b:157). Camp-following gourds fit easily into the coevolutionary model outlined in Chapter 3 as plants whose reproductive fitness was increased by virtue of the fact that humans increasingly dispersed them.

King (1985) has summarized the evidence for Middle and Late Archaic and Early Woodland pepo in eastern North America. None of the desiccated Ozark cucurbits are suspected of dating as early as the

Middle Archaic period, so they may not be helpful in solving problems of initial gourd husbundry. Chronological placement of cucurbits in general, however, was not one of the goals of this study. A series of radiocarbon dates on carefully chosen specimens might reveal greater antiquity than expected. Even if the Ozark specimens are all less than 2000 years old, the assemblages demonstrate the diversity of Woodland and Mississippian Period cucurbits. This type of manifestation is especially valuable since gourds are among those plants that are less likely than others to become carbonized and therefore preserved in the archaeological record of open sites. After carbonization and fragmentation, of course, many interesting features are no longer discernible.

Presence of Cucurbita mixta

Four bulbous, corky peduncles corresponding to photographs of *Cucurbita mixta* Pang. warranted special attention. This species, whose most popular cultivar is the green-striped cushaw pumpkin, was present in the Southwest by A.D. 900, and has been found archaeologically as far east as El Paso (Ford 1981:19). The species *C. moschata* Poir. has come from Historic contexts in eastern North America, but no species other than *C. pepo* had been documented prehistorically (Ford 1981). Therefore, a fragment from one of the distinctive *C. mixta* peduncles from the Ozarks was submitted for radiocarbon dating, with the resulting date of 520 +/- 75 B.P.: A.D. 1430 (Beta 14598). The specimen came from Putnam Shelter sample 32-44-217 (Figure 7.1). The uncalibrated 95% confidence interval for this assay would be A.D. 1280-1580, which includes a few decades of European presence in the southeast at the late end. Direct contact, however, does not seem to have been made with Ozark societies, and Spanish explorers are not considered likely candidates to have carried the new species. A later Mississippian period introduction from the West would be consistent with other evidence of increasing interaction during this time period.

The remaining three C. mixta peduncles in the University of Arkansas Museum collections came from Putnam Shelter sample 32-44-278 (Figure 7.1), from Edens Bluff sample 32-3-1789 (Figure 7.2), and from Cob Cave sample 31-75-55 (Figure 7.3). Four additional specimens of this type were observed in storage at the Museum of the American Indian in New York. Two came from Harrington's Bonebrake site (11/8810 and 11/8812), one from Agnew, which he called Bushwhack (11/6190), and the fourth from Blowing Springs (11/5837).

The presence of late prehistoric C. mixta peduncles in the Ozarks obviously raises the possibility that some of the seeds and rind fragments also came from this species and not from C. pepo fruits. I am not able to distinguish between the two taxa using seeds or rind fragments. Cutler and Meyer (1965) state that larger C. mixta fruits have corky ridges on the upper body, but that no ridges of the sort were observed on the rind fragments from Mesa Verde; nor were they found in these Ozark samples.

Peduncles were fairly uncommon in the Ozark collections, but specimens classified here as C. pepo outnumber the C. mixta stems in general. Twelve peduncles, many of them immature in appearance, came from Salts Bluff. Three came from Craddock, two from Holman, and five non-mixta peduncles were present in the Putnam Shelter samples.

I suspect that Gilmore was referring to the C. mixta specimens when he listed Cucurbita species other than pepo. In the 1931 "Vegetal Remains of the Ozark Bluff-Dweller Culture" paper, Gilmore used the designation C. maxima, which he recognized as incorrect by the time he wrote Edgar Anderson in 1936. Gilmore's 1930's laboratory reports on the Arkansas Museum collections contain frequent identifications of C. moschata. Since a description of C. mixta had not yet been published in English, researchers prior to 1950 usually included mixta under the moschata label (Cutler and whitaker 1961:481). Gilmore evidently believed that a number of the larger Ozark Cucurbita seeds did not come from C. pepo fruits, and he may have been correct.

Seed Size

Late Archaic and Woodland data reflect a possible trend toward increasing pepo rind thickness and increasing seed size (King 1985:83). Ozark rockshelters such as Putnam, Beaver Pond, and Craddock, which definitely include and probably are dominated by Mississippian material, have some relatively small seeds and some that are larger than those from any of the samples discussed by King (see Table 7.1). Smaller seeds (ca. 10-14 mm long) are most abundant at Agnew, Green Bluff, Gibson, and Marble Bluff. Samples that include seeds greater than 15 mm in length came from Salts Bluff, Green Bluff, Whitney, Putnam, Beaver Pond, and Craddock.

At Beaver Pond, there is clear evidence for a large-seeded type and a small-seeded type that appear to be contemporaneous. Sample 34-2-807 has exclusively large Cucurbita seeds, ranging from 15-19 mm in length (mean = 17.3) and 10-12 mm in width (mean = 10.7). Samples 34-2-768 and 34-2-773 have a mixture of smaller, darker seeds ranging from 11-15 mm in length and 7-9 mm in width together with longer, lighter colored seeds ranging from 15-19 mm in length and 9-11 mm in width. Measurements for the Beaver Pond seeds, analyzed in 1981, were recorded only to the nearest 1.0 mm. Both the larger and smaller types of seeds are also represented in Beaver Pond samples 34-2-637, 34-2-691a, and 34-2-810.

Sample 32-57-5c from Whitney Bluff includes hundreds of very thin and highly fragmented _Cucurbita_ seeds that appear to fall within the 17-20 mm length range and 8-10 mm width range. The sample includes cultigen _Chenopodium_ and _Polygonum_, described in Chapter 5. A radiocarbon date on gourd rind fragments from neighboring sample 32-57-3 turned out to be 785 +/- 75 B.P., and the starchy seeds in the two samples appear to be mixed. It is possible, but not certain, that the long, thin _Cucurbita_ seeds in sample 32-57-5 were deposited during the early Mississippian period, as were the directly dated rind fragments and probably also the _Polygonum_ and _Chenopodium_ seeds.

Rind Thickness

Sites with many samples of _Cucurbita_ rind tend to exhibit considerable variation in rind thickness (Table 7.1). Many rind fragments thinner than 2.0 mm appear to have come from fairly large and sturdy fruits, judging by the amount of curvature. A number of specimens deserve careful analysis as artifacts.

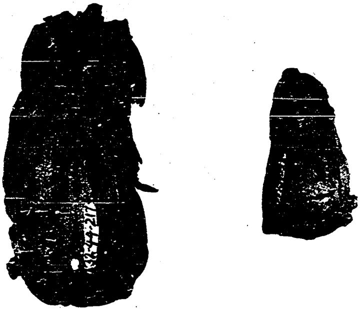


Figure 7.1 (Top) Putnam Shelter Cucurbita mixta peduncles.
Left: 32-44-217. Right: 32-44-278. Natural size.

Figure 7.2 (Bottom left) C. mixta peduncle from Edens Bluff, 32-3-1789.

Figure 7.3 C.mixta peduncle from Cob Cave, 31-75-55. Natural size.

Table 7.1

Cucurbita Rind and Seeds

	Rind Thk.	Rind Color	# Seeds Meas./ Present	Length Range	Length mean & s.d	Width range	Width mean & s.d.
	(mm)			(mm)		(mm)	
Alred							
32-4-88A	0.9	lt. brown					
32-4-96	1.4	tan					
Agnew							
32-1-4	.		30/156	9.9-11.6	10.8/0.50	5.5-6.8	6.3/0.31
32-1-59a	1.5	yel-brown					
32-1-59b	3.0	tan					
32-1-71	2.0	dk. brown					
32-1-113	2.2	brown					
32-1-121	1.1	lt. brown					
32-1-129	2.3	tan					
Edens Bluff							
32-3-28A	1.3	tan					
32-3-80A	3.1	yel-brown					
32-3-599b	2.7	tan					
32-3-821A	2.5	yellow					
32-3-889	1.5	tan					
32-3-1083	1.7	tan					
32-3-1194	2.5	yel-brown					
32-3-1253	1.8	tan/brown					
32-3-1270	indet.	brown					
32-3-1281	2.5	brown					
32-3-1288	1.1	br.-yel.					
32-3-1289			1/1	9.9		6.6	
32-3-1694	a)3.0	dk. brown					
	b)2.0	lt. brown					
32-3-1705	1.6	tan					
32-3-1714	1.4	tan					
32-3-1789	(1 C. mixta peduncle)						

Table 7.1, continued

	Rind Thk.	Rind Color	# Seeds Meas./ Present	Length Range	Length mean & s.d	Width range	Width mean & s.d.
Green Bluff							
33-7-5	0.75	yel-brown					
33-7-9			10 frags	12-14			
33-7-20b			4/6	11.2-13.9	12.6/1.1	7.7-8.5	3.1/0.30
33-7-21			1	14.1		9.3	
33-7-84			1/10	13.6		8.2	
33-7-99			1/1	frag.		8.2	
33-7-216			1/1	18.0		11.2	
33-7-217	1.5	lt. brown					
33-7-243			1/1	14.2		7.8	
33-7-263	0.6	tan					
33-7-271	0.6	tan					
33-7-332	2.0	tan & br.					
33-7-338	3.0	lt. brown					
33-7-379	4.0	brown					
33-7-380	1.8	brown					
33-7-412	2.0	yel-brown					
33-7-439			5 frags	13-14		7.9-9.1	
Salts Bluff							
33-15-1	1.5	brown					
33-15-11	1.3	tan? (eroded)					
33-15-48	(3 peduncles)						
33-15-58	(3 peduncles)						
33-15-59	(1 peduncle)						
33-15-60	(1 peduncle)						
33-15-65			1/1	15.5		incomplete	
33-15-73	(1 peduncle)						
33-15-89			0/1				
33-15-105			1/4	12.2		7.3	
33-15-123	1.8	tan					
33-15-125	2.0	tan	7/7	12.0-16.6	14.0/1.75	6.5-8.2	7.8/0.74
	(also 3 peduncles)						
33-15-126	1.3	tan					
33-15-127	inc..	tan					
33-15-128	1.0	brown	1/3	14.0		7.8	
33-15-145	.		1/1	11.6		7.2	
Whitney Bluff							
32-57-5c			100's (frags)	ca. 17-20		ca. 8-10	
32-57-32	2.8	stan	6 frags	17-20		?	

Table 7.1, continued

	Rind Thk.	Rind Color	# Seeds Meas./ Present	Length Range	Length mean & s.d	Width range	Width mean & s.d.
<u>Putnam Shelter</u>							
32-44-15	2.8	tan					
32-44-19			55/100	12.1-16.7	14.1/1.04	6.7-10.8	8.8/0.76
32-44-42			5/20	15.0-16.1	15.6/0.40	8.4-8.9	8.6/0.22
32-44-66	(1 peduncle)						
32-44-68	(1 peduncle)						
32-44-120	1.5	tan					
32-44-165	3.0	lt. brown					
32-44-198	3.5	tan					
"	1.5	tan					
32-44-217	(1 <u>C. mixta</u> peduncle)						
32-44-230	3.0	lt. brown					
32-44-241	3.0	lt. brown					
32-44-247	4.5	lt. brown					
32-44-252	2.0	lt. brown					
32-44-277a	2.3	tan					
32-44-278	(1 <u>C. mixta</u> peduncle)						
32-44-289a	(1 peduncle)						
32-44-289b	(1 peduncle)						
32-44-291	2.0	tan					
"	1.5	yel.-brown					
"	1.3	brown					
"	2.0	lt. brown					
32-44-315	3.3	smudged					
32-44-318	2.0	red-yel.					
32-44-335	(1 peduncle)						
"	2.5	yel.-brown					
32-44-346	1.0	light brown					
32-44-353b	0.8	light brown					
32-44-396a	1.5	dk. yellow					
32-44-467			2/2	12.4-16.1	14.3	9.5	
32-44-470	2.3	lt. brown					
"	3.5	yel-brown					
32-44-471	3.0	yel-brown					
"	1.5	yel-brown					
32-44-472	3.3	orange-brown					
32-44-479	1.8	tan					
32-44-481	3.0	yel-brown					
32-44-483	1.8	lt. brown	6/9	11.5-13.0	12.0/054	7.3-8.2	7.5/0.31
"	2.0	yellow					
"	2.0	tan/br. ridges					
32-44-498	1.8	tan					
"	3.8	brown					

Table 7.1, continued

	Rind Thk.	Rind Color	# Seeds Meas./ Present	Length Range	Length mean & s.d	Width range	Width mean & s.d.
Gibson							
32-21-71a			23/28	11.5-14.1	13.0/0.68	6.5-9.7	8.4/0.63
Brown Bluff							
32-10-113b	2.5	indet.					
32-10-130	2.8	brown					
Montgomery #4							
32-34-19	1.3	tan					
32-34-59	a)2.3	tan					
	b)1.3	brown					
32-34-60	2.3	tan					
32-34-65	2.75	tan					
32-34-107	4.5	tan					
32-34-167	3.0	tan					
32-34-170	1.3	tan					
"	2.0	lt. brown					
"	3.0	tan					
32-34-176	2.75	brown					
Holman Shelter							
32-22-16			2/2	15.5-17.0	16.3	17.0	
32-22-20	1.8	tan					
"	1.3	lt. brown					
32-22-28	1.8	yel-br.					
32-22-44	(1 button)						
32-22-45	3.0	lt. brown					
32-22-60	2.5	charred					
"	1.3	tan					
"	(2 peduncles)						
Cob Cave							
31-15-58	2.2	tan					
31-15-67	1.0	orange-tan					
31-15-69	2.2	tan					
31-72-25a	3.0	lt. brown					
b	2.5	lt. br./tan					
31-75-55	(*C. mixta* peduncle)						
Marble Bluff							
34-23-54	1.3	lt. brown					
34-23-228	1.5	brown					
34-23-345			4/? (several dozen, carbonized)	11.2-13.2	11.8/0.82	6.5-8.5	7.6/0.81

Table 7.1, cont.

