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Plant Remains from Carlston Annis (1972, 1974), Bowles, and Peter Cave

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Editors' Introduction: One of the central issues that drew us to the shell mound region was that of Archaic plant use. Hence, considerable effort was directed toward recovering and analyzing archaeobotanical remains. In this chapter, Crawford describes and interprets plant remains from our excavations at Carlston Annis (15Bt5), Bowles (15Oh13), and Peter Cave (15Oh94, a rockshelter in the uplands north of Green River).

INTRODUCTION

This chapter is the final report on the flotation series from the 1972 and 1974 Carlston Annis and Bowles site excavations. The 1975 data from Peter Cave, an upland rockshelter located near the shell mounds, are included here as well. For comparative purposes (with the permission of Richard Yarnell) the Riverton site plant remains that were not published in the Riverton monograph (Winters 1969) are also referred to here. Certain aspects of this research have been discussed elsewhere (Chomko and Crawford 1978; Crawford 1982).

My previous discussion (1982) includes the following interpretations: (1) that successive changes in relative abundance of plant remains categories from lower to upper levels of the two shell midden sites are similar; (2) that taxa composition (both qualitatively and quantitatively) is similar at all three sites except that more *Chenopodium* and walnut occur at Peter Cave; (3) that plant food remains are dominated by nuts (hickory and acorn) and fleshy fruits; and (4) that temporal changes interpreted from the plant remains and their context are not entirely consistent with a reorientation to food production evidenced by cucurbits mainly in the upper levels at the two shell mounds.

In addition, in my 1982 summary, I reported only the total assemblage composition from the three sites; a brief discussion of shell mound zonation was the only discussion of variation within the shell mounds. Details of intrasite sample variation are reported in this chapter. In light of recent developments in our understanding of prehistoric plant use, plant domestication, and subsistence ecology in eastern North America, I update several identifications, including *Cucurbita* and *Chenopodium*.

The antiquity of *Cucurbita* in the Green River Late Archaic has been confirmed by accelerator dating of rind fragments. The oldest Carlston Annis cucurbit rind fragment dates to 5740 ± 640 B.P. No rind fragments were recovered from the 1978 excavations (Wagner, this volume, Chapter 11).

One *Chenopodium* seed from Carlston Annis and three from Peter Cave are probably *C. berlandieri* and are intermediate between domesticated and wild *Chenopodium* in seed coat thickness. These are among the earliest reported *Chenopodium* seeds of this type in the East (Smith and Cowan 1987). They probably date to between 3500 and 3000 B.P.

I also reassess the evidence for increasing ecological disruption over time during the Green River Archaic, in relation to a progressive orientation toward plant husbandry, as well as the impact of long-term use of the shell mounds by the Late Archaic inhabitants. Anthropogenic communities are visible, in my view, although they are more forest edge or forest opening types of communities than garden associated communities. The possibility of a local, fire-induced ecology is proposed. The Late Archaic Green River material is consistent with an early stage in a continuum culminating in Early and Middle Woodland plant husbandry systems.

METHODS

Three vertical series of flotation samples (from excavation units A4, C1, and C13) and ten miscellaneous samples (from contexts designated for the recovery of non-plant remains) were collected from the Carlston Annis site. Unit A4 and several miscellaneous samples were processed in 1972 using the "garbage-can technique" (Watson 1976). Units C1 and C13 and the remaining miscellaneous samples were processed in 1974 using the SMAP machine. All sediment from units A4, C1, and C13 was processed. In 1974, one vertical series of flotation samples was collected from the Bowles site, unit A3. Approximately 50 percent of the sediment from unit A3 was processed, again using the SMAP machine. Two flotation sample series from Peter Cave, units A and B, were collected in 1975.

Both the SMAP machine and the garbage-can technique result in a light fraction (the portion of the sample that floats or is suspended in the water) and a heavy fraction (the relatively dense part of the sample that is caught in a 1.3 mm^2 mesh). The only heavy fraction data discussed in this chapter are from a Peter Cave sample.

Each archaeobotanical sample was floated from the sediment comprising one level of an excavation unit; hence, it consists of the archaeobotanical yield from several, approximately equal sized sediment portions, each being 2/3 to 3/4 of a 10-qt (9.2-l) bucket. At first, the floated archaeobotanical samples were weighed and examined individually, but the weight of residue in each sample was very small. Due to the minimal amount of data in each portion, all samples from a particular level of an excavation unit were ultimately combined for analysis. Thus, all the archaeobotanical residue floated from one excavated level in a unit became the minimal sample, and was weighed and analyzed together.

Analysis of the flotation samples followed a standardized procedure and closely follows that outlined by Yarnell (1974:113-114). A sample is weighed and then passed through a series of ten geological sieves of the following mesh sizes: 6.35, 4.00, 2.38, 2.00, 1.41, 1.00, 0.71, 0.42, and 0.21 mm. Each of the 11 fractions, into which a sample is thus divided, is weighed. The initial sample weight and the fraction weights are not used in the final tabulations of the sample composition but are used as a check against subsequent weighings. The fractions larger than the 2.38 mm screen are separated entirely into their constituents, which may number as many as fourteen: chert flakes, shell, small bone, wood charcoal, unidentified plant remains, hickory nutshell, acorn shell, acorn meat, walnut shell, hazelnut shell, squash rind, seeds, mineral, and uncarbonized organic material. Each of these components is weighed. Mineral and uncarbonized organic material are not included in the final results. Each of the other components is reported as a percentage of the total component weight.

In the fractions that pass through the 2.38-mm screen, only carbonized seeds are removed. The seeds are weighed together as a component. After the seeds have been removed, the fractions from the 2.00-, 1.41-, and 1.00-mm screens are combined and weighed together. The fractions with particles smaller than 1.00 mm are examined, but their weights are not included in the final calculations and tabulations. The expected weight of each component that would be found in the entire sample down to the 1.00-mm screen is then calculated based on the assumption that the same ratios that were found in the larger screens hold in the smaller fractions. Seeds are usually found in the fractions between the 2.38- and 1.00-mm screens, and their weight is usually quite small. The seed weights are not included in the calculations but are tabulated in the final report of the flotation sample contents.

IDENTIFICATIONS

Identification of the plant remains from the three sites has been summarized elsewhere (Crawford 1982). Here, I report modifications to previously published data, as well as new data and details not previously published. In 1982, I reported that six taxa dominate in the small seeds count; four are fleshy fruit (blackberry, grape, honey locust, persimmon) and two are herbaceous weeds (knotweeds and grasses). The seeds tentatively identified as squash (Chomko and Crawford 1978) are actually honey locust (Crawford 1982). The identified taxa now number 29 or 30, rather than 28. Little barley is among the grasses. Two types of chenopod seeds are present. I have also reconsidered the cinquefoil identification and now prefer to identify those seeds as strawberry. As many as 74 taxa are present in the collections I have analyzed. In other words, 44 taxa are identifiable but are presently unknown.

Identified taxa, preferred habitat, and season of availability are summarized in Table 10.1. Plants are grouped according to what was probably their main use. Tick clover (*Desmodium* sp.) and cleavers (bedstraw) may be fortuitous inclusions and not used by the shell mound and Peter Cave occupants. Fruits of both plants readily adhere to hair and clothing, and may not have been purposefully collected. However, hundreds of pod fragments of *Desmodium nudiflorum* were recovered from an Early Woodland storage cyst at the Cloudsplitter Rockshelter in Kentucky and were likely collected intentionally there (Cowan 1981:70-71). Consequently, the Green River Archaic use of *Desmodium* should not be ruled out. Discussion of six groups of remains follows. Distributional data are summarized in Tables 10.2 through 10.11 and Figures 10.1 through 10.4.

Knotweeds

Three or four species of knotweed (*Polygonum*) are discernible in the Carlston Annis and Bowles samples (Figure 10.5). *Polygonum* is an extremely variable genus so identification of their seeds (actually achenes) to species is difficult. For that reason, I refer to what appear to be species as "types." Type 1, probably *P. densiflorum* L. (although also resembling *P. amphibium* L.), includes 32 of the 82 knotweed seeds from the three sites. The seeds average 2.4 mm long (2.1 - 2.6 mm) by 2.1 mm wide (2.0 - 2.5 mm), and are lenticular in cross section. The *P. densiflorum* identification is problematic because the plant is supposed to have been introduced from tropical South America (Fernald 1950). Today, it is common in eastern North America, growing in wet, swampy woods, thickets, and margins of shallow ponds. I have examined the 11 knotweed seeds reported from the Riverton site and have found them all to be identical to the Type 1 seeds. Type 2 is likely all *P. erectum*. It comprises 20 percent of the total number of knotweed seeds and is found at both shell mounds.