	Rind Thk.	Rind Color	# Seeds	Length Range	Length mean & s.d	Width range	Width mean & s.d.
Craddock							
34-7-34	(1 peduncle)						
34-7-71	1.8	lt. brown					
34-7-83			2/2	11.7-13.7	12.7/	7.7	
34-7-86			1/1	15.2		10.1	
34-7-97	2.5	green/gray					
34-7-130	2.0	tan to br.					
34-7-134	3.0	lt. brown					
34-7-139			1/1	13.6		8.1	
34-7-147			1/1	10.8		6.7	
34-7-153			1/1	13.7		8.4	
34-7-169	indet.	1/1	11.7		7.7		
34-7-177	3.3	tan/gray					
34-7-190			1/1	17.4		10.5	
34-7-232			1/1	18.6		9.6	
34-7-253			1/1	16.0		9.9	
34-7-280	(2 peduncles)						
34-7-285	indet.	brown					
34-7-345	1.5	tan					
Beaver Pond							
34-2-89			1/1	14		9	
34-2-94			3/6	16-18	16.7	10	10
34-2-110			1/1	19		10	
34-2-131			1/1	17		10	
34-2-141			1/1	17		11	
34-2-151			1W/1	frag		10	
34-2-164	2.0	dk. br.					
34-2-213			1/1	19		11	
34-2-279			0/2 frags				
34-2-290			1/1	15		10	
34-2-584	3.0	tan					
34-2-586			1/1	12		9	
34-2-609			1/1	18		10	
34-2-615			1/1	18		10	
34-2-616			1/1	19		10	
34-2-622			1/1	19		10	
34-2-637			9/15	11-19	15.7/2.40	8-10	9.4/0.90
34-2-679			2/3	10-14	12.0/	7-8	7.5/
34-2-685			2/3	11	11.0/	8-9	8.5/
34-2-691a			5/6	12-17	14.6/2.15	8-10	9.2/0.98
34-2-701	4.0	tan					
34-2-703			6	11-13	12.3/0.75	7-8	7.6/0.47
34-2-722	4.5	lt. brown					
34-2-760	4.0	tan					
34-2-768	3.0	lt. brown	20/23	11-19	14.2/2.43	7-11	8.6/0.98
34-2-773			16/21	11-18	14.7/2.23	7-11	9.2/1.01
34-2-806			1/1	18		10	
34-2-807			18/40	15-19	17.3/1.15	10-12	10.7/0.59
34-2-810			22/35	13-19	17.0/1.35	8-11	10.1/0.85
34-2-872			0/2 or 3 frags				
34-2-925			3/3	17-18	17.7/	9-12	10.5/

LAGENARIA

The bottle gourd (Lagenaria siceraria [Mol.] Standl.) was a second important container crop in the Ozarks, and the seeds may have been ingested here as they were at Salts Cave (Yarnell 1974). Table 7.2 presents rind thicknesses, rind colors, seed sizes, and seed colors for the samples from the 14 shelters covered in this study which yielded recognizable Lagenaria plant parts. Bottle gourd seeds were not measured individually, but sample length and width ranges were recorded.

Seed Size

Lagenaria seeds were present in samples from only five sites, half as many sites as yielded Cucurbita seeds. This crop was not targeted for chronological problem-solving, but it appears that the longest bottle gourd seeds came from late sites--Beaver Pond and Craddock. Since these are geographically separated from the White River shelters, a spatial rather than temporal explanation is also possible.

Two samples from Alred include 60 and 50 bottle gourd seeds, respectively. Seed lengths for both samples range from 10.5 to 12.5 mm. Widths range from 6.0 to 7.5 mm in sample #32-4-45 and from 5.7 to 7.0 mm in sample #32-4-62. Describing color subjectively, seeds in both samples are tan and light brown (slightly darker and less tawny than "tan"), with a tendency for the margins to be a bit lighter in color than the central body areas. The single seed from Green Bluff, measuring 11.7 x 6.1 mm and having a tan color, would fit well into the Alred population. As discussed in Chapter 2, the Alred site yielded no pottery, maize, or other items that would necessarily date to the Mississippian period. The single Alred radiocarbon date, on Iva—1600 +/- 75 B.P.—is among the earliest of the new series of assays on desiccated rockshelter plant remains. I suspect that both of the Alred Lagenaria seed samples are also pre-Mississippian, but they would have to be dated directly before any such statement could be made with confidence.

Two samples of bottle gourd seeds came from Putnam Shelter, and both include specimens that are longer and narrower than any from Alred or Green Bluff. Sample 32-44-15 held 510 brown Lagenaria seeds ranging from 10.5-13.2 mm in length and 5.0-6.5 mm in width. These were found buried in an ash lens under a layer of limestone and ashes at a recorded depth of 14". They were mixed with Cucurbita seeds (see Table 7.1), occupying a space 14" long, 6" wide, and 5" thick, according to the sketch map in the field notes. Sample 32-44-457 from Putnam included eight light brown seeds, ranging from 12.2-13.1 mm in length and 5.8-6.5 mm in width.

The Craddock site Lagenaria seeds, probably deposited during the middle or later part of the Mississippian period, range from 12.9 to 14.4 mm in length, overlapping with the longest Putnam Shelter bottle gourd seeds but uniformly exceeding the Alred seeds in length. Only one of the Craddock seeds is wider than the maximum Alred width value of 7.5, however. The six Craddock seeds range from 6.7 to 8.3 mm in width, and three are more than twice as long as they are wide. They are all distinctly colored, having brown bodies with thin tan or yellow stripes along the longitudinal ridges.

The three *Lagenaria* seeds from Beaver Pond are long and thin, like those from Craddock, ranging from 13-16 mm in length and 6-7 mm in width. Again, dimensions of these seeds were recorded only to the nearest 1 mm in 1981. Seed color was unfortunately not recorded.

Rind Thickness and Color

While there is evidence for increased seed length and presence of a striped seed type during later times, no trend in *Lagenaria* rind thickness or color was noticed. Mean rind thickness varies from 3.4 mm at Craddock to 5.2 mm at Cob Cave. Color of the outer rind surface is usually dark brown, reddish brown, or brownish-red, and very few fragments deviate from these colors. King's (1985) overview of early bottle gourd in eastern North America shows that the Ozark rind specimens are, if anything, slightly thinner on the average than those at earlier sites. Salts Cave bottle gourd rind was 3.2-6.2 mm thick, with a mean of 4.9 mm. Cloudsplitter bottle gourd was 2.8-6.5 mm thick, averaging 5.2 mm.

WATERMELON

Watermelon seeds, *Citrullus lanatus* (Thunb.) Matsumara and Nakai var. *lanatus*, were found in three samples from Beaver Pond and in one from Whitney Bluff. Measurements are presented in Table 7.3. The 95% confidence interval for a radiocarbon date on maize from Whitney Bluff would extend into the period of European contact in the southeast. Aboriginal utilization of the Beaver Pond shelter is even more likely to have occurred during the protohistoric period. Since native farmers quickly adopted and spread Old World melon upon its arrival in North

America (Blake 1981), it would not be surprising to find it in the Ozarks before 1700. Sources cited by Swanton (1942:131) indicate that watermelons were being grown during the late 1600's by Caddo Indians. It is also possible, however, that the seeds were tossed by whites into rockfall crevices and worked downward to eventually mix with aboriginal deposits. The presence of two watermelon seeds in sample 32-57-5c from Whitney Bluff is especially disturbing because of the radiocarbon date of 785 +/- 75 B.P. on gourd rind from sample 32-57-3a, which has the same provenience data (Tr. 11, Bl. 3, 8") and is sketched as lying in the same "cache" as sample 32-57-5c. A cross-section sketch of the cache in the field notes depicts an opening between rock slabs that cover the crevice where samples 32-57-3a, 32-57-4b (a woven "grass bag"), and 32-57-5c were found. No other Historic material was encountered in any of these samples. The fact that some contamination must have occurred highlights the difficulty of assessing temporal associations in these collections.

Table 7.2

Ozark *Lagenaria* Rind and Seeds

	Rind Thck. (mm)	Rind Color	# Seeds	Length Range (mm)	Width Range (mm)	Seed Color
Alred						
32-4-20	3.7	orange-brown				
32-4-34	5.8	reddish-brown				
32-4-45	indet.	dark brown	ca.60	10.5-12.5	6.0-7.5	tan
32-4-62			ca.50	10.5-12.5	5.7-7.0	lt. brown
32-4-77	2.5	reddish-brown				
32-4-88A	2.8	reddish-brown				
32-4-117	3.0	dark red-brown				
32-4-157a	6.1	brown				
32-4-157b	3.5	dark red-brown				
(Mean=3.9; s.d.=1.34)						
Agnew						
32-1-1a	3.5	dark red-brown				
32-1-8a	3.3	dark red-brown				
32-1-121	4.0	dark brown				
32-1-140	4.0	dark red-brown				
32-1-146	4.0	dark brown				
(Mean=3.75; s.d.=0.32)						
Edens Bluff						
32-3-19t	3.8	dark brown				
32-3-19u	4.9	dark red-brown				
32-3-58	4.4	purple				
32-3-75a	4.4	dark brown				
32-3-80a	3.5	red-brown				
32-3-148	4.6	brown				
32-3-205	3.4	dark red-brown				
32-3-557	3.9	reddish-brown				
32-3-599c	6.3	reddish-brown				
32-3-599d	3.1	brown				
32-3-599e	3.6	brown				
32-3-599f	4.1	reddish brown				
32-3-624	3.5	dark brown				
32-3-695	4.0	reddish brown				
32-3-752	5.5	dark red-brown				
"	3.5	dark brown				
32-3-806	3.8	dark brown				

Table 7.2, cont.

	Rind Thck. (mm)	Rind Color	# Seeds	Length Range (mm)	Width Range (mm)	Seed Color
Edens Bluff, cont.						
32-3-821a	4.3	reddish-brown				
32-3-889	3.3	dark brown				
32-3-899	4.3	brownish red				
32-3-970	3.8	reddish brown				
32-3-1060	3.8	brownish-red				
32-3-1077	5.9	dark brown				
32-3-1111	6.0	dark brown				
32-3-1150	3.6	dark brown				
32-3-1153	3.0	brownish-red				
32-3-1412	3.5	brown				
32-3-1556	3.0	brown				
32-3-1663	4.4	reddish-brown				
32-3-1714	4.5	dark red-brown				
"	6.0	brown				
"	4.1	red-brown				
"	4.2	red-brown				
"	3.6	brown				
"	3.9	brown				
"	4.4	dark red-brown				
"	3.2	brown				
Green Bluff						
33-7-60			1	11.7	6.1	tan
33-7-457	4.0	dark brown				
White Bluff						
32-56-17b	ca.4.0	brown (very deteriorated)				
Whitney Bluff						
32-57-3a	indet.	reddish brown				
Gibson Bluff						
32-21-58	4.3	brown				
32-21-113	4.0	light brown				
	(Mean=4.2)					

Table 7.2, cont.

	Rind Thck. (mm)	Rind Color	# Seeds	Length Range (mm)	Width Range (mm)	Seed Color
Putnam						
32-44-15	3.3	reddish brown				
32-44-19			510	10.5-13.2	5.0-6.5	lt. brown
32-44-129	3.5	reddish brown				
32-44-204	3.0	dark brown				
32-44-230	4.5	dark red-brown				
32-44-396b	3.3	reddish brown				
32-44-396c	3.5	reddish brown				
32-44-467			8	12.2-13.1	5.8-6.5	light brown
32-44-470	4.0	charred				
(mean=3.6; s.d.-0.48)						
Brown Bluff						
32-10-47	4.5	reddish brown				
32-10-54	3.8	dark brown				
32-10-55	4.0	brown				
32-10-62	4.0	reddish brown				
32-10-68	3.7	dark reddish brown				
32-10-109	3.0	dark red				
32-10-113a	3.0	dark reddish brown				
(Mean=3.7; s.d.=0.51)						
Montgomery #4						
32-34-19	6.0	brown				
"	3.8	reddish brown				
32-34-19g	4.0	dark red-brown				
32-34-59	4.0	dark red-brown				
32-34-65	5.0	dark brown				
32-34-155	5.0	dark red-brown				
32-34-156	5.0	dark red-brown				
32-34-168	3.8	dark brown				
32-34-170	2.5	dark red-brown				
"	3.0	dark red-brown				
32-34-176	4.0	reddish-brown				
(Mean=4.2; s.d.=0.95)						
Cob Cave						
31-15-41	5.25	brown				
31-15-63	5.6	dark red-brown				
31-72-6a	4.9	dark red-brown				
31-72-6b	5.9	dark red-brown				
31-72-6c	4.1	light brown				
(Mean=5.2; s.d.=0.62)						

Table 7.2, cont.

	Rind Thck. (mm)	Rind Color	# Seeds	Length Range (mm)	Width Range (mm)	Seed Color
Marble Bluff						
32-23-172	5.3	dark brown				
32-23-283	5.3	dark red-brown				
32-23-406	2.5	dark red-brown				
(Mean=4.35)						
Craddock						
34-7-90	4.0	dark brown				
34-7-123	2.8	orangish-brown				
34-7-130	inc.	reddish brown				
34-7-247			1	12.9	7.1	br./tan striped
34-7-269			1	13.8	7.1	"
34-7-282			1	12.9	8.3	"
34-7-291			1	14.1	7.0	"
34-7-304			1	14.4	7.0	"
34-7-321			1	14.1	6.7	"
34-7-341	inc.	dark brown				
(Mean=3.4)		(Mean=13.7.......7.2				
			s.d.=	0.59	0.51	
Beaver Pond						
34-2-140	5.5	dark brown				
34-2-214	5.0	dark brown				
34-2-500	3.0	brownish orange	1	13	6	not recorded
34-2-611	4.0	dark brown				
34-2-691a			2	15-16	7	not recorded
34-2-753	3.8	reddish brown				
34-2-782	4.5	dark brown				
34-2-829	4.5	reddish brown				
34-2-845	5.0	dark brown				
34-2-858	5.0	dark brown				
(Mean=4.5; s.d.=0.73)						

Table 7-3. Watermelon Seeds

Acc. Number	# Seeds	Length	Width
Beaver Pond			
34-2-4	1	13 mm	8 mm
34-2-279	1	11	7
34-2-580	2	14	8
Whitney Bluff			
32-57-5c	2	11.3	7.4 (both)
		(2nd seed is broken)	

CHAPTER 8

BEANS

DOMESTICATED COMMON BEANS

The common garden bean, Phaseolus vulgaris L., is present in samples from six of the sites studied at this time (Table 8.1). Thirty-three of the analyzed samples from Craddock contain bean seeds and/or valves, making this site the largest contributor of domesticated beans by far. The other Crawford County site, Beaver Pond, has 10 samples with common bean seeds or pods. Bean valves are present in three samples from Salts Bluff and in at least one from Putnam Shelter. A single common bean was found in the analyzed samples from Edens Bluff. One valve and one seed were among the Cob Cave samples. This uneven distribution is thought to reflect the heavy utilization of Craddock and Beaver Pond during the latter part of the Mississippian period. Plant remains from several of the other sites have been dated as late Mississippian also, but none of the Beaver Lake area sites appear to have been used as intensively as Craddock during this time.

The common bean had spread as far east as Ohio and New York by A.D. 1000 (Yarnell 1976; Ford 1985), so there is no known reason why it could not be present in earlier Mississippian or even late Late Woodland Ozark deposits. No beans were dated chronometrically in this study, so the ages of these samples can only be indirectly inferred. The evidence leads to a general interpretation that the common bean was not so common in the Ozarks until after about A.D. 1250.

The 70 beans from Craddock range in length from 9.7 to 12.9 mm and in width from 6.2 to 8.7 mm. The largest sample, containing 37 measurable seeds out of a total 41, has a mean length of 11.3 mm and mean width of 7.4 mm. The remaining 25 measurable seeds from 21 samples have a mean length of 11.6 mm and mean width of 7.6 mm. All but four of the Craddock beans are dark red-brown grading into dark brown. One is yellow, one cream-colored, one white, and one tan with dark brown flecks. Shape is reniform (indented at the hilum) to subreniform (very slightly indented, see Kaplan [1956]).

Empty fruit valves are present in 14 Craddock samples. They were not measured precisely due to being folded and often twisted, but an approximate length range of 60 to 100 mm would probably cover most specimens. The largest single concentration of bean valves is in sample 34-7-345, which includes 1-2 liters of pods.

The seven beans from the Beaver Pond site are similar in size and shape to those from Craddock, with mean length of 12.0 mm and mean width of 7.6 mm. Three of the five beans with uneroded seed coats are dark red-brown. The other two are tan with brown flecks. Fruit valves from four samples range from 80 to 100 mm in length.

The single bean from Cob Cave is dark brown, and the one from Edens Bluff is dark red-brown, indicating that this is the predominant color type across the southwestern Ozarks. The common bean from Edens Bluff is the largest bean from any of the shelters studied, measuring 13.3 x 8.6 mm.

Empty P. vulgaris valves measuring between 60 and 100 mm in length were present in three samples from Salts Bluff. A tiny fragment of a dark purple/black seed coat clings to one of the valves from sample 33-15-6. Most of these valves are twisted to a greater or lesser extent, but they are longer than, paler, and not as thick as native wild bean types so are classified as P. vulgaris without serious reservations. One valve from Putnam (32-44-479), 55 mm long, is classified as P. vulgaris and a second valve fragment (32-44-498), is listed as such with question.

The dark brown and red-brown Ozark beans seem to correspond most closely to Kaplan's Southwestern types C-3 and C-10. Both of these are dark red-brown, reniform or subreniform in shape, with subapiculate or round anterior ends and round posterior ends. The main difference between the two Southwestern types is that C-3 is flatter in cross section. Type C-10 was based on only two seeds, from separate collections. The Ozark seeds are considerably smaller on the average than either of the dark red-brown, reniform Southwestern types. The C-3 type beans measured by Kaplan ranged from 1.07-1.67 cm in length (median = 1.43 cm) and from 0.68-0.92 cm in width (median = 0.80). The C-10 type specimens were 1.61 cm and 1.69 cm in length and 0.70 cm and 0.79 cm in width. Kaplan (1956:203) points out that "seed dimensions may be differentially affected by environmental conditions" and that beans from the dry West planted in the humid East produce shorter, less flat progeny than the parent seeds.

NATIVE BEANS

Two species of native "wild" beans, Phaseolus polystachios (L.) BSP and Strophostyles helvola (L.) Ell., are present in the rockshelter collections. Associations, distributions, and in some cases morphological characters indicate that these species were involved in the ongoing husbandry process to some extent.

Phaseolus polystachios

Phaseolus polystachios seeds and valves came from Marble Bluff, Edens Bluff, and Putnam Shelter. Eight of the analyzed samples from Edens Bluff include the shiny purple-black beans, with 18 seeds free from their fruits or exposed inside partially open valves. Lengths of the 16 measurable specimens range from 8.3 to 9.9 mm (mean = 9.0) and widths from 6.1 to 7.7 mm (mean = 6.9). The three valves present in Edens Bluff samples are 55, 62, and 64 mm long. Valves in two of the samples are twisted, one still enclosing four mature beans, the other holding two. The third pod is folded but not tightly twisted, and the five beans in the sample are free from the pod.

The five wild bean valves in Putnam Shelter sample 32-44-68 are loosely curled but not tightly twisted. They measure between 57 and 61 mm in length. The six P. polystachios seeds in this sample are 8.7 to 10.0 mm long (mean length = 9.2) and 6.0 to 7.0 mm wide (mean width = 6.5).

A second sample of P. polystachios from Putnam Shelter (32-44-296) is listed in Gilmore's Laboratory Notes. Gilmore described UMMA #1046a as follows in Ethnobotanical Report 71a: "A mass of black beans and their pods which appear surely to be Phaseolus polystachyus, both in characters of pods and seeds. Cultivated? It appears so." A rather poor photograph of this sample *in situ* was taken by the excavators (University of Arkansas Museum negative number 320337). The pods are clearly untwisted. No beans are currently curated under this catalog number at the University of Arkansas Museum.

The three black *P. polystachios* seeds from Marble Bluff range from 8.0 to 9.0 mm in length and from 6.1 to 7.2 mm in width.

I could find no seed size range for wild populations of *P. polystachios*. Legume length is given as 3 to 8 cm in Radford et al (1964). The seeds could fall within the natural size range and yet still have larger mean dimensions or have undergone some other change in their association with human activities. Valves from Edens Bluff and Putnam serve as evidence that the wild bean's natural technique of explosively expelling its seeds by twisting had been relaxed. At least one seed in Edens sample 32-3-1280 is still attached, several of the pods are only loosely twisted, and valves in two samples are either barely curled or not really twisted at all. *Phaseolus vulgaris* valves from Ozark shelters also exhibit a broad range of variation, some being twisted from end to end, some twisted at one end only, some curled, and some folded but not twisted at all. This means of distinguishing wild from domesticated beans could not be applied to many Ozark samples.

In the humid eastern woodlands, it may have been impossible to harvest mature dry beans and thresh them free from their pods in or beside the field. Kaplan (1956) speculates that the presence of bean valve concentrations in Mexican and Southwestern shelters resulted from unusually wet seasons when fruits could not dry outside but needed to be harvested and dried under a shelter. This could have been the general practice in prehistoric eastern North America. The fact that "wild" bean valves and seeds occur together in Ozark shelters indicates that Phaseolus polystachios grew in some domestilocalities and that relaxation of the natural seed expulsion habit had selective advantage as people took on the role of dispersal agents. It seems most likely that these native beans were utilized primarily prior to the introduction of the tropical common bean, but direct dating would be needed to establish a chronology. The native beans are large and could have provided a good deal of food if their numbers were sufficient, but it will be extremely difficult to assess the importance of this species in the diet.

Samples from Holman, Green Bluff, Gibson, and Putnam Shelters have small, tightly curled bean valves that may be P. polystachios, but might also have come from Strophostyles legumes. These are detailed in Table 8.2.

The Domino Diamond Matchbox Bean

Marble Bluff sample 34-23-377 consists of a Domino Diamond Matchbox containing a complete, untwisted, unfolded bean pod enclosing two attached seeds. A third bean has fallen loose outside the pod. The pod measures 47.0 x 10.5 mm and is light brown in color with small orange flecks. The loose bean is an unusual brownish-gray color and has faint dark, thin lines radiating from the hilum area. These lines are reminiscent of the "testa venation radiating from hilum of lima [sieva] bean" depicted in Kaplan's (1956) Figure 1-E. The loose bean measures 7.2 mm in length, 6.2 mm in width, and 3.7 mm in thickness. The two beans attached to the pod are approximately 7.5 mm and 7.8 mm long, respectively.

Gilmore described this specimen (UMMA #1802, Ethnobotanical Laboratory Report 72A) as a "Wild Bean pod (Phaseolus polystachyus variation)". It is listed in the 1934 field notes as a "Bean pod containing beans". If it is really a type of P. polystachios, the non-twisting pod with mature beans persisting and the pale seed coat color would appear to be good evidence of domestication. I have given the specimen special attention because it is very different from the other rockshelter beans.

Strophostyles helvola

Two samples labelled as "Cow Ford" site materials consisted of twisted Strophostyles helvola valves mixed with cultigen Chenopodium stems and attached infructescences. Only one of these (32-17-22) was sorted, as described in Chapter 5.. A radiocarbon date of 1620 +/- 70 B.P. was derived from chenopod stem material from this sample. Strophostyles valves larger than 2.38 mm (#8 U.S. Standard sieve) weigh approximately 40 g. They were not counted, but several hundred valves are represented. Only seven Strophostyles beans were loose in the sample debris. These varied in length from 5.6 mm to 8.4 mm, with a mean length of 7.3 mm. Seed size for S. helvola seeds is given as 6 to 12 mm in Radford et al (1964:640).

Johannessen (1984) has reported that Strophostyles is a regularly occurring seed type in Middle and Late Woodland flotation samples from the American Bottom. Rindos and Johannessen (n.d.) apparently include it among the native fruit and seed species (other than the main pre-maize starchy and oily seed crops) that "occur so regularly throughout the record that some patterning in consumption, and the likely existence of a symbiotic relationship, between humans and these plants must be presumed". The Cow Ford shelter samples of mixed Strophostyles and Chenopodium are unlikely to represent an isolated occurrence of unwelcome garden invasion by this vining wild bean. Bruce Smith (personal communication, November, 1985) observed Strophostyles growing rampant over tall, wild Chenopodium berlandieri in eastern Arkansas, suggesting a plant-to-plant relationship between this nitrogen-fixing legume and the chenopod, which requires soil that is rich in nitrogen. The Cow Ford Chenopodium is a pale-seeded cultigen, implicating humans in a prehistoric menage-a-trois.

A single S. helvola seed came from Edens Bluff sample 32-3-914 (Table 8-2), but there is a cataloguing inconsistency since the Field Notes describe this sample as "points".

Table 8.1

Common Beans

	# Beans	Length (mm)	Width (mm)	Mean LxW	Color	# Valves
Craddock						
34-7-18						many *
34-7-19						5
34-7-29	1	10.8	7.9		dark brown	
34-7-32						2
34-7-68						1
34-7-82	1	12.2	7.5		dark brown	
34-7-86	1	11.9	8.2		dark red-br.	
34-7-89	1	12.7	8.7		dark brown	
34-7-98	1	10.7	8.0		dark brown	
34-7-138	1	11.5	7.4		dark brown	
34-7-149A						*
34-7-149B						*
34-7-179	1 frag				dark brown	
34-7-186						1
34-7-237	1	12.5	7.8		dark brown	
34-7-244	1	11.1	7.7		dark brown	
34-7-248	1	11.1	7.2		flecked	
34-7-252						1 frag
34-7-255	2	11.5-12.2	7.1-7.7		dark brown	
34-7-265	2	10.5	6.8		dark brown	
34-7-274	41	9.7-12.8	6.2-8.3	11.3x7.4	dark brown	1
34-7-326	1				& dk. red-br.	
34-7-303	2	12.2	7.8		dark brown	
34-7-341						4
34-7-342						*
34-7-345						ca.100*
34-7-346	1	11.1	7.0		dk. red-brown	
34-7-352	2	10.9;11.6	7.4;7.9		dark brown	
"	1	12.2	7.7		yellow	
"	1	12.4	7.5		cream	
34-7-359	1	12.5	7.5		white	
34-7-361	1	10.8	7.0		dark brown	
"	1	10.8	7.1		dk. red-brown	
34-7-362						5
34-7-363	3	10.0-12.9	7.0-8.3	11.5x7.5	dark brown	
34-7-377	1	12.2	7.5		dark brown	1 frag

* Sample not sorted

Table 8.1, cont.

	# Beans	Length (mm)	Width (mm)	Mean LxW	Color	# Valves
Beaver Pond						
34-2-71						2
34-2-232						2
34-2-279						2
34-2-686	1	10.5	7.5		flecked	
34-2-716	1	11.0	7.5		dk. red-brown	
34-2-742	1	13.0	7.5		eroded	
34-2-768	1	12.5	8.0		flecked	
"	1	13.0	7.5		eroded	
34-2-773	1	12.0	8.0		dk. red-brown	
34-2-784	1	12.0	7.5		dk. red-brown	
34-2-872						2
Cob Cave						
31-71-43	1	11.1	7.4		dark brown	
31-71-66						1
Edens Bluff						
32-3-1362	1	13.3	8.6		dk. red-brown	
Salts Bluff						
33-15-6						6
33-15-96						9
33-15-106						5
Putnam						
32-44-479						1
32-44-498						1?