Two subtypes of *P. erectum* are present. One averages 1.8 mm long (1.7-1.9 mm), is unequilaterally triangular in cross section and has a faintly striated to smooth

Table 10.1. Names*, Habitat, and Season of Availability for Plants Discussed in this Chapter.

Common Name	Scientific Name	Preferred Habitat	Season of Availability
		NUTS	
Acorn	*Quercus* sp.	variety	fall
Hazel	*Corylus* sp.	clearings, borders of woods	August-September
Hickory	*Carya* sp.	variety	fall
Walnut	*Juglans nigra* L.	rich woods	fall
		FLESHY FRUITS	
Blackberry	*Rubus* sp.	variety	late summer
Elderberry	*Sambucus* sp.	wet or rich soils to woods or openings	late summer, fall
Grape	*Vitis* sp.	woods, openings, borders, thickets	late summer
Hackberry	*Celtis* sp.	bottoms, rich banks, rocky slopes	fall
Hawthorn	*Crataegus* sp.	openings, borders	September-October
Honey Locust	*Gleditsia triacanthos* L.	rich woods, bottoms, along water courses	fall
Persimmon	*Diosporos virginiana* L.	dry, open woods, clearings, rich bottoms	September-November
Plum	*Prunus americana* L.	openings, borders of woods	August-October
Strawberry	*Fragaria* sp.	openings, borders of woods	Late Spring
		GRAINS	
Chenopod**	*Chenopodium* sp. cf. *C. bushianum* Aellen or *C. berlandieri* spp. *berlandieri*	disturbed soil	fall
		GRASSES	
Little Barley	*Hordeum pusillum*	see text of this chapter	
Foxtail Grass	*Setaria* sp.	see text of this chapter	
Panic Grass	*Panicum* sp.	see text of this chapter	
Knotweeds**	*Polygonum* sp. *P. erectum, P. densiflorum P. pensylvanicum*	see text of this chapter	
Senna	*Cassia* sp.	moist, open woods, streambanks	fall
Wild Bean	*Strophostyles* cf. *S. umbellata* Britt	sandy woods, clearings, uplands	fall
Wild Rice	*Zizania aquatica* L.	marshes, river mouths, quiet waters	September
		OTHER	
Cleavers	*Galium* sp.	rich woods to open ground	fall
Legumes	Leguminosae	see text of this chapter	fall
Purslane***	*Portulaca oleracea* L.	disturbed soils	fall
Tick-clover	*Desmodium* sp.	alluvial soils, clearings, disturbed areas	fall
		CULTIGENS	
Squash	*Cucurbita* sp. cf. *C. pepo* L.		summer-fall

* nomenclature follows Fernald (1950)
** greens also eaten
*** only greens eaten

Table 10.2. Carlston Annis Site (15Bt5), Unit C1 Flotation Samples: Carbonized Seeds.

C1 Level	Weight (gm)	Count	FLESHY FRUIT SEEDS							GRAIN SEEDS					OTHER SEEDS				
										Knotweed types			Grasses						
			Blackberry	Elderberry	Grape	Hawthorn	Honey Locust	Persimmon	Plum	1	2	*Polygonum* sp.	Paniceae	Type 1	Senna	Cleavers	Legume	Unknown	Unidentifiable
3	*	5	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–
4	*	36	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	34
5	*	6	–	–	2	–	1	–	–	–	–	1	–	–	–	–	–	–	2
6	*	5	1	–	–	–	1	1	–	–	–	1	–	–	–	–	–	–	1
7	*	6	1	–	–	–	1	1	–	–	1	1	–	–	–	–	–	–	1
8	–	nil	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9	0.47	5	–	–	1	–	1	–	1	1	–	–	–	–	–	–	–	–	1
10	0.08	8	–	–	–	–	1	1	–	4	–	–	–	–	–	–	–	–	2
11	*	15	–	–	–	–	2	1	–	–	–	–	–	–	–	–	2	–	10
12	0.14	10	1	–	–	–	1	–	–	1	1	–	–	–	–	–	1	–	5
13	0.24	15	–	–	2	–	2	1	–	–	–	2	–	2	3	–	–	1	2
14	0.51	24	3	1	–	–	2	3	–	1	–	1	–	1	1	–	1	3	7
15	*	13	–	–	3	1(?)	1	1	–	–	–	2	–	–	–	–	–	–	5
16	1.42	41	2	–	3	–	10	5	–	–	–	–	–	6	–	9	–	1	5
17	0.45	22	2	–	–	–	4	1	–	–	1	1	–	1	–	2	–	1	9
18	0.07	8	–	–	1	–	2	–	–	–	–	–	–	–	–	2	–	–	3
19	*	4	–	–	1	–	1	–	–	–	–	–	–	1	–	–	–	–	1
20	*	11	1	–	–	–	1	–	–	–	1	1	–	–	–	–	1	1	5
Total	3.3 gm	234	11	1	13	1(?)	31	15	1	7	5	10	6	11	4	13	5	7	93

* less than 0.10 gm

Table 10.3. Carlston Annis Site (15Bt5), Unit C13 Flotation Samples: Carbonized Seeds.

C13 Level	Weight (gm)	Count	FLESHY FRUIT SEEDS								GRAIN SEEDS								OTHER SEEDS			
			Blackberry	Elderberry	Grape	Hawthorn	Honey Locust	Persimmon	Plum	Strawberry	Knotweed types				Grasses		Senna	Chenopod	Legume	Clevers	Unknown	Unidentifiable
											1	2	3	*Polygonum* sp.	Poaceae	Type 1						
3	*	9	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	3	4
4	*	3	–	–	1(?)	–	–	–	–	–	–	–	–	1(?)	–	–	–	–	–	–	–	1
5	*	14	–	–	1	–	–	–	–	–	–	–	–	5	1	–	–	–	–	–	–	7
6	*	5	–	–	–	–	–	1	–	–	–	–	–	2	1	–	–	–	–	–	–	1
7	*	3	–	–	–	–	1(?)	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–
8	*	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–
9	*	12	1	–	1	–	2	–	–	–	–	–	–	2	–	–	–	–	1	–	–	5
10	*	9	1	–	–	–	1	–	–	–	–	–	3	1	–	–	1	–	1	–	–	1
11	*	8	–	–	–	–	1	1	–	–	2	–	–	–	–	–	–	–	–	–	–	4
12	0.21	14	–	–	2	1(?)	4	–	–	–	1	–	1	1	–	–	–	–	–	–	–	4
13	*	28	–	–	–	–	–	–	–	–	9	3	5	–	–	1	–	–	1	–	4	5
14	*	12	–	–	–	–	2	2	–	–	1	–	1	3	–	1	–	–	–	–	2	–
15	0.46	14	1	–	–	–	1	7	–	–	–	1	–	–	–	–	–	–	–	–	3	1
16	*	31	1	–	1	–	5	1	–	1	–	3	–	1	–	1	–	–	2	–	5	10
17	0.18	13	1	–	1	–	1	2	–	3	–	–	–	–	–	–	–	–	–	1	1	3
18	0.14	18	1	1(?)	–	–	–	2	1	–	–	1	–	–	1	–	–	–	1	1	1	8
19	–	nil	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
20	–	nil	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21	–	nil	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total	0.99 gm	195	6	1(?)	8	1(?)	18	16	1	4	13	8	10	17	3	3	2	1	6	2	21	54

* less than 0.10 gm

Table 10.4. Carlston Annis Unit A4 Flotation Samples: Carbonized Seeds.

A4 Level	Weight (gm)	Count	Blackberry	Grape	Honey Locust	Persimmon	Plum	Knotweed Types		Cleavers	Unknown	Unidentifiable
								1	*Polygonum* sp.			
3	–	nil	–	–	–	–	–	–	–	–	–	–
4	*	5	–	2	–	–	–	1	–	–	–	2
5	*	13	–	2	–	4	–	2	1	–	–	4
6	*	7	–	2	–	–	–	–	–	–	–	5
7	*	4	1	3	–	–	–	–	–	–	–	–
8	*	8	–	1	2	1	1	–	–	1	1	1
9	*	7	–	4	3	–	–	–	–	–	–	–
Total	*	44	1	14	5	5	1	3	1	1	1	12

* less than 0.10 gm

Table 10.5. Carlston Annis Miscellaneous Flotation Samples: Contents as Percentage of Total Sample Weight and Total Plant Food Weight.