Table 8.2

Native Beans

	# Beans	Length Range (mm)	Mean Length (mm)	Width Range (mm)	Mean Width (mm)	# Valves
I. Phaseolus polystachios						
Edens Bluff (3BE6)						
32-3-914	1	8.8		7.0		
32-3-1230	4	8.8-9.1	9.0	6.6-7.6	7.0	1
32-3-1245	2	9.1-9.5	9.3	7.4-7.7	7.6	
32-3-1280	2	indet.				1
32-3-1284	1	8.8		7.0		
32-3-1287	5	8.3-9.9	9.0	6.5-7.3	6.7	1
32-3-1346	1	8.4		6.1		
32-3-1785	2	9.0-9.3	9.2	6.6-6.9	6.8	
Putnam Shelter (3WA4)						
32-44-68	6	8.7-10.0	9.2	6.0-6.7	6.5	5
32-44-246	"a mass of black beans and their pods"--Missing					
Marble Bluff (3SE1)						
34-23-243	1	8.0		6.1		
34-23-285	1	9.0		7.2		
34-23-311	1	8.0		indet.		
34-23-407						1
II. Strophostyles helvola						
Edens Bluff						
32-3-914	1	8.3		3.7		
Cow Ford (3BE7)						
32-17-22	7	5.6-8.4	7.3			hundreds

Table 8.2, continued

	# Beans	Length Range (mm)	Mean Length (mm)	Width Range (mm)	Mean Width (mm)	# Valves
III. Valves, Could be either P. polystachios or Strophostyles helvola						
Putnam						
32-44-190						9 frags
32-44-479						4 frags
Gibson						
32-21-58						1
32-21-78						2
Holman						
32-22-12						2
32-22-20						2
32-22-26						3
32-22-28						3
32-22-60						1 frag.
Green Bluff						
33-7-224						1
33-7-263						2
33-7-302						1
33-7-310						1
33-7-315						1

CHAPTER 9

MAIZE

Maize (Zea mays L. ssp. mays) was present in samples from all sites included in this analysis with the exception of Alred Shelter. Only one sample of husk fragments is present in the University of Arkansas Museum collections from Agnew, but 16 cob segmnts from that site (Harrington's Bushwhack Shelter) were observed in storage at the Museum of the American in New York. No maize from White Bluff is currently present at the University of Arkansas Museum. but Gilmore listed it in five samples from that site. The samples in question are in storage at the University of Michigan Museum of Anthropology (letter from Tristine Smart, November, 1984). Gilmore's inventory of University of Arkansas Museum plant remains includes 134 references to maize, from 20 sites.

Table 9.1 summaries the occurrences of maize in the Arkansas Museum collections from sites included in this study. Collections from Edens Bluff, Cow Ford, and Craddock were not fully analyzed, so the numbers do not reflect all specimens that exist. It is also known that the excavators did not always save all maize cobs. For example, the field notes from Putnam Shelter state that 1048 cobs were found there and that they occurred "at all depths", but only 69 cob segments currently exist among the Putnam Shelter samples. This number does not include samples with questionable proveniences—that is, those that do not match the descriptions in the field notes.

CHRONOMETRY

Cob segments or kernels from 17 samples were radiocarbon dated in an attempt to determine when maize was introduced to northwestern Arkansas, when it became abundant, and what changes through time resulted from local maize husbandry. The uncalibrated, fractionation-corrected dates are presented in chronological order in Table 9.2. The earliest date, 1468 +/- 250 B.P., is on kernels which had fallen loose from three cobs found together at Montgomery Shelter #4. The large standard deviation makes the early date uncertain, and it provisionally is viewed with skepticism. A segment without kernels from one of the three cobs in this sample has been submitted for back-up dating in order to correct for the large uncertainty. The hard kernels themselves did not respond well to pretreatment, resulting in low carbon yield for the sample (letter from Dr. Herbert Haas, Radiocarbon Laboratory, Southern Methodist University, February 26, 1986).

Two samples of small maize cobs from Edens Bluff yielded dates that would fall into the Late Woodland or initial Mississippian period using 95% confidence intervals. The 12-row cob from sample 32-3-161f (Figure 9.1), with an accelerator date of 1120 +/- 85 B.P., was 42 mm long missing only its tip, had 12 rows of open, overlapping cupules, a contracting base, and narrow shank. The cob diameter at midpoint, including rather long but flattened glumes, was 14.5 mm. Visible cupules in the midpoint area average 4.6 mm in width.

Table 9.1

Maize Distribution Among Sites

	# Samples Maize	# Samples Cobs	# Cob Segments	# Loose Kernels	# Loose Shanks	# Samples Tassels	# Samples Stalk
Edens Bluff	21 *	15	29	3	-	1	-
Cow Ford	3 **	3	6	-	-	-	-
Putnam	42	17	69	15	11	-	8
Gibson	8	6	131	-	1	-	-
Agnew	1	-	- ***	-	-	-	-
Green Bluff	14	8	13	1	-	-	-
Salts Bluff	7	4	18	-	-	-	-
Whitney	5	4	14	-	3	-	-
Montgomery 4	13	11	31	3	1	-	-
Poole 2	7	5	50	-	2	-	-
Holman	6	5	7	1	1	-	-
Craddock	60 **	29	87	49	11	1	-
Beaver Pond	29	8	52	7	13	-	-
Brown Bluff	5	5	53	-	-	-	-
Cob Cave	8	4	6	-	2	-	-
Marble Bluff	5	2	35	2	1	-	-
Buzzard Roost	1	1	11	-	-	-	-
White Bluff (these samples were reported by Gilmore, but are no longer at Arkansas)	5	4	13	-	-	-	-

* At least 16 more, in unanalyzed samples
** Many more in unalyzed samples
*** 14 cobs observed at the Museum of the American Indian, excavated by Harrington

Table 9.2

Radiocarbon Dates on Maize

Site	Sample #	Cob Dated	Sample Mean Row #	Sample Diam. Range (mm)	C-14 Age
Montgomery 4	32-34-19p	8-12 row kernels	10.0	19-23	1468+/-232 BP
Edens Bluff	32-3-161F	12-row	12	14.5	1120+/-85
"	32-3-1711	8 & 10-row	10.0	11-22	976 +/- 77
Putnam	32-44-479	12-row	12.0	18-22	877 +/- 40
Edens Bluff	32-3-1774	12-row	10.0	12-26	856 +/- 68
Gibson	32-21-76	10-row	9.9	12-29	702 +/-105
Cow Ford	32-17-2	8-row	not determined		681 +/- 62
Craddock	34-7-19	10-row	9.5	17-23	658 +/- 67
Salts Bluff	33-15-5	8-row	7.8	9-17	650 +/- 80
Cow Ford	32-17-21	12-row	11.0	21-23	581 +/- 34
Beaver Pond	34-2-647	14-row	10.6	13-25	547 +/-46
Whitney	32-57-45	8-row	9.4	15-24	536 +/- 102
Putnam	32-44-38	12-row	9.6	14-23	526 +/- 103
Craddock	34-7-93	12-row	12	23	518 +/- 60
Brown Bluff	34-10-69	10-row	10.2	18-24	322 +/- 47
Buzzard Roost	32-15-2	16-row	14.4	19-30	modern
Putnam	32-44-283	16-row	16	29	modern

The date of 976 +/- 77 B.P. from Edens Bluff sample 32-3-171l comes from two similar cobs, processed collectively. They are 8 and 10-row cobs with diameters of 13 and 17 mm, respectively (Figure 9.2). Cupules near the middle of the 8-row cobs averaged 6.0 mm in width and those of the 10-row cob averaged 6.5 mm in width. Internode length—determined by measuring the length of 10 kernel spaces along a row and dividing by 10—is 3.5 mm for the 8-row cob and 3.8 mm for the 10-row cob. The glumes of both specimens were relatively hard. No row pairing was evident.

A substantially larger 12-row cob from Putnam Shelter falls into the early Mississippian period, with a radiocarbon date of 877 +/- 40 B.P. and a 95% confidence interval of 993-1153 A.D. This cob is from sample 32-44-479, and its diameter at approximate midpoint was 22 mm. The base was basically straight, but slightly narrower than the cob midpoint (Figure 9.3). Soft chaff between the glumes obscured the cupules and made precise measurements of cupule widths and internode length impossible. Two other 12-row segments from the sample are morphologically similar, but slightly narrower.

These dated cobs from Edens Bluff and Putnam Shelter do not give as clear a picture of the earliest Ozark maize as would be desired. In the first place, the oldest specimens may not have been dated. The small 12-row cob (32-3-161f) from EdensBluff dating to 1120 +/- 85 B.P. was submitted because it was suspected of being early, but a number of even thinner cobs from the same site could be earlier still. These vary in row number from 8 to 12, in length from 30 to 72 mm, and in diameter from 8 to 16 mm. They have overlapping rows, open cupules less than 6.0 mm wide, contracting bases, and narrow shanks. They tend to be dark in color and hard and brittle. The Edens Bluff site appears to have been heavily utilized in the Middle and Late Woodland periods, but these cobs remain undated and therefore could have been deposited by later visitors to the site. A few similar specimens are present in the Putnam and Green Bluff assemblages.

These samples indicate that maize was probably present in the Ozarks by A.D. 1000 at the latest. If the very small 8-12 row specimens from Edens Bluff predate A.D. 900, it would appear that terminal Woodland period maize was considerably smaller that later varieties.

A radiocarbon assay of A.D. 1094 +/- 68 was obtained, however, on a relatively robust 12-row cob segment from Edens Bluff that was suspected of being several centuries more recent. This cob (Figure 9.3) from sample 32-3-1774 had a midpoint diameter of 26 mm, average cupule width of 8.3 mm., average glume width of 6.5 mm, and internode length of 4.3 mm. A slight tendency toward row pairing was observed. Shape is uncertain, but the base appears to be basically stright or possibly slightly expanded. The dated cob was one of seven maize specimens from a mixed "botanical sample" that was not from a described pit or other sort of feature. The 8-10 row cobs in this sample are considerably smaller than the two 12-row cobs (12-18 mm diameter as opposed to 25-26 mm diameter), and two low row numbered specimens have contracting bases and very narrow shanks (5-6 mm). The items in samples of this type can not be assumed to have been deposited at the same time, however. The 12-row cob was submitted because it was so much larger than the other dated specimens from Edens Bluff. I still suspect that some of the Edens Bluff cobs in undated samples were grown during the middle or late Mississippian Period.

Most of the maize samples post-date A.D. 1200, and the specimens falling within the 13th to 15th centuries A.D. exhibit considerable morphological variation. Row numbers range from 4 to 14, diameters usually fall between 15 and 25 mm, bases may be slightly contracting, striaght, or expanded, shanks may be narrow or wide, and row pairing may or may not be evident. While some of the cobs could be considered characteristic of the "Eastern complex" (Anderson and Cutler 1942; Yarnell 1964) or "Northern Flint" (Brown and Anderson 1947) or "Eastern eight-row" (Cutler and Blake 1973) or "Maiz de Ocho" (Galinat 1985) series that dominated the Midwest and northeastern United States after A.D. 1000, it is clear that a separate history of maize breeding took place in the Ozarks. Eastern complex (8 to 10 row maize with wide butts) was never the predominant type of corn here. Robust cobs with 10 to 14 rows of wide cupules and kernels occur in many samples, and this appears to be an evolved rather than primitive or transitional type, as I will attempt to demonstate below. No trend toward decreasing number of rows through time can be seen, and yet the tendency toward higher row numbers than is typical of samples found farther north appears in no way to result from a conservative retention of older varieties.

One unusual sample from Salts Bluff (33-15-5) consists of 18 distinctive 4 to 10 row cobs. Fifteen of the segments are 8-row cobs, while one has only four rows, one has six, and one has 10 rows (Figure 9.5). Mean row number is 7.8. Diameters vary from 9 mm to 17 mm, and lengths of complete or nearly complete specimens range from 20 to 53 mm. The largest segment (Figure 9.5, bottom left) is much more robust than the other cobs in the sample, with eight rows, a diameter of 17 mm, and cupules 8.4-8.8 mm wide. The remaining cobs have cupules averaging between 5.1 and 6.8 mm in width. Bases are contracting or straight, and shanks are narrow. A radiocarbon date of 650 +/- 80:A.D. 1300 (B-14588) was obtained using an 8-row cob (Figure 9.5, middle row, second from top) from this sample, demonstrating contemporaneity between these and the larger specimens with higher mean row numbers that are represented from other sites. A group of five similar cobs (one 5-row, three 8-row, and one 10-row) was found in association with common bean valves inside a bag at the Arch Vaughn Shelter, 3MA1 (Fritz 1982). Small cobs such as these could have grown on tiller stalks, or they might have resulted from unfavorable environmental conditions. Another possibility, however, is that they represent a distinct variety. Ethnohistoric descriptions of Caddo maize document the presence of a small, early season corn with a stalk less than one meter high, "covered from bottom to top with ears which are very small but covered with grain" (Swanton 1942:129). These samples of very small, predominantly 8-row maize from Salts Bluff and Arch Vaughn might be late prehistoric examples of early maturing "little corn".

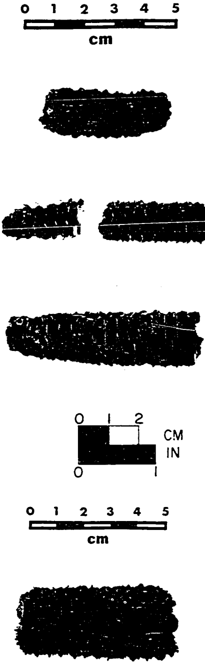


Figure 9.1 (Top) Edens Bluff maize, sample 32-3-161f.

Figure 9.2 (2nd and 3rd from top) Edens Bluff maize, 32-3-1711.

Figure 9.3 (Bottom) Edens Bluff maize, sample 32-3-1774.

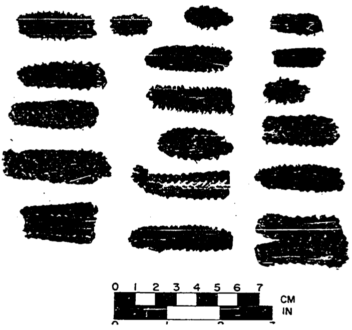


Figure 9.4 (Top) Putnam Shelter maize, sample 32-44-479.

Figure 9.5 (Bottom) Salts Bluff maize, sample 33-15-5.

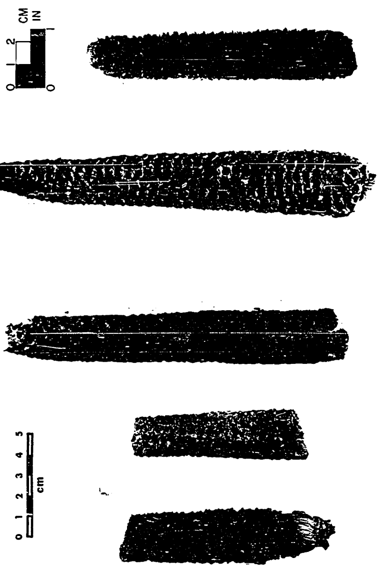


Figure 9.6 (Top) Cob from Gibson Shelter sample 32-21-76.

Figure 9.7 (2nd from top) Cob from Beaver Pond 34-2-647, (same scale as Fig. 9.6).

Figure 9.8 (3rd from top) Craddock 34-7-93, same scale as 9.9.

Figure 9.9 (Bottom two) Cow Ford maize sample 32-17-21.

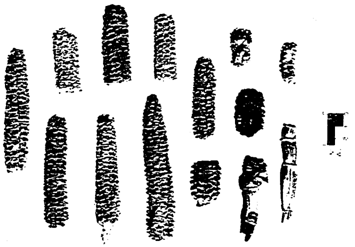


Figure 9.10 (Top) Craddock sample 34-7-19.

Figure 9.11 (Bottom) Whitney Bluff sample 32-57-45.

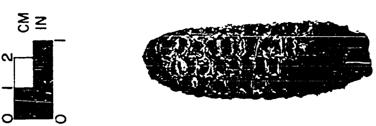
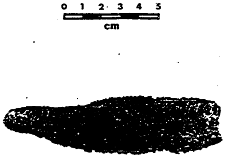


Figure 9.12 (Top) Putnam Shelter corn cache 32-44-38 in situ. University of Arkansas Museum Photograph Negative # 320324.

Figure 9.13 (Center) Putnam Shelter, cob from 32-44-38.

Figure 9.14 (Bottom) Brown Bluff, cob from 34-10-69.



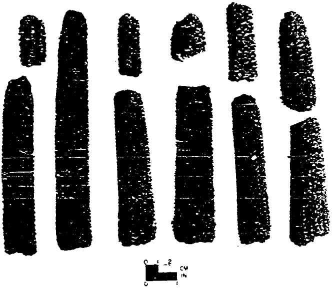


Figure 9.15 (Top) Putnam shelter 16-row maize, sample 32-44-283.

Figure 9.16 (Bottom) Buzzard Roost sample 32-15-2.

The dated cobs from Gibson sample 32-21-76, Craddock sample 34-7-19, Beaver Pond sample 34-2-647, Whitney Bluff sample 32-57-45, and Putnam Shelter sample 32-44-38 all come from relatively large lots of maize cobs that appear to have been deposited as discrete "caches". Although context is never totally clear, my best guess is that these groups represent ears of unshelled corn buried with the intention of retrieval at some future date that became infested or were for some other reason never claimed and utilized by people. This interpretation would reconstruct the kernels as having been eaten by other organisms. As individual samples and as a group of samples, together with Salts Bluff sample 33-15-5, they allow a glimpse at the corn being grown in the southwestern Ozarks between about A.D. 1200 and 1500.

The Gibson Shelter sample 32-21-76 is the largest single corn cob "cache" in the collections. The excavators counted 162 segments during recovery of the sample, and 120 segments were in curation before submission of one cob for radiocarbon dating. A sketch in the field notes depicts a basin-shaped pit 14" in diameter dug into ashes and shale with its bottom 11" below the surface and its top 5" below the surface. Many of the cobs are charred in spots, and some are carbonized overall. The radiocarbon determination of 702+/- 105 B.P. : A.D. 1248 (S.M.U. 1560) on a 10-row cob (Figure 9.6) dates the sample to the earlier half of the Mississippian period. The 95% confidence interval of A.D. 1038-1458 spans the temporal units of the Harlan/Loftin phases and Spiro/War Eagle phases.

Row numbers and measurements for this sample (32-21-76) are given in Table 9.2. Mean row number for the sample is 9.9, with 36 eight-row cobs, 54 ten-row cobs, 29 12-row cobs, and one 14-row cob. Diameters at about the midpoint across the extant glumes vary from 12 mm (a carbonized 8-row specimen) to 29 mm (an uncarbonized 12-row specimen). Mean diameter for the 25 longest segments is 21 mm. Lengths of nearly complete cobs range from approximately 75 mm to 140 mm. Four cobs are slightly wider at the base than at the midpoint, seven have basically straight bases, and five expand slightly below the midpoint but are compressed at the base itself. Cupules are wide, with midpoint cupule widths averaging between 7.5 mm and 11.2 mm. Some degree of row pairing was observed on 14 of the 25 most complete specimens. Shanks range from 12 mm to 18 mm in diameter, with mean diameter of 15.4 mm for eight attached shanks. The 12-row cobs in this sample are larger in general than those with lower row numbers, ranging from 18 to 29 mm in diameter, with a mean diameter of 22.7 mm for 10 measured cobs. Ten-row cobs range from 18 to 24 mm, with a mean of 21.6 mm for 10 measured specimens. Diameters of eight-row cobs range from 12 to 21 mm, with a mean of 16.4 mm for the five measured specimens.

Eleven maize cobs were recovered from Gibson Shelter outside of the pit described above. These are distributed across five samples, but all fall within the range of variation exhibited by sample 32-21-76. Mean row number is 10.4, with two 8-row, five 10-row, and four 12-row cobs. Lengths are between 80 and 130 mm, diameters are between 16 and 25 mm, and bases are either straight or else the cobs are widest in the area between the midpoint and the slightly tapering base.

Craddock sample 34-7-19 consisted of 20 cobs for which row number could be determined and seven additional poorly preserved segments. Figure 9.10 is a photograph of the entire sample, which includes bean valves and a husk fragment. A mean row number of 9.5 is derived from eight 8-row, one 9-row, eight 10-row, and three 12-row cobs. The 13 measured specimens had midpoint diameters (again, including extant glumes) between 17 and 23 (mean = 19.2 mm). The larger nearly complete cobs are only 65 mm to 81 mm long and, in addition to those, there are two nubbin-like 8-row cobs less than 40 mm in length with veary narrow shanks. Bases are straight or contracting. Visible cupules in cob midpoint regions range between 6.6 mm and 9.6 mm after averaging cupules of different widths on individual segments. Internode lengths range from 3.5 to 4.5 mm. Row pairing was observed on three cobs. The radiocarbon date of 658 +/- 67 B.P. on a 10 row cob from this sample results in an uncalibrated 95% confidence interval of A.D. 1158-1426, making probable a Spiro Phase affiliation.

The dated cob from sample 34-2-647 from the nearby Beaver Pond site indicates a slightly later or possibly contemporaneous (ca. A.D. 1300-1500 95% confidence interval) maize assemblage. The sample of 22 segments includes five 8-row, eight 10-row, six 12-row, and three 14-row cobs. Mean row number is 10.6. The 1934 field notes describe the sample as a corn cob cache "between rock slabs and at the end of two others which formed sort of a pit." The excavators regarded the cobs as "trash", specificallly as the "remains of some meal by these inhabitants."

Lengths of nearly complete cobs in Beaver Pond sample 34-2-647 range from 79 to 175 mm (mean = 117 mm for 10 cobs). Diameters vary from 13-25 mm. The 8-row cobs are slightly narrower, with a mean of 17.0 mm compared to 19.0 mm for 10-row cobs, 18.3 mm for 12-row cobs, and 22.0 mm for the 14-row cobs. Internode lengths range from approximately 3.1 to 5.1 mm, and cupule widths from 5.5 mm for a narrow 8-row cob to 9.4 mm for a relatively robust 10-row segment. Eight cobs exhibit basal expansion, while three have basically straight bases and three are compressed at the base. Figure 9.7 illustrates the 14-row cob used for radiocarbon dating. Prior to sectioning, this robust cob was 158 mm long. Its midpoint diameter is 23 mm, and shank diameter is 12 mm. Although 14-row cobs are not abundant in the Ozark samples, the specimens represented tend to be large and in no way reminiscent of any hypothetical, early high row numbered "race" of popcorn that may have been present in the southeast.

Two cobs were submitted from samples included among the Cow Ford site material, and both assays fall within the middle centuries of the Mississippian period. Sample 32-17-2, which was not fully analyzed, consisted of 11 maize cob segments. The dated specimen was an 8-row basal segment with a 20 mm midpoint diameter, an expanded base, and 17 mm wide shank. Row pairing was not evident, but this specimen conforms in general to descriptions of Eastern 8-row maize. Cupules at the broken end, somewhat distal of the midpoint, were 8.1-8.5 mm wide. The radiocarbon date for this specimen is A.D. 1270 +/- 62. Cow Ford sample 32-17-21 consisted of one 10-row and one 12-row segment, the latter of which was sectioned and dated to A.D. 1369 +/- 41. Midpoint diameter was 23 mm; the base is slightly wider at 25 mm; the shank is 19 mm in diameter. Cupules at the distal break are 7.0-8.2 mm wide (Figure 9.9).

The 95% confidence interval for the uncalibrated radiocarbon date on an 8-row cob from Whitney Bluff, lot 32-57-45, is A.D. 1210-1618, encompassing the time periods of both the Spiro/War Eagle phases and

Ft. Coffee/Neosho phases. The specimen came from a sample including 11 cobs, one rachis fragment, and two shanks (Figure 9.11), associated with a bed of grass described as being found near large slabs of rock and being covered with slabs. The sample includes one cob with seven rows, two with eight rows, and eight with 10 rows. Mean row number is 9.4; mean diameter is 19.3 mm. The seven-row cob is only 66 mm long, and the longest cob, a 10-row specimen, is 120 mm long but missing its base. Shanks are 8-16 mm in diameter. Average midpoint cupule widths range from 6.3 to 11.5 mm; internode lengths vary from 3.4 to 5.1 mm. Row pairing is distinct on five of the cobs.

Sample 32-44-38 from Putnam Shelter yielded a radiocarbon date with virtually the same 95% confidence interval as Whitney Bluff sample #32-57-45: ca. A.D. 1200-1600. The Putnam Shelter sample was a distinct "cache of corn, squash, and corn stalk" photographed in the field (Figure 9.12). Mean row number for the 44 cob segments is 9.6, with 19 eight-row, 15 ten-row, and 10 twelve-row cobs. Twenty-two of these, the most complete and least distorted, were measured. As with previously described samples, the eight-row cobs tend to be the smallest. This sample includes at least 10 eight-row cobs that are thin (mean diameter = 15.9 mm) and have contracting bases and narrow shanks (5-12 mm diameter). They range in length between 38 mm and 76 mm, the shorter ones appearing stubby and nubbin-like, and the longer ones resembling slightly larger versions of the specimens from Salts Bluff sample 33-15-5. Row pairing characterizes five of the ten 8-row cobs that were measured.

Ten-row cobs from Putnam 32-44-38 are 90 mm to 130 mm long, with a mean diameter of 20.5 mm (range = 17-23 mm) for the six measured specimens. Two have straight bases, one is slightly wider at the base than midpoint, and two have contracting bases. The six measured twelve-row cobs are 19-23 mm in diameter (mean = 21.2 mm), but the only two nearly complete specimens are short: 70 and 73 mm long. Two have straight bases and two have contracting bases. Weak row pairing was observed on one 12-row and on two 10-row cobs. The specimen submitted for dating is a rather short but wide 12-row cob with a contracting base (Figure 9.13). Two of the cobs in this sample still bear kernels. The longest 10-row cob (length = 130 mm, diameter = 23 mm) has a brown kernel still attached near the base. It is 9.1 mm wide and 6.1 mm thick. Kernel height (sometimes called kernel depth) could not be measured without removing the kernel from its cupule. A 12-row cob with a midpoint diameter of 20 mm, contracting base and 9 mm wide shank bears two small, brown kernels near the distal break. They are 4.5 mm and 4.3 mm wide.

A large, straight 12-row cob (Figure 9.8) from Craddock is another example of 14th-15th century maize in the southwestern Ozarks. With an uncalibrated radiocarbon date of A.D. 1432 +/- 60, this specimen represents the successful agricultural practices that seem to have existed during the full Mississippian Period. No other cobs were present in the sample.

The radiocarbon date of 320 +/- 50 B.P. on a 10-row segment (Figure 9.14) from a sample (#34-10-69) of 34 cobs found at Brown Bluff appears to date a very late Mississippian or Contact period Ozark maize assemblage, with a 95% (uncalibrated) confidence interval of A.D. 1534-1722. The sample includes nine 8-row cobs, thirteen 10-row cobs, eleven 12-row cobs, and one 14-row cob, for a mean row number of 10.2.

Fourteen of the least fragmented specimens were measured. Most showed evidence of charring, but none was completely burned. The eight-row cobs were slightly smaller in diameter (18.8 mm average) than 10-row (19.8 mm) or 12-row (22.3 mm) segments, but this sample is different from previously described samples by lacking the very narrow cob type represented by many 8-row Ozark specimens. These Brown Bluff segments are uniformly more robust. The shortest of four nearly complete cobs has 12 rows and is 99 mm long. The longest has 10 rows and is 166 mm in length. Two bases are slightly compressed, two are straight, and five are somewhat expanded. In addition, two cobs have the familiar shape that is widest between the midpoint and base. Row pairing was evident on only six of the 14 measured segments.

Chronometric determinations on high row-number maize from Buzzard Roost and Putnam Shelter established that the Southern Dent-like cobs (Brown and Anderson 1948) in these samples (Figures 9.15 and 9.16) are modern in age and were probably deposited in the shelters by white Ozark farmers. Six of the 11 cobs in Buzzard Roost sample 32-15-2 are very long, straight, wide, and hard as compared to the aboriginal maize of the region. They have between 14 and 20 rows, with diameters between 25 and 30 mm. The longest has 18 rows and is 190 mm in length. Five segments in the sample, however, are within the range of native types. Two of these have 10 rows and three have 12 rows. Since only one segment of a 16-row cob was dated, it remains uncertain whether or not the cobs with lower row numbers were being grown along with Southern Dent in the 19th or early 20th century.