Level	Sample Weight (gm), excluding fine debris	SAMPLE COMPONENTS (% OF TOTAL WEIGHT)					Total Plant Food Weight (gm)	PLANT FOOD (% OF TOTAL WEIGHT)					
		Shell	Small Bone	Wood Charcoal	Unidentified Plant Remains	Plant Food		Hickory Nutshell	Acorn		Walnut	Tuber	Seeds
									Shell	Meat			
C15-3-1	0.93	20.4	–	39.8	–	39.8	**0.47**	43.3	*	*	–	–	56.9
B4-4	33.32	70.4	*	7.3	*	18.8	**6.27**	77.5	*	20.3	2.2	–	*
C3-5-1/1	13.53	1.4	–	98.3	–	0.3	**0.05**	–	–	100.0	–	–	–
C16-7-1	7.03	38.4	–	8.1	*	53.5	**3.76**	85.9	*	14.1	–	–	–
C3-8-1	5.66	48.6	–	34.8	–	16.6	**0.94**	50.0	9.6	40.4	–	–	–
C13-8 to 11	4.70	94.5	–	1.5	3.8	*	**	*	*	–	–	–	*
C2-10-1	1.74	–	20.11	5.8	–	74.1	**1.29**	85.3	–	–	–	14.7	–
C2-11-1	0.92	–	–	27.2	–	72.8	**0.70**	100.0	–	–	–	–	–
C2-12-0	1.16	–	–	8.6 (cane)	–	91.4	**1.06**	100.0	–	–	–	–	–
A1-12	0.57	*	–	70.2	–	29.8	**0.17**	99.9	*	–	–	–	–
C2-13-0/2	18.84	3.3	–	85.8	5.3	5.5	**1.04**	91.4	*	8.7	–	–	–
C3-13-1	27.81	10.4	–	81.1	–	8.5	**2.35**	99.9	*	*	–	–	–
C3-14	5.46	29.7	–	54.9	2.0	13.6	**0.74**	64.9	*	–	–	–	35.1
C3-15	0.63	*	28.6	50.8	–	20.6	**0.13**	99.9	*	–	–	–	–
Total	122.30 gm	32.6%	1.1%	49.6%	1.3%	15.4%	18.97 gm	12.4%	0.2%	2.2%	*	*	*

* less than 1.0%
** less than 0.10 gm

Table 10.6. Carlston Annis Miscellaneous Flotation Samples: Carbonized Seeds.

Level	Weight (gm)	Count	Grape	Honey Locust	Persimmon	Plum	Knotweed	Unidentifiable
C15-3	0.21	2	–	–	1	–	–	1
B4-4	*	2	1	–	–	–	–	1
C3-5	–	nil	–	–	–	–	–	–
C16-7	–	nil	–	–	–	–	–	–
C3-8	–	nil	–	–	–	–	–	–
C13-8 to 11	*	2	–	–	–	–	1	1
C2-10	–	nil	–	–	–	–	–	–
C2-11	–	nil	–	–	–	–	–	–
C2-12	–	nil	–	–	–	–	–	–
A1-12	–	nil	–	–	–	–	–	–
C2-13	*	2	1	1	–	–	–	–
C3-13	*	2	–	1	–	–	–	1
C3-14	0.26	1	–	–	–	1	–	–
C3-15	–	nil	–	–	–	–	–	–
Total	0.47	11	2	2	1	1	1	4

* less than 0.10 gm

Table 10.7. Bowles Site (15Oh13), Unit A3 Flotation Samples: Number of Carbonized Seeds.

A3 Level	Weight (gm)	Count	FLESHY FRUIT SEEDS						GRAIN SEEDS					OTHER SEEDS					
			Blackberry	Grape	Hackberry	Hawthorn	Honey Locust	Persimmon	Knotweed Types 1	Knotweed Types 2	Partridge Pea	Wild Bean	Wild Rice	Purslane	Legume	Cleavers	Tick Trefoil	Unknown	Unidentifiable
4	*	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
5	*	4	–	1	–	–	–	–	1	2	–	–	–	–	–	–	–	–	–
6	0.17	4	1	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–
7	*	4	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	2	–
8	*	3	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–
9	0.08	6	–	–	–	–	–	2	1	–	–	–	1	–	–	–	–	1	1
10	*	4	1	–	–	–	–	1	1	–	–	–	–	–	–	–	1(?)	–	–
11	0.12	10	–	2	–	–	–	1	–	–	1	–	–	1	–	–	–	1	4
12	0.11	3	–	–	–	–	1	2	–	–	–	–	–	–	–	–	–	–	–
13	0.61	12	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	3	7
14	0.09	9	–	1	–	1	1	1	–	–	–	1	–	–	–	2	–	2	–
15	0.10	7	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	4
16	0.23	15	–	4	–	–	3	3	–	–	–	–	–	–	1	–	–	–	4
17	0.16	9	–	2	–	–	3	1	–	–	–	–	–	–	–	–	–	3	–
Total	1.67 gm	91	4	11	1	1	10	12	3	3	2	1	1	1	3	2	3	13	20

* less than 0.10 gm

Table 10.8. Peter Cave Shelter, Unit A Flotation Samples: Contents as Percentage of Total Sample Weight and Total Plant Food Weight.

Level	Total Sample Weight (gm)	SAMPLE COMPONENTS (% OF TOTAL WEIGHT)					Total Plant Food Weight (gm)	PLANT FOOD (% OF TOTAL WEIGHT)					
		Snail Shell	Small Bone	Wood Charcoal	Unidentified Plant Remains	Plant Food		Hickory Nutshell	Acorn		Walnut Shell	Squash Rind	Seeds
									Shell	Meat			
2	12.70	–	13.8	25.5	–	60.6	7.70	99.4	–	–	*	–	0.6
3	9.70	*	22.0	33.5	*	44.5	4.32	95.8	–	*	3.0	–	1.2
4	24.57	*	32.5	10.8	–	56.7	14.03	86.0	–	–	12.6	–	1.4
5	18.90	2.2	5.4	43.9	0.5	48.0	9.08	88.0	–	10.4	1.1	–	0.6
6	26.53	4.9	*	49.1	1.2	44.9	11.90	90.9	*	2.4	6.2	–	0.4
7	23.19	8.2	5.0	40.8	4.4	41.6	9.69	76.2	*	7.0	15.8	*	1.0
8	8.31	*	2.0	36.0	7.0	55.0	4.57	88.0	–	12.0	–	*	*
Total	123.90 gm	2.9%	11.5%	34.9%	1.6%	49.3%	61.24 gm	88.4%	*	4.0%	7.0%	*	0.6%

* less than 0.4%

Table 10.9. Peter Cave Shelter, Unit B Flotation Samples: Contents as Percentage of Total Sample Weight and Total Plant Food Weight.

Level	Total Sample Weight (gm)	SAMPLE COMPONENTS (% OF TOTAL WEIGHT)					Total Plant Food Weight (gm)	PLANT FOOD (% OF TOTAL WEIGHT)					
		Snail Shell	Small Bone	Wood Charcoal	Unidentified Plant Remains	Plant Food		Hickory Nutshell	Acorn		Walnut Shell	Hazel Nutshell	Seeds
									Shell	Meat			
2	0.87	–	5.7	71.3	17.2	5.7	0.05	99.9	–	–	–	*	*
3	2.54	*	37.8	44.9	3.1	14.2	0.36	99.9	–	–	–	–	*
4	12.34	0.4	26.8	57.2	1.0	14.6	1.80	97.2	–	–	–	–	2.8
5	20.45	1.4	8.3	41.8	1.0	47.5	9.71	97.8	–	*	1.6	–	0.5
6	22.57	–	3.9	61.9	2.1	32.1	7.39	96.9	–	*	1.2	–	1.9
7	1.95	–	13.3	31.8	*	54.9	1.07	95.3	–	–	–	–	4.7
8, 9	16.08	*	12.9	25.1	2.4	59.5	9.59	86.2	*	1.5	11.8	–	0.5
Total	76.80 gm	0.4%	12.1%	46.9%	1.8%	38.9%	29.97 gm	94.4%	*	0.5%	4.6%	*	0.5%

*less than 0.4%

Table 10.10. Peter Cave, Unit A, Flotation Samples: Number of Carbonized Seeds.