The 16-row cob from Putnam sample 32-44-283 also turned out to be modern. This specimen (Figure 9.15) differs from the Buzzard Roost cobs by having a distinctly conical distal end and a slightly contracting base. Maximum diameter is 29 mm. Length is 113 mm. Like the Buzzard Roost specimens with high row numbers, the 16-row Putnam cob is very hard, with thick cupules and glumes.

DISCUSSION

This study obviously does not approach a rigorous quantitative analysis and leaves a great deal of work to future researchers. I have tried to establish something of a baseline for further analysis by dating a range of cobs that were morphologically representative and came from relatively secure proveniences, when possible in groups or "caches" showing variation that might have characterized a given population. A special effort will have to be made to determine whether or not cobs were deposited in Ozark rockshelters before A.D. 800-900. Indications so far are that it was present but rare prior to A.D. 1000, and that early maize might have been considerably less productive due to small cob size.

Previous overviews of maize agriculture in the eastern United States describe two main typological groupings, sometimes referred to as "races" of maize. The earliest maize was supposed to resemble the Mexican and Southwestern "race" called Chapalote in being cigar-shaped (tapering at both ends) and having 12-16 rows of narrow, deep, flinty kernels (Galinat 1970; Cutler and Blake 1973). Yarnell's description is a variation on this scheme by referring to a Basketmaker complex rather than Chapalote race, but the Basketmaker-like maize in the east is described as small, cigar-shaped, and high in row number, as is the Chapalote maize of other authors (Yarnell 1964).

A supposedly different type of corn is found in Midwestern and Northeastern archaeological components after A.D. 1000. This is, of course, the Eastern eight-row or Maiz de Ocho "race", Yarnell's Eastern complex, which is represented historically by the Northern Flint varieties grown from NewEngland to the Plains (Brown and Anderson 1947). Galinat (1985:266) views Maiz de Ocho as having

> originated from a reconstitution of eight-rowed germplasm derived from an earlier hybridization of Chapalote and Harinoso de Ocho producing the so-called Pima-Papago race in the Southwest. Its modified eight-row derivative diffused out of the Southwest along multiple pathways.

Both Yarnell (1964) and Cutler and Blake (1973) noted that corn from Cahokia and other sites south of the Ohio-Mississippi River confluence had higher row numbers than typical Eastern complex assemblages. This was interpreted as possibly reflecting a sort of conservatism--a retention of earlier, high row number varieties while farmers to the north and east were producing more and more of the eight-row type that became Northern Flint.

Eastern complex maize collections have mostly 8-row cobs with lesser numbers of 10 and 12-row specimens. Shanks are wide, and bases are frequently expanded. Cupules and kernels are both relatively wide (Wagner 1986). Galinat (1970) reports that Maiz de Ocho can easily be distinguished from Chapalote because the former has kernels that are wider than they are high and cupules that are wider than the internode length. A carbonized kernel of Eastern 8-row maize is typically crescent shaped since the embryo has disappeared.

Ozark maize does not fit into a scenario of an earlier, high row-number population followed by the Eastern 8-row complex. There is no good evidence for a Chapalote-like variety with consistently high row numbers. The data base is restricted to a few specimens, but cobs that yielded the earliest radiocarbon dates had 8, 10, and 12 rows. There may have been a different early type, but higher row number is not one of its distinguishing characters. Furthermore, later Ozark maize differs from classic Eastern complex collections in several respects. Samples with mean row numbers of less that 10 usually have a high proportion of 8-row cobs that are small (less than 17 mm in diameter) and have contracting bases and narrow shanks. Classic eight-row cobs with wide butts are rare, but 10 and 12 row cobs are frequently robust and have wide bases and wide cupules. The cupules of 12 and even 14-row cobs in these collections are much wider than the internode length.

A separate evolutionary history for maize agriculture in the Trans-Mississippi South should not be surprising given the environmental differences between this region and the northeast, and also considering its closer proximity to the Southwest. Maize being carried eastward between A.D. 500 and 1000 could have anywhere between 8 and 16 rows, might or might not contain germplasm from a purported Harinoso de Ocho ancestor, and would in general have the potential diversity of the rich Basketmaker/early Pueblo genetic base (see Winter 1973 and 1974; Cutler and Meyer 1965). Some of the selection pressures at the western end of the southeast would be similar to those farther north and east, while others would be different.

The end result in the Ozarks appears to be a maize population with a high frequency of 10 and 12-row cobs along with a few 14-row cobs. Eight-row cobs are common, but many are representatives of unfavorable growing conditions, tillers, or possibly at times, of an early-season "little corn" variety. Collections from Cahokia and Lower Mississippi

Valley sites that diverge from the classic Eastern eight-row pattern might also reflect a separate trajectory where the uniform Eastern complex simply never developed. An assemblage with higher mean row number does not necessarily reflect conservatism or indicate the presence of a transitional stage between Chapalote-like and Eastern eight-row "races".

CHAPTER 10

IMPLICATIONS AND CONCLUSIONS

The rockshelter plant collections are important sources of information for reconstructing agricultural history in the southwestern Ozarks and for extending the understanding of prehistoric food production in eastern North America. The sequence of new radiocarbon dates demonstrates that these dry shelters were used for crop storage for at least 2500 years. The range of species represented changed through time, and individual species changed morphologically.

During the Late Archaic and throughout the Woodland period, the husbanded crops from Ozark rockshelter deposits are basically the same types as those found in contemporaneous sites elsewhere in the Eastern Woodlands. Genera include *Cucurbita*, *Lagenaria*, *Helianthus*, *Iva*, *Chenopodium*, *Polygonum*, *Phalaris*, and *Ambrosia*.

The two samples with radiocarbon dates of approximately 3000 B.P. from Marble Bluff show that domestication of *Chenopodium* was well underway by that time. A recent accelerator date on thin-testa *Chenopodium* from Newt Kash rockshelter in Kentucky is 3400 +/- 150 B.P., and two dates on thin-testa chenopod from Cloudsplitter rockshelter are 3450 +/- 150 B.P. and 2440 +/- 80 B.P. (Smith and Cowan 1986), so the crop was evidently being produced across a wide area. The two Marble Bluff samples differ with respect to seed coat thickness and surface texture, showing that fruits grown at about the same place and time—possibly during the same season—could differ from each other considerably.

The two dates of ca. 2000 B.P. on stored, thin-testa chenopod from Edens Bluff and White Bluff document continued production of this crop in the Ozarks, just as samples from Salts Cave, Kentucky, Russell Cave, Alabama, Ash Cave, Ohio, and various open sites in Illinois show that it was an important Early-Middle Woodland food across a widespread geographical range. Its presence in the White River Valley of northwest Arkansas, where Hopewellian-related manifestations have not been recognized, may mean that gardening could have become just as important for subsistence without the heightened ceremonialism, exchange, and organizational complexity associated with the Hopewellian phenomenon.

Pale-seeded Chenopodium was being grown in the Ozarks by approximately A.D. 500, possibly a few centuries earlier. The specimens themselves have not been recognized as clearly different from Mesoamerican C. berlandieri ssp. nuttalliae, and it is possible that a prehistoric huauzontli was imported from Mexico. Given the now well-documented sequence of chenopod husbandry in eastern North America between 1500 B.C. and A.D. 500, however, diffusion from the south seems less likely than local evolution. Chenopod had been an important food across a wide region for thousands of years. Further genetic modification locally would not seem to be a drastic acheivement, especially since evidence now supports the independent evolution of pale-seeded chenopods in South America and in Mexico (Heiser and Nelson 1974: Wilson and Heiser 1979).

Other genera in the 3000 year old cache of mixed seeds from Marble Bluff are Cucurbita, Helianthus, and Polygonum. Cucurbita had already been in eastern North America for millennia. Its presence at Phillips Spring in the western Missouri Ozarks by 4200 B.P. (Kay et al 1980) increases the likelihood that it was present in the Arkansas Ozarks considerably earlier than 3000 B.P. as well. The sunflower achenes are larger than others of the first millennium B.C. that have been found archaeologically. There are few archaeobotanical collections from the Lower Mississippi Valley, and it is possible that sunflower domestication had resulted in larger seeds there than farther north. The Ozark specimens are from storage context rather than midden or hearth debris and may have been selected for storage because of their size. The Marble Bluff knotweed achenes are within the size range of the dimorphic species Polygonum erectum. In light of the sequence of Woodland period Polygonum husbandry and the Mississippian-aged cultigen knotweed from the Hill Creek site in Illinois and from Whitney Bluff in northwest Arkansas, the Marble Bluff Polygonum appears to reflect early mutualism that eventually resulted in full domestication of another native crop.

Maygrass seed heads were being stored in Ozark rockshelters by 2000 B.P., and the deposition of maygrass panicle clusters continued into the Late Woodland or early Mississippian Period. Only three maygrass samples were dated, so the lack of dates after A.D. 1000 can not be interpreted as firm evidence for its decline in importance thereafter. It does fit into a general pattern, however of heavier concentration upon the native starchy seed crops at a relatively earlier date in the Ozarks.

The dated sumpweed samples indicate that Iva achene size may have increased in the Ozarks by the Middle/Late Woodland to an extent not reached farther north until later If so, as yet unrecovered pre-Mississippian specimens from elsewhere in the midsouth might also turn out to be surprisingly large. However, the difference in size between rockshelter achenes and those from open sites is thought to be partly a function of the formula used to correct for shrinkage during carbonization. The special rockshelter storage context might also be a factor. Some Mississippian Ozark farmers seem to have placed less emphasis upon achene size of cultigen sumpweed than did their Woodland counterparts, and cultigen Iva annua may have been on the road to extinction in this area throughout the last centuries of prehistory. Sunflower, on the other hand, continued to bear large achenes. Mississippian sunflower achenes are white or light gray or gray-and-white striped. Smaller, reddish achenes are suspected of being Woodland in age.

The two native "wild" bean taxa, Phaseolus polystachios and Strophostyles helvola, are occasional members of rockshelter samples. The natural mechanism for dehiscence of Phaseolus polystachios seeds was evidently selected against in the Ozark domestilocalities or gardens, and an obligate dispersal relationship of sorts seems to have developed. A middle first millenium A.D. date for a sample of Strophostyles mixed with pale-seeded chenopod leads me to suspect that the symbiosis flourished primarily in pre-Mississippian times, but samples with the native beans are infrequent and only that one has been dated.

Using a coevolutionary perspective, Rindos (1984) has shown that intentionality is not necessary in order for fitness to be increased and mutualism established using a coevolutionary perspetive. By 2000 B.P., however, if not earlier, the Ozark gardeners—probably women as Caldwell noted—may have had strong preferences for certain types of crops. Exchange of seeds between individuals and groups and transport of favored varieties by brides or families in transit could have created a shifting network of crop types resulting in panregional similarities as well as local divergences.

The initial date for introduction of maize remains obscure. It was almost certainly present in small amounts before A.D. 1000, but may not have become an important crop in the Ozarks until about A.D. 1200. Current chronometric precision is inadequate for documenting varietal change in Ozark maize between A.D. 1100 and 1700. The larger individual samples usually contain 8, 10, and 12-row cobs. While traits of the Eastern eight-row maize complex are present, the assemblages consistently differ from classic Maiz de Ocho collections by having more 12-row segments and fewer large eight-row cobs. I have interpreted this variation as a reflection of local ecological and historical factors—the early gene pool may have been somewhat different from that of maize diffusing northward in the first place, and, in the second place, differences between climate and soil are obvious. There were probably contacts between Mississippian (Arkansas Valley Caddoan-related) groups in northwest Arkansas and those of the Plains. Caddoan societies in Oklahoma and Texas maintained trading networks with the Southwest, and populations in northwest Arkansas were closely connected with their Caddoan contemporaries in eastern Oklahoma. Drought-resistant Southwestern corn might have been more productive than Maiz de Ocho in the southwestern Ozarks, but it is not necessary to invoke wholesale diffusion of maize from any outside source after A.D. 1200 to account for the complex that evolved.

Some new types of plants were coming in from the outside, however. *Cucurbita mixta* was probably acquired during the Mississippian Period. Cultigen amaranth may have been imported from the Southwest before the beginning of the Mississippian Period. Its presence north of Mexico is poorly understood as yet. The Ozark material leaves open the possibility of temperate North American amaranth domestication, but clearly demonstrates that its evolutionary history was separate from that of *Chenopodium* in the Eastern Woodlands. The presence of *Cucurbita mixta*, cultigen amaranth, and non-Eastern Complex maize distinguishes Ozark agriculture from that of areas farther east during late prehistory. The Lower Mississippi Valley, however, may be found to resemble the Ozarks as archaeobotanical evidence accumulates, at least with regard to maize. I hold to the belief or bias that late prehistoric Ozark agriculture will be demonstrated to share essential characteristics with Arkansas Valley Caddoan and probably also Red River Valley Caddoan agriculture.

At about A.D. 1100-1200, there seems to have been a shift in emphasis away from *Chenopodium*, maygrass, and possibly also sumpweed. All chenopod concentrations were dated to before A.D. 1200. The chenopod samples from Whitney Bluff (A.D. 1165 +/- 75) and Craddock (a seemingly uniformly Mississippian site) are mixtures of pale and dark seeds. Maygrass was relatively scarce at Craddock, and the two late-dating samples of sumpweed have small fruits. As maize became what would seem to have been the most productive crop, husbandry of the previous staples appears to have become more casual. Introgression from the by then probably highly evolved weedy companions may have been permitted to the point that something akin to a gradual reversal of the domestication process went into effect. If so, some of the polymorphism that exists today in Chenopodium and also in Polygonum may be a legacy of the prehistoric agriculture, as Wilson (1981) suggests for chenopod. European descriptions of the sowing of widglowill, choupichoul and melden would then bear little resemblance to the native starchy/oily seed gardening of the first millennium A.D.