Level	Count	Grape	Hackberry	Persimmon	Chenopod	Knotweed	*Setaria*	Tick Trefoil	Unknown	Unidentifiable
2	2	–	1	–	1	–	–	–	–	–
3	3	–	1	–	–	1	–	1	–	–
4	12	–	5	–	6	–	–	–	–	1
5	6	1	2	1(?)	2	–	–	–	–	–
6	4	–	3	–	–	–	–	–	1	–
7	8	–	3	–	3	–	1	–	1	–
8	–	–	–	–	–	–	–	–	–	–
Total	35	1	15	1	12	1	1	1	2	1

Table 10.11. Peter Cave, Unit B, Flotation Samples: Number of Carbonized Seeds.

Level	Count	Grape	Hackberry	Honey Locust	Chenopod	*Panicum*	Tick Trefoil	Legume	Unknown	Unidentifiable
2	3	–	–	–	–	–	–	1(?)	–	2
3	2	–	–	–	–	–	–	–	–	2
4	8	–	2	–	4	1	–	–	–	1
5	14	2	1	1	5	–	2	1	2	–
6	3	–	3	–	–	–	–	–	–	–
7	1	–	1	–	–	–	–	–	–	–
8, 9	4	–	2	–	–	–	–	–	–	2
Total	35	2	9	1	9	1	2	2	2	7

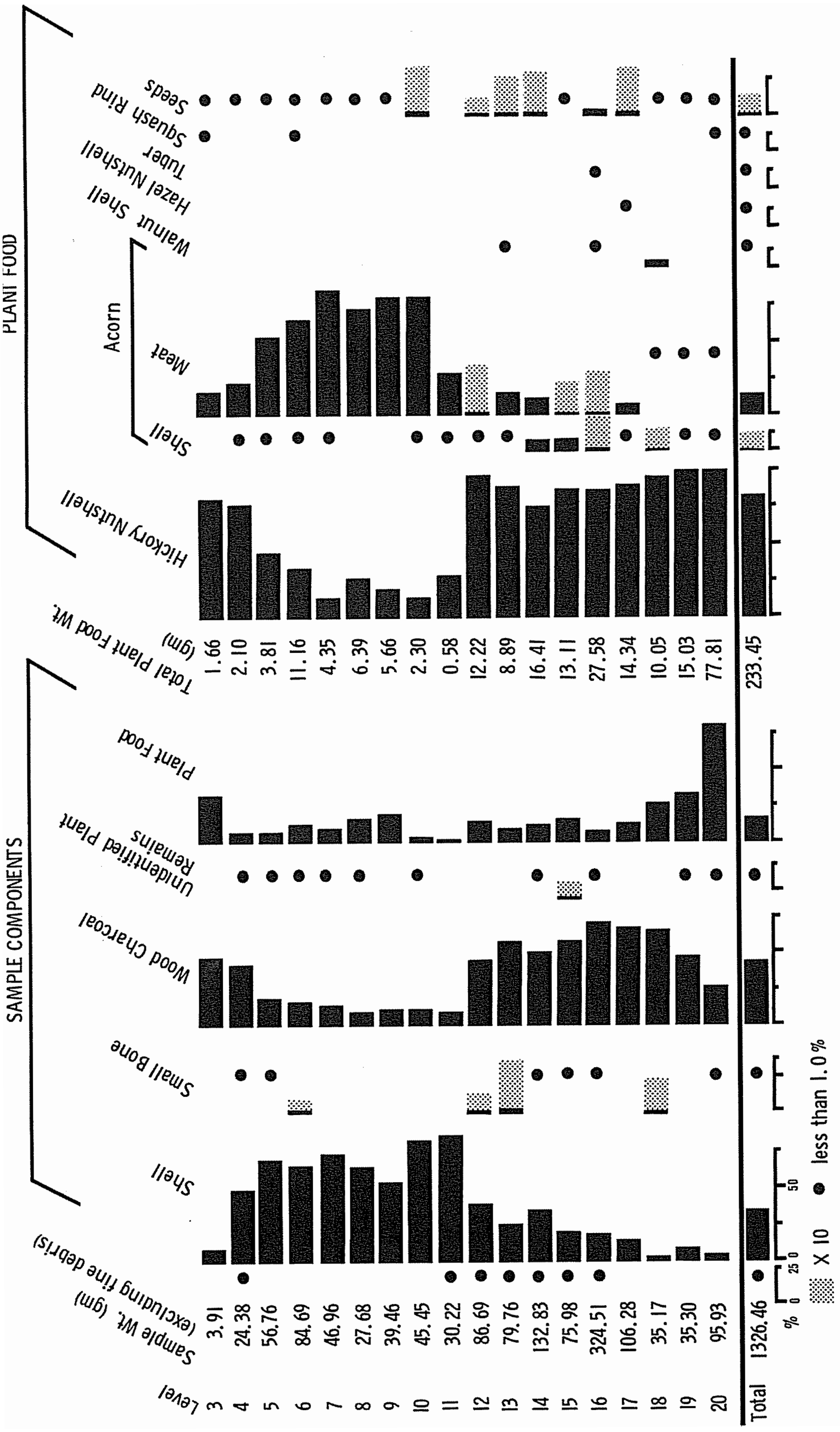

Figure 10.1. Carlston Annis, unit C1 flotation samples. Contents are shown as a percentage of total sample weight (in grams) and as a percentage of total plant food weight (in grams).

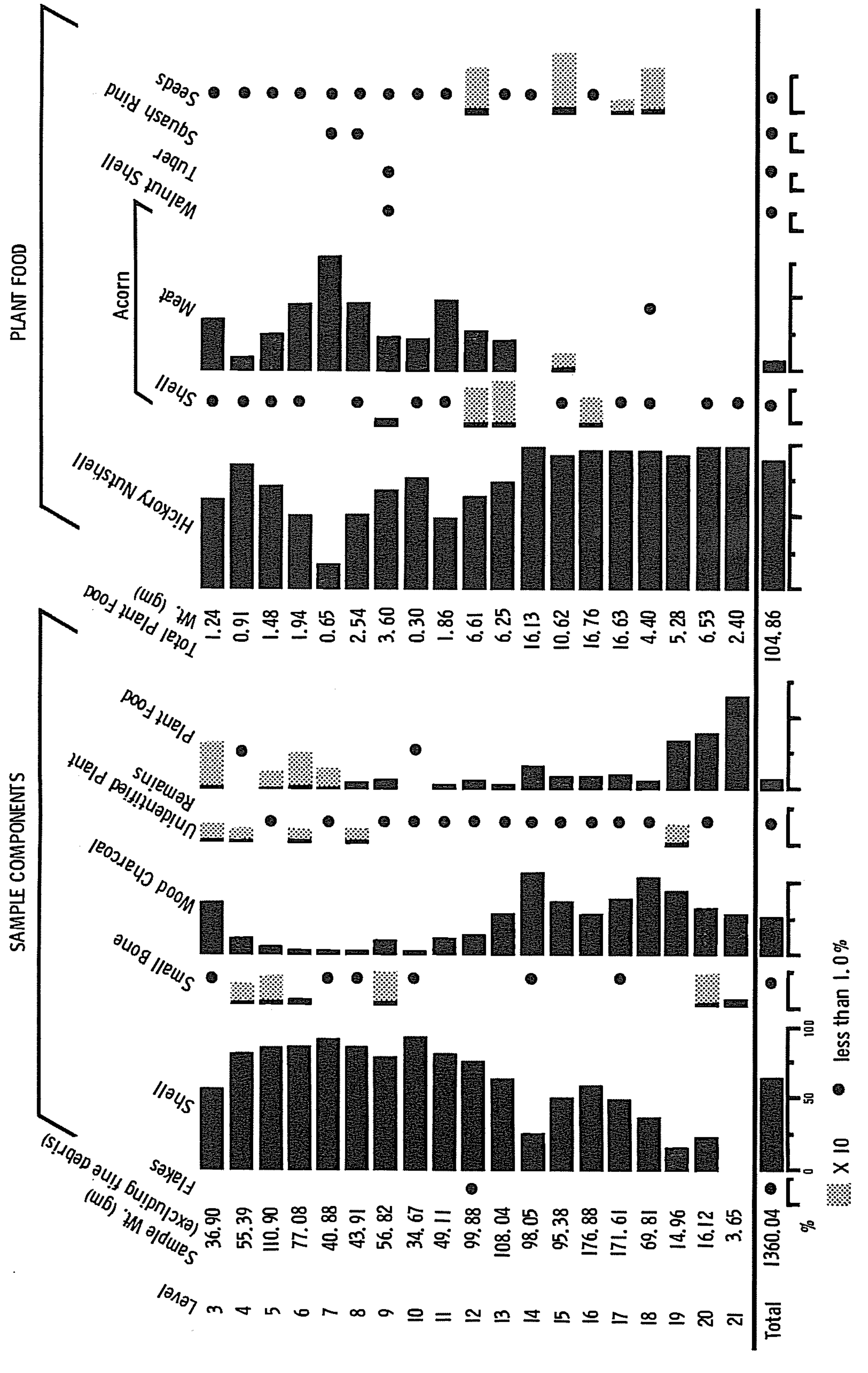

Figure 10.2. Carlston Annis, unit C13 flotation samples. Contents are shown as a percentage of total sample weight (in grams) and as a percentage of total plant food weight (in grams).

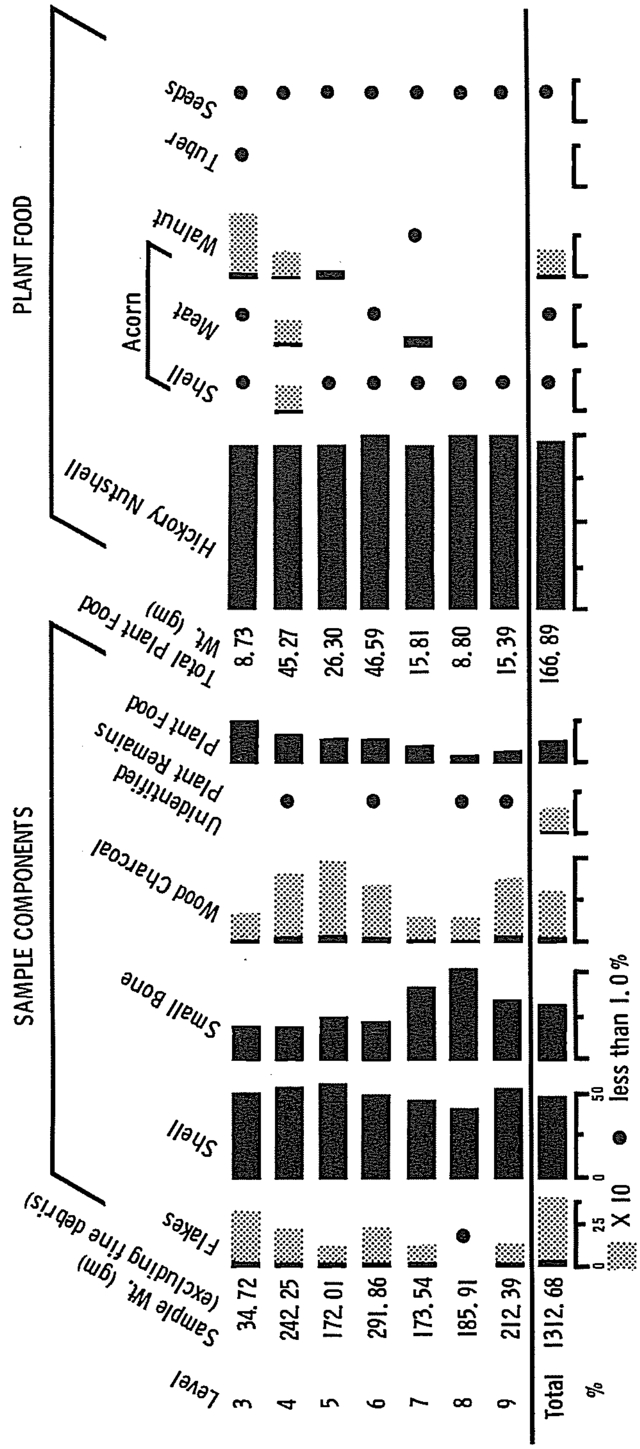

Figure 10.3. Carlston Annis, unit A4 flotation samples. Contents are shown as a percentage of total sample weight (in grams) and as a percentage of total plant food weight (in grams).

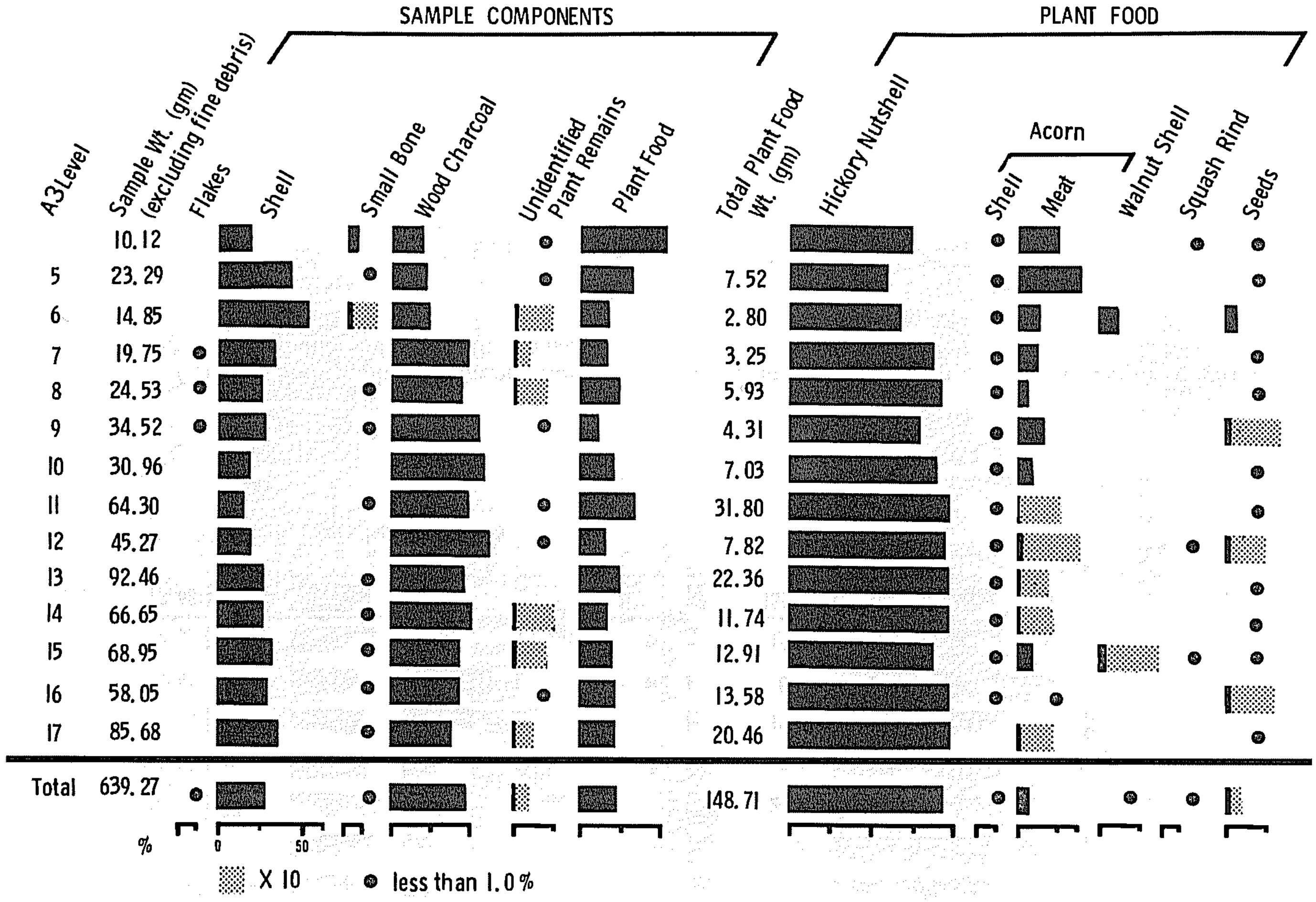

Figure 10.4. Bowles, unit A3 flotation samples. Contents are shown as a percentage of total sample weight (in grams) and as a percentage of total plant food weight (in grams).