The ca. A.D. 1200 benchmark for entrenchment of maize as an important food in the Ozarks corresponds to the chronology inferred on the basis of bioanthropological studies and stable carbon isotope analysis in the Mississippi Alluvial Valley in eastern Arkansas. Individuals buried during the emergent Mississippian Big Lake phase (A.D.900-1050) at the Zebree site in northeast Arkansas "exhibit no evidence of substantial maize ingestion" (Lynott et al 1986:62), while a sample dating to A.D. 1200 "shows isotopic evidence for substantial maize in the diet." A change in types of paleopathologies after A.D. 1200 has similarly been interpreted by Rose and Marks (1985) as evidence for little use of maize in eastern Arkansas until after that date.

Quantities of the native seed crops have not been recovered from Lower Mississippi Valley sites, probably because intensive flotation recovery and analysis have not been conducted there. The new Ozark dates document a flourishing small grain husbandry during the Woodland period, so eastern Arkansas was surrounded on the west, north, and east by pre-Mississippian gardeners. It would be surprising to find the native crops unrepresented at Baytown components.

The collections of desiccated rockshelter plant remains at the University of Arkansas proved to be too extensive for complete analysis during this project. A wealth of material exists and should be used by ethnobotanists in the pursuit of answers to unsolved problems and also to correct inevitable current misinterpretations. Frustrations caused by dealing with material excavated under less that optimal conditions are outweighed by the potential information that plants preserved by desiccation can yield. I wholeheartedly echo the sentiments of Melvin R. Gilmore, expressed in his 1936 letter to Edgar Anderson, that this is "about the most interesting piece of work which I have ever found."

REFERENCES CITED

Adair, Mary J.
1984 Prehistoric Cultivation in the Central Plains: Its Development and Importance. Ph.D. dissertation, University of Kansas.

Anderson, Dennis E.
1961 Taxonomy and Distribution of the Genus Phalaris. Iowa State Journal of Science 36(1):1-96.

Anderson, Edgar
1952 Plants, Man and Life. University of California Press, Berkeley.

Anderson, Edgar, and H. C. Cutler
1942 Races of Zea Mays I: Their Recognition and Classification. Annals of the Missouri Botanical Garden 29:69-89.

Asch, David L., and Nancy B. Asch
1977 Chenopod as Cultigen: A Re-evaluation of Some Prehistoric Collections from Eastern North America. Midcontinental Journal of Archaeology 2:3-45.

1978 The Economic Potential of Iva annua and its Prehistoric Importance in the Lower Illinois Valley. In The Nature and Status of Ethnobotany, edited by Richard I. Ford, pp. 300-341. Anthropological Papers No. 67, Museum of Anthropology, University of Michigan, Ann Arbor.

1980 Early Agriculture in Westcentral Illinois: Context, Development and Consequences. Paper presented at School of Americal Research, Advanced Seminar on "The Origins of Plant Husbandry in North America", March 2-8, 1980. Archeobotanical Laboratory, Center for American Archeology, Kampsville, Illinois, Report 35.

1982 A Chronology for the Development of Prehistoric Horticulture in Westcentral Illinois. Paper presented at the 47th Annual Meeting of the Society for American Archaeology, Minneapolis. Center for American Archeology, Archeobotanical Laboratory Report No. 46.

1985a Archeobotany. In Smiling Dan, Sturcture and Function at a Middle Woodland Settlement in the Lower Illinois Valley, edited by Barbara D. Stafford and Mark B. Sant, pp. 327-401. Published for the Illinois Department of Transportation by the Center for American Archeology, Kampsville Archeological Center, Kampsville, Illinois.

1985b Prehistoric Plant Cultivation in West-Central Illinois. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 149-203. Anthropological Papers No. 65, Museum of Anthropology, University of Michigan, Ann Arbor.

Asch, Nancy B., and David L. Asch
1985a Archeobotany. In Deer Track: A Late Woodland Village in the Mississippi Valley, edited by C. R. McGimsey and Michael D. Conner, pp. 44-117. Center for American Archeology, Kampsville Archeological Center, Technical Report 1.

1985b Archeobotany. In The Hill Creek Homestead and the Late Mississippian Settlement in the Lower Illinois Valley, edited by Michael D. Conner, pp. 115-170. Center for American Archeology, Kampsville Archeological Center, Research Series Vol. 1.

Asch, Nancy B., Richard I. Ford, and David L. Asch
1972 Paleoethnobotany of the Koster Site: The Archaic Horizons. Illinois State Museum, Reports of Investigations, 24.

Bell, Robert E.
1984 Arkansas Valley Caddoan: The Harlan Phase. In Prehistory of Oklahoma, edited by Robert E. Bell, pp. 221-240. Academic Press, New York.

Black, Meredith Jean
1963 The Distribution and Archeological Significance of the Marsh Elder, *Iva annua* L. Papers of the Michigan Academy of Science, Arts, and Letters 48:541-547.

Blake, Leonard W.
1981 Early Acceptance of Watermelon by Indians of the United States. Journal of Ethnobiology 1(2):193-199.

Blake, S. F.
1939 A New Variety of *Iva ciliata* from Indian Rock Shelters in the South Central United States. Rhodora 41:81-86.

Brown, James A.
1984a Arkansas Valley Caddoan: The Spiro Phase. In Prehistory of Oklahoma, edited by Robert E. Bell, pp. 241-271. Academic Press, New York.

1984b Prehistoric Southern Ozark Marginality: A Myth Exposed. Missouri Archaeological Society Special Publications No. 6.

Brown, William L., and Edgar Anderson

1947 The Northern Flint Corns. Annals of the Missouri Botanical Gardens 34(1):1-28.

1948 The Southern Dent Corns. Annals of the Missouri Botanical Gardens 35:255-275.

Caddell, Gloria

1982 Plant Resources, Archaeological Plant Remains, and Prehistoric Plant-use Patterns in the Central Tombigbee River Valley. Bulletin of the Alabama Museum of Natural History No. 7.

Caldwell, Joseph R.

1958 Trend and Tradition in the Prehistory of the Eastern United States. Memoirs of the American Anthropological Association, 88.

1962 Eastern North America. In Courses Toward Urban Life, edited by Robert J. Braidwood and Gordon R. Willey. Aldine Publishing Co., Chicago.

Carter, George F.

1945 Plant Geography and Culture History in the American Southwest. Viking Fund Publications in Anthropology 5.

Chapman, Jefferson, and Andrea Brewer Shea

1981 The Archaeobotanical Record: Early Archaic Period to Contact in the Lower Little Tennessee River Valley. Tennessee Anthropologist 6:64-84.

Chomko, Stephen, and Gary W. Crawford

1978 Plant Husbandry in Prehistoric Eastern North America: New Evidence for its Development. American Antiquity 43(3):405-408.

Christenson, Andrew L.

1980 Change in the Human Food Niche in Response to Population Growth. In Modeling Change in Prehistoric Subsistence Economies, edited by Timothy K. Earle and Andrew L. Christenson, pp. 1-29. Academic Press, New York.

Cleland, Charles E.

1960 Analysis of the Animal Remains in the Prehistoric Ozark Bluff Dwellings of Northwest Arkansas. M.A. thesis, University of Arkansas, Fayetteville.

1965 Faunal Remains from Bluff Shelters in Northwest Arkansas. The Arkansas Archeologist 6:39-63.

Conard, Nicholas, David L. Asch, Nancy B. Asch, David Elmore, Harry E. Gove, Meyer Rubin, James A. Brown, Michael D. Wiant, Kenneth B. Farnsworth, and Thomas G. Cook
1984 Accelerator Radiocarbon Dating of Evidence for Prehistoric Horticulture in Illinois. Nature 308:443-446.

Cowan, C. Wesley
1978 The Prehistoric Use and Distribution of Maygrass in Eastern North America: Cultural and Phytogeographical Implications. In The Nature and Status of Ethnobotany, edited by Richard I. Ford, pp. 263-288. Anthropological Papers No. 67, Museum of Anthropology, University of Michigan, Ann Arbor.

1979 Excavations at the Haystack Rock Shelters, Powell County, Kentucky. Midcontinental Journal of Archaeology 4(2):1-33.

1985 Understanding the Evolution of Plant Husbandry in Eastern North America: Lessons from Botany, Ethnography and Archaeology. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 205-243. Anthropological Papers No. 75, Museum of Anthropology, University of Michigan, Ann Arbor.

Cowan, C. Wesley, H. Edwin Jackson, Catherine Moore, Andrew Nicklehoff, and Tristine L. Smart.
1981 The Cloudsplitter Rockshelter, Menifee County, Kentucky: A Preliminary Report. Southeastern Archaeological Conference Bulletin 24:60-76.

Crane, H. R., and James B. Griffin
1968 University of Michigan Radiocarbon Dates XII. Radiocarbon 10:61-114.

Crawford, Gary W.
1982 Late Archaic Plant Remains from West-Central Kentucky: A Summary. Midcontinental Journal of Archaeology 7:205-224.

Crites, Gary D.
1978 Paleoethnobotany of the Normandy Reservoir in the Upper Duck River Valley, Tennessee. M.A. thesis, Department of Anthropology, University of Tennessee.

Cutler, Hugh C., and Leonard W. Blake

1971 Travels of Corn and Squash. In Man Across the Sea, edited by C. L. Riley, J. C. Kelly, C. W. Pennington, and R. L. Rands, pp. 356-375. University of Texas Press, Austin.

1973 Plants from Archaeological Sites East of the Rockies. Missouri Botanical Gardens, St. Louis.

Cutler, Hugh C., and Winson Meyer

1965 Corn and Cucurbits from Wetherill Mesa. Contributions of the Wetherill Mesa Archeological Project, assembled by Douglas Osborne. Memoirs of the Society for American Archaeology 19:136-152.

Cutler, Hugh C., and Thomas W. Whitaker

1956 Cucurbita mixta Pang., Its Classification and Relationship. Bulletin of the Torrey Botanical Club 83(4):253-260.

1961 History and Distribution of the Cultivated Cucurbits in the Americas. American Antiquity 26:469-485.

Davis, Hester A.

1969 A Brief History of Archeological Work in Arkansas Up to 1967. The Arkansas Archeologist 10:2-4.

Dellinger, Samuel C.

1936 Baby Cradles of the Ozark Bluff Dwellers. American Antiquity 1:197-214.

n.d. Data on Cob Cave by S. C. Dellinger. Ms. on file, Registrar's Office, University Museum, University of Arkansas, Fayetteville.

Dellinger, Samuel C., and Samuel D. Dickinson

1942 Pottery from the Ozark Bluff Shelters. American Antiquity 7:276-289.

Fernald, Merritt Lyndon

1950 Gray's Manual of Botany.. 8th edition. American Book Co., New York.

Ford, Richard I.

1977 Evolutionary Ecology and the Evolution of Human Ecosystems: A Case Study from the Midwestern U.S.A. In Explanations of Prehistoric Change, edited by J. N. Hill, pp. 153-184. University of New Mexico Press, Albuquerque.

1979 Gathering and Gardening: Trends and Consequences of Hopewell Subsistence Strategies. In Hopewell Archaeology, the Chillicothe Conference, edited by David Brose and N'omi Greber, pp. 234-238. Kent State Press.

1981 Gardening and Farming Before A.D. 1000: Patterns of Prehistoric Cultivation North of Mexico. Journal of Ethnobiology 1(1):6-27.

1985 Patterns of Prehistoric Food Production in North America. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 341-364. Anthropological Papers No. 75, Museum of Anthropology, University of Michigan, Ann Arbor.

Foti, Thomas L.

1974 Natural Divisions of Arkansas. In Arkansas Natural Area Plan, prepared by the Arkansas Department of Planning, pp. 11-34. Arkansas Department of Planning, Little Rock.

Fowler, Melvin L.

1971 The Origin of Plant Cultivation in the Central Mississippi Valley: A Hypothesis. In Prehistoric Agriculture, edited by Stuart Struever, pp. 122-128. Natural History Press, New York.

Freeman, Joan E.

1962 The Neosho Focus: A Late Prehistoric Culture in Northeastern Oklahoma. Ph.D. dissertation, University of Wisconsin.

Fritz, Gayle J.

1982 Analysis of Archaeological Plant Remains from Thirteen Madison County, Arkansas, Bluff Shelter Sites. Paper submitted to the Graduate School, University of North Carolina at Chapel Hill.

1983 A New Look at Desiccated Plant Remains from the Ozarks. Paper presented to the 48th Annual Meeting of the Society for American Archaeology, Pittsburgh.

1984a Harlan Phase Subsistence at the Spiro Site. Paper presented to the 26th Annual Caddo Conference, Nacogdoches, Texas.

1984b Identification of Cultigen Amaranth and Chenopod from Rockshelter Sites in Northwest Arkansas. American Antiquity 49(3):558-572.

1986 Desiccated Botanical Remains from Three Bluffshelter Sites in the Pine Mountain Project Area, Crawford County, Arkansas. In Contributions to Ozark Prehistory, edited by George Sabo III, pp. 86-97. Arkansas ARcheological Survey Research Series No. 27.

Fritz, Gayle J., and Richard A. Yarnell
1985 Location and Frequency of Plant Food Remains Reported From Ozark Bluff Shelters. Paper presented to the Eighth Annual Ethnobiology Conference, Boston.

Galinat, Walton C.
1970 Maize from the Blain Site. In Blain Village and the Fort Ancient Tradition in Ohio, by O. H. Prufer and Orrin C. Shane III, pp. 219-231. Kent State Press.

Gasser, Robert E.
1982 Hohokam Use of Desert Plant Foods. Desert Plants 3(4):216-234.

Gilmore, Melvin R.
1931 Vegetal Remains of the Ozark Bluff-Dweller Culture. Papers of the Michigan Academy of Science, Arts, and Letters 14:83-102.

Griffin, James B.
1952 Archeology of Eastern United States. University of Chicago Press, Chicago.