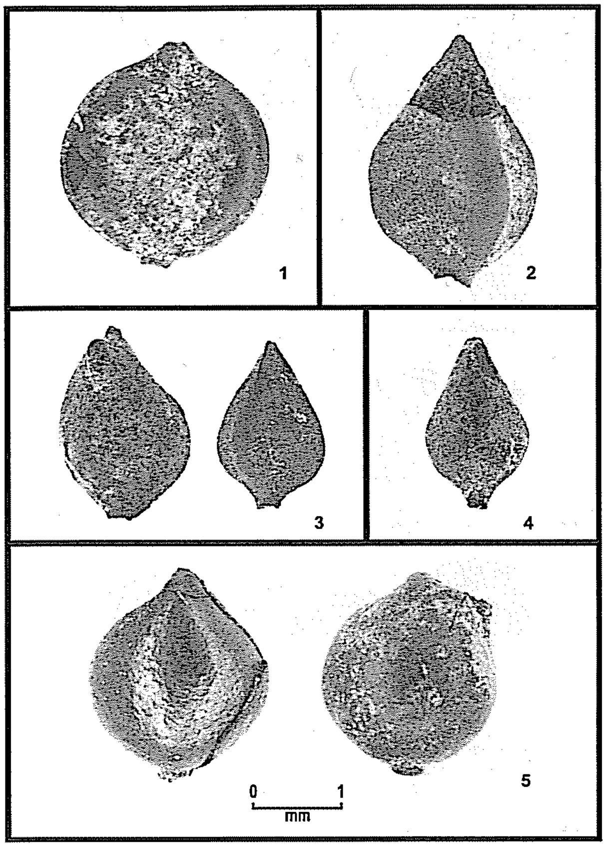

Figure 10.5. Knotweed achenes: (1) type 3 (*Polygonum pensylvanicum* L.); (2 and 3) *P. erectum*; (4) type 3 variant (?), (5) type 1 (*P. densiflorum* ?).

pericarp. My re-examination of the knotweed seeds from Salts Cave (Yarnell 1974) has shown that one of them appears to be this type of *P. erectum*. At least five fatter and clearly striated achenes of *P. erectum* occur in the samples. These are slightly longer, measuring 2.0 (1.8-2.1) mm. *P. erectum* has dimorphic achenes (Asch and Asch 1985:184). The wider type is usually shorter but the sample size here is quite small. Type 3 is probably *P. pensylvanicum*. It comprises 12 percent of the total knotweed seeds and occurs only at Carlston Annis. The seeds average 2.6 mm long (2.5-2.7 mm) by 2.3 mm wide (2.2-2.4 mm). A final unknown specimen is 1.9 mm long, striated, and lenticular in cross section. About 36 percent of the knotweed seeds are not classifiable beyond the genus level. These are represented only by pericarp or endosperm fragments.

Grasses

The 26 grass (Gramineae) seeds are divided into five types. The first, Type 1, is 58 percent of the total number of grass seeds, and is, as yet, unidentified (Figure 10.6). The average length, width, and thickness of the caryopses are 1.2 (3.0-4.0), 1.2 (1.0-1.6), and 1.0 (0.8-1.2) mm. These have a prominent ventral furrow and a striated dorsal surface. Next are seeds of the Paniceae tribe, which comprise about 25 percent of the grasses. All but one of these is probably *Setaria* (Figure 10.6). The seeds measure 1.5 (1.4-1.6) mm long, 1.1 mm wide and 0.7 mm thick. One specimen from Peter Cave is probably *Panicum*.

Wild rice is the only grass from Bowles (Figure 10.6). It measures 1.5 mm wide by 1.2 mm thick. The specimen is broken so its length could not be measured. Wild rice is rare today in Kentucky and adjacent southern Indiana, southern Illinois, and Tennessee (Gattinger 1901; Jones and Fuller 1955; McFarland 1972). The source of this grain, however, need not have been far away. Wild rice requires clear, moving water only a meter or so deep. Such habitats are not found today near the shell mounds but they may have existed during the Late Archaic when the Green River appears to have been shallower near the shell mounds. The shellfish species found in the mounds thrive in shallow water and riffles (Patch, this volume, Chapter 13; Marquardt and Watson 1983). Although the shellfish habitats are in fast flowing water, shallow and slower moving water was probably not too distant. Other evidence for Late Archaic wild rice use in the Southeast is rare, but includes Bacon Bend and Iddins in Tennessee (Chapman and Shea 1981).

One specimen of little barley is in a sample from C13, level 6 (Figure 10.6). It is 2.8 mm long, 1.1 mm wide, and 0.9 mm thick. One other grass seed from the shell mounds is not further identifiable.

Legumes

Legumes (Fabaceae or Leguminosae) are represented by at least eight taxa, four of which are honey locust,

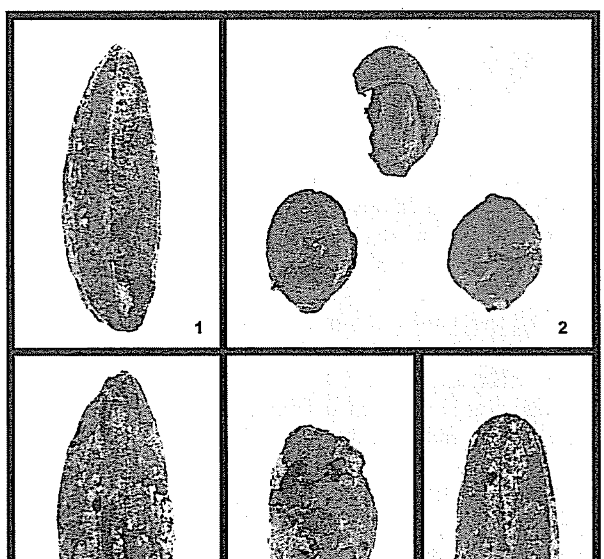

Figure 10.6. Grass seeds: (1) type 1; (2) foxtail grass; (3) wild rice; (4) unknown grass; and (5) little barley.

senna, tick clover, and wild bean. The unidentified beans are represented by one specimen each (Figure 10.7).

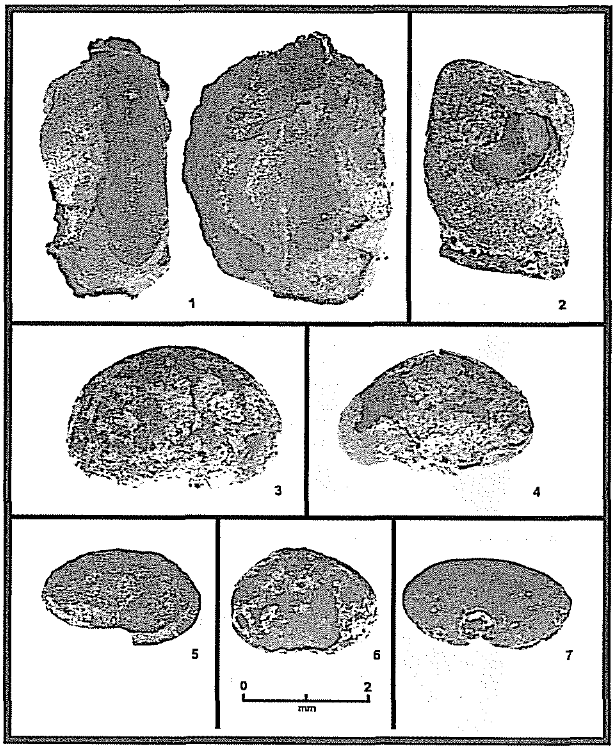

Figure 10.7. Legumes: (1) wild bean, view of hilum (left) and side view (right); (2) senna; (3) unknown; (4) tick clover; (5, 6, and 7) unknown.

Cucurbita

The context and dating of 15 cucurbit rind fragments from the three sites have been described previously (Crawford 1982). The Bowles, A3 level 12 rind has an accelerator radiocarbon date of 4060 ± 220 B.P. This is consistent with earlier interpretations that the same rind was older than the 3440 ± 80 B.P. radiocarbon date from level 11 (Chomko and Crawford 1978; Marquardt and Watson 1983). Rind is also found in level 15 (Chomko and Crawford 1978; Crawford 1982).

The single, small piece of AMS-dated rind (2.2 by 1.1 mm and 1.4 mm thick) from Carlston Annis was the basis for an initial interpretation that cucurbits were present at the site before 4500 B.P. The uncalibrated accelerator date for this rind from C1, level 20 is 5730 ± 640 B.P. (Watson 1985:112). Another date from deep in the midden — D14-2, level 19 — is 5350 ± 80 B.P. (Marquardt and Watson 1983). There is a date for D14-2, level 20 (4350 ± 85 B.P.), but it is younger than, and outside the range of the level 19 date (Marquardt and Watson 1983). The AMS-dated rind from Level 20 does not resolve the dating reversal for levels 19 and 20 other than to suggest that the date for Level 20 is probably closer to 5350 B.P. than to 4350 B.P. Cucurbit rind fragments from the Illinois valley are reported to be thicker than *C. foetidissima* (Conard et al. 1984:444), but King (1985) notes that rind thickness of *C. pepo* and *C. foetidissima* overlap. Cucurbit rind less than 2 mm thick could be either *C. pepo* or *C. foetidissima*. Rind from Green River Archaic sites ranges from 0.7 to 1.4 mm thick. Modern *C. pepo* var. *ovifera* rind fragments and the Green River Archaic rind fragments are compared in Figure 10.8. They are structurally identical. The cucurbit rind in both the modern and the archaeological examples exhibits the characteristics that make it unmistakably *Cucurbita*: thick walled, polygonal, sclerenchymatous cells lying immediately below an epidermal layer. At 800 magnifications the only apparent distinction is cell wall thickness, which is a developmental rather than a taxonomic variation. From a purely structural point of view, the Green River Archaic specimens are best identified as *Cucurbita* sp. Kentucky is not within the range of *Cucurbita foetidissima*, the only cucurbit in the East that could be confused with the Green River cucurbit (see also Chomko and Crawford 1978:407 and Asch and Asch 1985:156). Seeds accompanying cucurbit rind from the Archaic Phillips Spring site (Chomko and Crawford 1978; Kay, King, and Robinson 1980) and Cloudsplitter Rockshelter (Cowan 1981) make a positive identification of *C. pepo* at these two sites possible. In all likelihood, the Green River Archaic cucurbits are *C. pepo* as well.

Chenopodium

All but one of the *Chenopodium* seeds reported in this chapter are from Peter Cave. The single chenopod seed from the shell mounds is from Carlston Annis C13, level 3, presumably the most recent level of the units reported here from that site. Wagner's two chenopod seeds are from upper, presumably more recent, levels as well. The C13, level 3 chenopod is 1.6 mm in diameter and belongs to the subsection *Cellulata*. The Peter Cave chenopods belong to two groups. Only three seeds belong to the subsection *Cellulata*; each measures 1.3 mm in diameter.

Two species of *Chenopodium* subsection *Cellulata* are indigenous to the Midwest: *C. bushianum* and *C. berlandieri* (Asch and Asch 1977; Smith 1985a). Another chenopod, *C. berlandieri* ssp. *jonesianum* (Smith and Funk 1985) is a domesticated variety present in eastern North America as early as 3400 B.P. (Smith and Cowan 1987). When the pericarp is missing, then archaeological seeds of the two weedy species are distinguished on the basis of seed diameter (Asch and Asch 1985). *C. berlandieri* seed diameters range from 1.2 to 1.6 mm while *C. bushianum* seeds range from 1.5 to 2.0 mm (Asch and Asch 1985). On this basis, the chenopods from Peter Cave are probably *C. berlandieri*. The Carlston Annis seed could be either species, the sample from Carlston Annis being too small to enable a confident species choice.

The other chenopod seeds from Peter Cave are smooth and smaller, averaging 1.2 (1.1-1.4) mm. The seeds are all biconvex; none have truncate margins characteristic of cultigen chenopods (see Wilson 1981). The testa of each of the alveolate seeds, however, is thinner than those reported by Smith (1984, 1985a) for wild *C. berlandieri*.

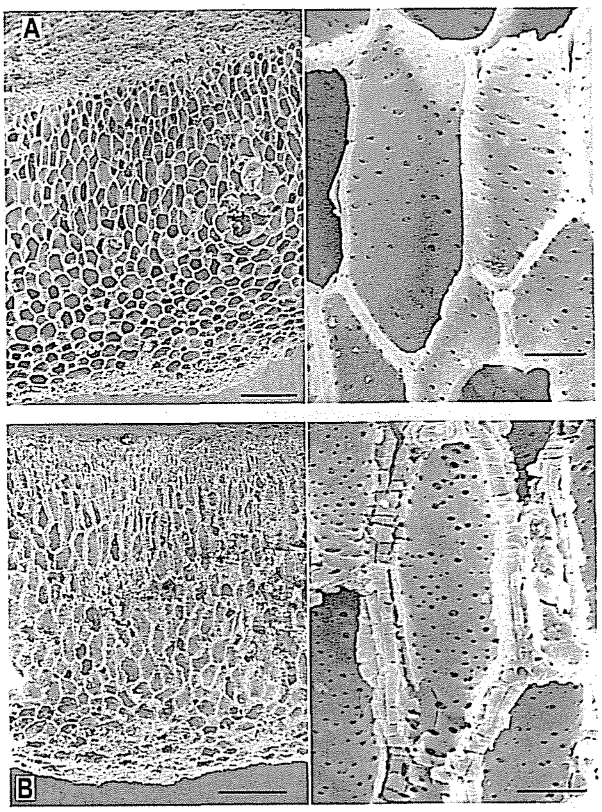

Figure 10.8. Cross section of rinds: (1) *Cucurbita pepo* var. *ovifera* (carbonized reference), (2) *C.* sp. cf. *C. pepo*, Carlston Annis. The scale bar in the left photos (A and B) is 0.20 mm; in the right hand photos (A and B) it is 30 µm.

The Carlston Annis sample measures 28.8 microns except for one portion of the seed coat that measures 33.6 microns. The Peter Cave specimens measure 23.0 - 28.8 microns. The smaller non-*Cellulata* chenopods from Peter Cave have distinctly thicker seed coats, (38.4 - 43.2 microns). The seed coats of the alveolate specimens are intermediate in thickness between the cultigen and wild forms of *Chenopodium* reported by Smith (1984, 1985a, 1985b). One problem is that thin testa seeds do occur in the wild; the seeds are reddish and constitute a small portion of the seeds of several *Chenopodium* species (Asch and Asch 1985:179). These seeds have testa thicknesses ranging up to 30 microns. Seeds with thin seed coats are rare in the wild, however, and unusual conditions are necessary for the seed type to predominate (Asch and Asch 1985:180). Thus, the four chenopod seeds may represent an intermediate type in domestication of *Chenopodium*, or they may be examples of the wild thin testa red-morph (Figure 10.9).

The Green River Archaic sample is too small and provides no opportunity to document the range of variation in chenopod at this time. Domesticated chenopod (*C. berlandieri* ssp. *jonesianum*) is present by 3400 B.P. at Cloudsplitter and Newt Kash Rockshelters in eastern Kentucky (Smith and Cowan 1987), by 2000 B.P. at Russell Cave, Alabama (Smith 1984) and Ash Cave, Ohio (Smith 1985b), and by 1500 B.P. at the John Roy and Newbridge sites in Illinois (Asch and Asch 1985). A hypothetical intermediate stage of chenopod domestication would account for the dimorphic chenopods at Early Woodland Salts Cave (Asch and Asch 1985:182-3). Chenopod harvesting was becoming important by 4000 B.P. in west-central Illinois, but all of the chenopod seeds from this period are of the thick-coated, wild type. The thin seed coat chenopods from Peter Cave are from levels A4 and B4. The Carlston Annis chenopods come from contexts stratigraphically higher than any radiocarbon dated levels (C3 level 5 at Carlston Annis has a date of 3330 ± 80 B.P. while level A4 at Peter Cave is dated to 3415 ± 105 B.P.). It is likely, however, that all of the specimens date to the late fourth millennium B.P., contemporaneous with the fully domesticated specimens reported from eastern Kentucky. The chenopods from the Green River Archaic are suggestive of an intermediate domestication stage, but until more specimens from the Late Archaic shell mounds can be recovered and directly dated, any suggestions regarding the intermediate status of these seeds must remain tentative.

Other

One carbonized purslane seed is in unit A3, level 10 at Bowles. Wagner (this volume, Chapter 11) also reports purslane in her samples. This is further evidence of the plant's precontact presence in eastern North America (Byrne and McAndrews 1975; Chapman, Stewart, and Yarnell 1974).