1960 Climatic Change: A Contributory Cause of the Growth and Decline of Northern Hopewellian Culture. The Wisconisn Archeologist 41(2):21-33.

1967 Eastern North American Archaeology: A Summary. Science 156(3772):175-191.

Hammett, Julia E.
1986 Ethnohistory of Aboriginal Landscapes and Land Use in the Southeastern United States. M.A. thesis, Department of Anthropology, University of North Carolina at Chapel Hill.

Harlan, Jack R., R. M. J. De Wet, and E. Glen Price
1973 Comparative Evolution of Cereals. Evolution 27:311-325.

Harrington, Mark R.
1924 The Ozark Bluff-Dwellers. American Anthropologist 26(1):1-21.

1960 The Ozark Bluff-Dwellers. Indian Notes and Monographs, Vol. 12, Museum of the American Indian, Heye Foundation, New York.

Heiser, Charles B., Jr.
1985 Some Botanical Considerations of the Early Domesticated Plants North of Mexico. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 57-72. Anthropological Papers No. 75, Museum of Anthropology, University of Michigan, Ann Arbor.

Heiser, Charles B., Jr., and David C. Nelson
1974 On the Origin of the Cultivated Chenopods. Genetics 78:503-505.

Hilliard, Jerry E.
1980 Prehistoric Ozark Settlement Subsistence and Nut Resource Utilization. M.A. thesis, Department of Anthropology, University of Arkansas, Fayetteville.

Hoffman, Michael P.
1982 The Pendulum and the Pit: Vogues in Interpretation of Mississippian Period Occupation in the Southwestern Arkansas Ozarks. Paper presented at the 39th Southeastern Archaeological Conference, Memphis.

Hoffman, Michael P., N. E. Meyer, D. Printup, and C. L. Bond
1977 Ozark Reservoir Papers: Archeology in West-Central Arkansas 1965-1970. Arkansas ARcheological Survey Reserach Series 10.

Jackson, R. C.
1960 A Revision of the Genus Iva L. The University of Kansas Science Bulletin 41(7):793-876.

Johannessen, Sissel
1984 Paleoethnobotany. In American Bottom Archaeology, edited by Charles J. Bareis and James W. Porter, pp. 197-214. University of Illinois Press, Urbana.

Jones, Volney
1936 The Vegetal Remains of Newt Kash Hollow Shelter. In Rock-Shelters in Menifee County, Kentucky, edited by William S. Webb and William D. Funkhouser, pp. 147-165. University of Kentucky Reports in Anthropology and Archaeology 3(4).

Kaplan, Lawrence
1956 The Cultivated Beans of the Prehistoric Southwest. Annals of the Missouri Botanical Garden 43:189-227.

Kay, Marvin
1982 Radiometric chronology of the Huntsville Mound Site, 3MA22, Madison County, Arkansas. Paper presented at the 24th Annual Caddo Conference, Fayetteville.

Kay, Marvin, Frances B. King, and Christine K. Robinson
1980 Cucurbits from Phillips Spring: New Evidence and Interpretations. American Antiquity 45:802-822.

King, Frances B.
1985 Early Cultivated Cucurbits in Eastern North America. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 73-97. Anthropological Papers No. 75, Museum of Anthropology, University of Michigan, Ann Arbor.

Linton, Ralph
1924 North American Maize Culture. American Anthropologist 26(1):345-359.

1955 Tree of Culture. Alfred A. Knopf, New York.

Lynott, Mark J., Thomas W. Boutton, James E. Price, and Dwight E. Nelson
1986 Stable Carbon Isotopic Evidence for Maize Agriculture in Southeast Missouri and Northeast Arkansas. American Antiquity 51(1):51-65.

Payne, Willard W., and Volney H. Jones
1962 The Taxonomic Status and Archaeological Significance of a Giant Ragweed from Prehistoric Bluff Shelters in the Ozark Plateau Region. Papers of the Michigan Academy of Science, Arts and Letters 47:147-163.

Perttula, Timothy K.
1983 The Loftin Site and Phase in Western Ozark Prehistory. In The Loftin Component, 23SN42, edited by W. R. Wood. The Missouri Archaeologist 44:40-62.

Quimby, George L.
1946 The Possibility of an Independent Agricultural Complex in the Southeastern United States. Selected Readings Series, Human Origins No. 31:206-210.

Raab, L. Mark, compiler
1976 Pine Mountain: A Study of Prehistoric Human Ecology in the Arkansas Ozarks. Arkansas Archeological Survey Research Report 7.

Radford, Albert E., Harry E. Ahles, and C. Ritchie Bell
1968 Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill.

Rafferty, Milton D.
1980 The Ozarks, Land and Life. University of Oklahoma Press, Norman.

Rindos, David
1980 Symbiosis, Instability, and the Origins and Spread of Agriculture: A New Model. Current Anthropology 21(6):751-772.

1984 The Origins of Agriculture, An Evolutionary Perspective. Academic Press, New York.

Rindos, David, and Sissel Johannessen
n.d. Human/Plant Interactions and Cultural Change in the American Bottom. Ms. on file, Ethnobotany Laboratory, University of North Carolina at Chapel Hill.

Robertson, Kenneth R.
1981 The Genera of Amaranthaceae in the Southeastern United States. Journal of the Arnold Arboretum 62:267-314.

Rohrbaugh, Charles L.
1984 Arkansas Valley Caddoan: Fort Coffee and Neosho Foci. In Prehistory of Oklahoma, edited by Robert E. Bell, pp. 265-286. Academic Press, New York.

Rose, Jerome C., and Murray K. Marks
1985 Bioarchaeology and Subsistence in the Central and Lower Mississippi Valley. Paper presented to the 42nd Southeastern Archaeological Conference, Birmingham, Alabama.

Sabo, George III
1982 Structural Features in Mound A at the Huntsville Site (3MA22), Madison County, Arkansas. Paper presented at the 24th Annual Caddo Conference, Fayetteville.

1986 Preliminary Excavations at the Huntsville Site: A Caddoan Civic-ceremonial Center in Northwest Arkansas. In Contributions to Ozark Prehistory, edited by G. Sabo III, pp. 55-76. Arkansas Archeological Survey Research Series No. 27.

Sabo, George III, David B. Waddell, and John H. House
1982 A Cultural Resource Overview of the Ozark-St. Francis National Forests, Arkansas. Report Submitted to the U.S.D.A. Forest Service, Ozark-St. Francis National Forests, by the Arkansas Archeological Survey, Fayetteville.

Sauer, Jonathan D.
1950 The Grain Amaranths: A Survey of their History and Classification. Annals of the Missouri Botanical Garden 37:561-633.

Scarry, C. Margaret Mosenfelder
1981 Plant Procurement Strategies in the West Jefferson and Moundville I Phases. Southeastern Archaeological Conference Bulletin 24:94-96.

Scholtz, James A.
1969 A Summary of Prehistory in Northwest Arkansas. The Arkansas Archeologist 10:51-60.

Scholtz, Sandra C.
1975 Prehistoric Plies: A Structural and Comparative Analysis of Cordage, Netting, Basketry, and Fabric from Ozark Bluff Shelters. Arkansas Archeological Survey Research Series No. 9.

Schoolcraft, Henry Rowe
1819 Journal of a Tour into the Interior of Missouri and Arkansas in 1818 and 1819. Reprinted in 1955 by Press-Argus Printers, Van Buren, Arkansas.

Smith, Bruce D.
1984 Chenopodium as a Prehistoric Domesticate in Eastern North America: Evidence from Russell Cave, Alabama. Science 226:165-167.

1985a The Role of Chenopodium as a Domesticate in Pre-Maize Garden Systems of the Eastern United States. Southeastern Archaeology 4:51-72.

1985b Chenopodium berlandieri ssp. jonesianum: Evidence for a Hopewellian Domesticate from Ash Cave, Ohio. Southeastern Archaeology 4:107-133.

1986a The Archaeology of the Southeastern United States: From Dalton to de Soto, 10,500-500 B.P. In Advances in World Archaeology, Vol. 5, pp. 1-92. Academic Press, New York.

1986b The Independent Domestication of Indigenous Seed-Bearing Plants in Eastern North America. Center for Archaeological Research, Southern Illinois University, Occasional Papers 7, in press.

Smith, Bruce D., and C. Wesley Cowan
1986 Domesticated Chenopodium in Prehistoric Eastern North America: New Accelerator Dates from Eastern Kentucky. Ms. in possession of the author.

Smith, Bruce D., and Vicki A. Funk
1985 A Newly Described Subfossil Cultivar of Chenopodium (Chenopodiaceae). Phytologia 57:445-448.

Struever, Stuart
1962 Implications of Vegetal Remains from an Illinois Hopewell Site. American Antiquity 27:584-587.

1964 The Hopewell Interaction Sphere in Riverine-Western Great Lakes Culture History. In Hopewellian Studies, edited by Joseph R. Caldwell and Robert L. Hall, pp. 87-106. Illinois State Museum Scientific Papers 12.

1968 Woodland Subsistence-Settlement Systems in the Lower Illinois Valley. In New Perspectives in Archeology, edited by Sally R. Binford and Lewis R. Binford, pp. 285-312. Aldine, Chicago.

Struever, Stuart, and Kent D. Vickery
1973 The Beginnings of Cultivation in the Midwest-Riverine Area of the United States. American Anthropologist 75(5):1197-1220.

Swanton, John R.
1942 Source Material on the History and Ethnology of the Caddo Indians. Bureau of American Ethnology, Bulletin 132. Washington, D.C.

Thornbury, W. D.
1964 Regional Geomorphology of the United States. John Wiley and Sons, New York.

Trubowitz, Neal L.
1980 Pine Mountain Revisited: An Archeological Study in the Arkansas Ozarks. Arkansas Archeological Survey Research Report 23.

1983 Caddoan Settlements in the Arkansas Ozarks: The Upper Lee Creek Valley. Midcontinental Journal of Archaeology 8:197-210.

Wagner, Gail E.
1986 The Corn and Cultivated Beans of the Fort Ancient Indians. The Missouri Archaeologist 47 (in press).

Wakefield, E. G., and Samuel Dellinger
1936 Diet of the Bluff Dwellers of the Ozark Mountains and its Skeletal Effects. Annals of Internal Medicine 9(10):1412-1418.

1940 Diseases of Prehistoric Americans of South Central United States. Ciba Symposia 2(12):453-462.

Wakefield, Elmer G., Samuel C. Dellinger, and John D. Camp
1937 Study of the Osseous Remains of a Primitive Race Who Once Inhabited the Shelters of the Bluffs of the Ozark Mountains. American Journal of the Medical Sciences 193(2):223-231.

Watson, Patty Jo
1969 The Prehistory of Salts Cave, Kentucky. Illinois State Museum, Reports of Investigations 16. Springfield.

1985 The Impact of Early Horticulture in the Upland Drainages of the Midwest and Midsouth. In Prehistoric Food Production in North America, edited by Richard I. Ford, pp. 99-147. Anthropological Papers 75, Museum of Anthropology, University of Michigan.

Watson, Patty Jo, editor
1974 Archeology of the Mammoth Cave Area. Academic Press, New York.

Wilson, Hugh D.
1980 Artificial Hybridization among Species of Chenopodium sect. Chenopodium. Systematic Botany 5:253-263.

1981 Domesticated Chenopodium of the Ozark Bluff Dwellers. Economic Botany 35:233-239.

Wilson, Hugh D., and Charles B. Heiser, Jr.
1979 The Origin and Evolutionary Relationships of 'Huauzontli' (Chenopodium nuttalliae Safford), Domesticated Chenopod of Mexico. American Journal of Botany 66:198-206.

Winter, Joseph C.
1973 The Distribution and Development of Fremont Maize Agriculture: Some Preliminary Interpretations. American Antiquity 38(4):439-451.

1974 Aboriginal Agriculture in the Southwest and Great Basin. Ph.D. dissertation, University of Utah.

Wolfman, Daniel
1979 Archeological Assessment of the Buffalo National River. Arkansas Archeological Survey Research Report 18.

Wood, W. Raymond
1963 Breckenridge Shelter--3CR2: An Archeological Chronicle in the Beaver Reservoir Area. In Arkansas Archeology 1962, edited by C. R. McGimsey III, pp. 67-96. Arkansas Archeological Society, Fayetteville.

Yarnell, Richard A.
1964 Aboriginal Relationships Between Culture and Plant Life in the Upper Great Lakes Region. Anthropological Papers 23, Museum of Anthropology, University of Michigan, Ann Arbor.

1969 Contents of Human Paleofeces. In The Prehistory of Salts Cave, Kentucky, by Patty Jo Watson, pp. 41-54. Illinois State Museum, Reports of Investigations 16, Springfield.

1972 Iva annua var. macrocarpa: Extinct American Cultigen? American Anthropologist 74:335-341.

1974 Plant Food and Cultivation of the Salts Cavers. In Archeology of the Mammoth Cave Area, edited by Patty Jo Watson, pp. 113-122. Academic Press, New York.

1976 Early Plant Husbandry in Eastern North America. In Cultural Change and Continuity, edited by Charles E. Cleland, pp. 265-273. Academic Press, New York.

1978 Domestication of Sunflower and Sumpweed in Eastern North America. In The Nature and Status of Ethnobotany, edited by Richard I. Ford, pp. 289-299. Anthropological Papers No. 67, Museum of Anthropology, University of Michigan, Ann Arbor.

1981 Inferred Dating of Ozark Bluff Dweller Occupations Based on Achene Size of Sunflower and Sumpweed. Journal of Ethnobiology 1(1):55-60.

1983 Prehistory of Plant Foods and Husbandry in North America. Paper presented at the 48th Annual Meeting, Society for American Archaeology, Pittsburgh.

1985 A Survey of Prehistoric Crop Plants in Eastern North America. Paper presented to the 42nd Southeastern Archaeological Conference, Birmingham, Alabama.

Yarnell, Richard A., and M. Jean Black
1985 Temporal Trends Indicated by a Survey of Archaic and Woodland Plant Food Remains from Southeastern North America. Southeastern Archaeology 4(2):93-106.