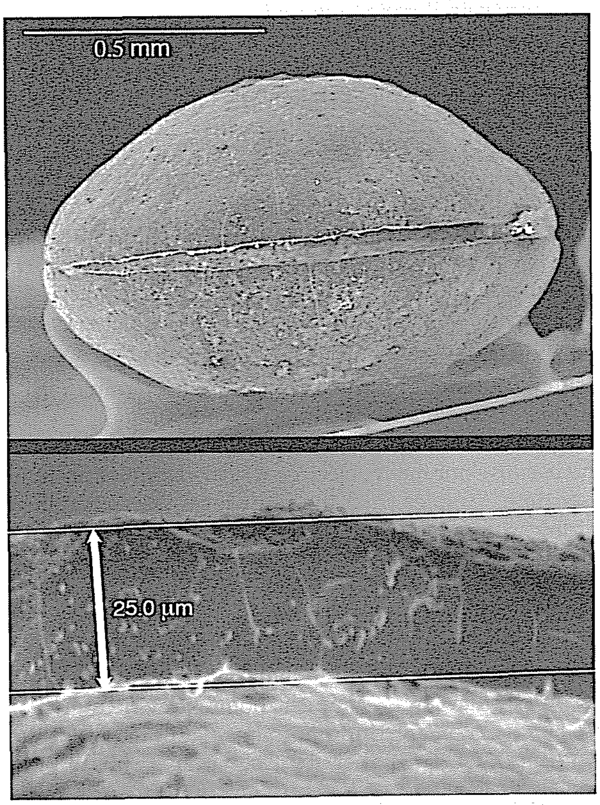

Figure 10.9. Weedy *Chenopodium* from Peter Cave, Unit A, Level 4.

Five tubers (Figure 10.10) are found in the Carlston Annis samples, one each in unit C1 level 16, unit C13 level 9, and unit C2 level 10. Two are from unit C1 level 14.

Honey locust (Figure 10.11) is grouped with the fleshy fruits because the sweet pulp in the bean pods was probably eaten. Honey locust seeds are not reported from 100 Salts Cave fecal samples, but they do occur in flotation samples from the same site (Yarnell 1974:120).

Finally, Wagner (this volume, Chapter 11) reports *Euphorbia*, *Silene*, and *Oxalis* in the 1978 flotation series. These occur in the flotation samples collected in 1972 and 1974, but none is carbonized.

SAMPLE VARIATION AND SITE ZONATION

The interpretation of flotation sample contents in general, and of those from the shell mounds in particular, is limited by many factors. Preservation of different classes of plant remains varies (see Munson, Parmalee, and Yarnell 1971). Differential attrition, and excavation and recovery procedures all affect the way in which plant and animal remains came to represent subsistence ecology (Yarnell 1982). At the shell mounds, the process of midden formation was complex. Deposition rates, horizontal and vertical variation, and other midden formation processes ought to be controlled in order to achieve a detailed understanding of subsistence and ecological variation. On the other hand, subsistence and ecological interpretations are not entirely ruled out. Few of the factors outlined can be controlled for at this time; however, flotation methods for each unit discussed here were the same except for unit A4 at Carlston Annis. All but unit A4 sediments were processed with the SMAP machine. Unit A4 at Bowles was floated using the garbage-can technique, the same method used to process the first two series of Salts Cave deposits (Watson 1974:107-108; 1976).

One factor that may have imparted variation to the samples and whose influence is possible to explore, is sample volume. Constant sediment sample volumes were not used in this analysis, although samples were originally collected by the individual bucket-full, and the resulting flotation residues were stored separately. This yielded 1,100 flotation samples, each averaging 4.4 gm of light fraction. Because individual samples were small, and because our main objective was to examine variation over time, samples from the same level were combined during the analysis. Seventy-two samples resulted, averaging 67 gm each.

There was an important time and a related economic factor to consider, and we suspected at the outset that cultigens, if present at these sites, would be rare. Assuming that larger samples should provide a greater probability of recovering rare items, I studied all of the available material, rather than equal size subsamples, from each level. Thus, level by level, sediment sample volume varies. This is a common problem with intersite and intrasite comparisons.

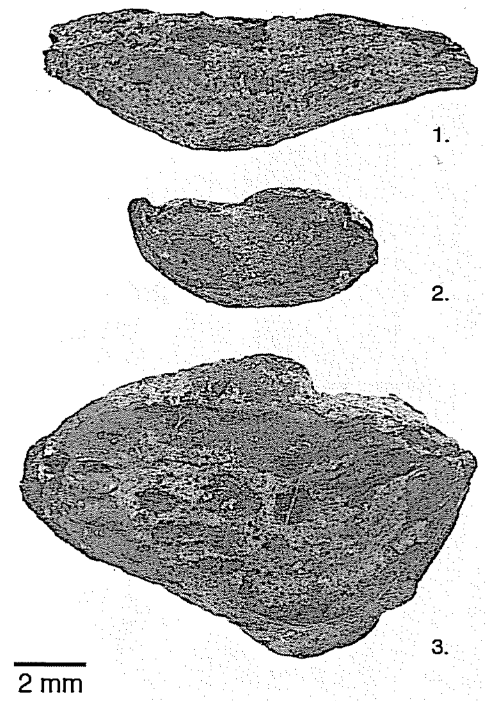

Figure 10.10. Tuber remains: (1) Carlston Annis unit C13, level 9; (2) Carlston Annis unit C1, level 16; (3) Carlston Annis unit A4, level 3.

Data independent of sample volume are desirable. For this reason, several quantities were examined to test variation with sample volume (Table 10.12). In order to test relationships, all the samples were used. The null hypothesis is that the selected flotation sample variables do not covary with sample volume.

The null hypothesis is rejected for all but plant food weight for Carlston Annis units C1, C13, A4, Bowles unit A3, and Peter Cave units A and B. That is, total weight of plant remains per sample, wood charcoal, seed weight, seed number, and number of plant taxa per sample are all likely to vary according to sediment sample volume. The latter variable is significant in that I have used it as a factor in the delineation of zones at the mounds (Crawford 1982:209). Each variable has a positive linear relationship to volume except for seed weight (Table 10.12 and Figure 10.12), which has a strong negative correlation with volume. Therefore, absolute values of these variables in level-by-level comparisons should not be used, except perhaps for plant food weight.

Correlations were calculated using Wagner's data (this volume, chapter 11) for units D14, D15, D16, E12, E16, and J as well (Table 10.12). Four variables were examined: wood charcoal weight, plant food weight, seed number, and taxa number. The first three were taken directly from Wagner's tables, while the taxa number was obtained by counting the number of taxa per level in the same tables. The null hypothesis is rejected for all four variables. The main difference between my data and Wagner's is that

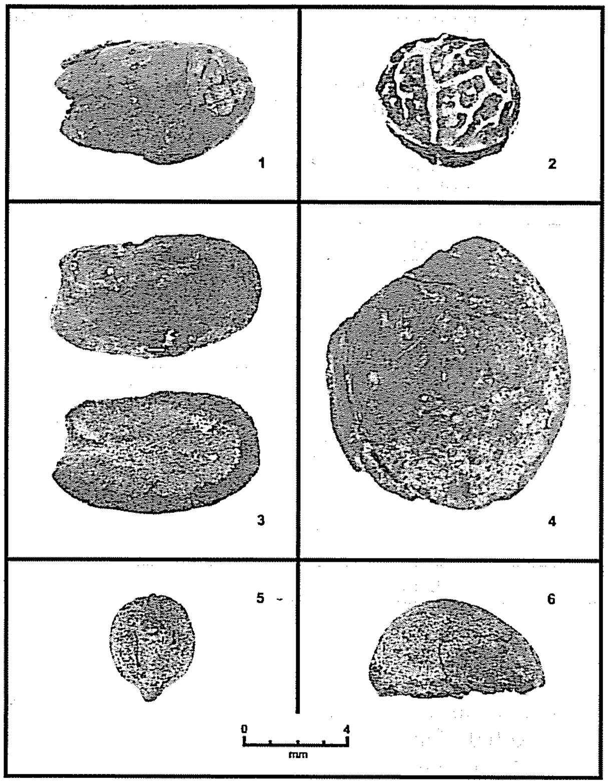

Figure 10.11. Fleshy fruit seeds: (1) honey locust; (2) hackberry; (3) persimmon; (4) plum; (5) grape; (6) hawthorn.

plant food weight correlates with volume in Wagner's data, but not in mine.

Clearly, sample comparisons are best made using ratios such as densities, percentages, and seeds per g plant food (or nuts). The last ratio can be used as a measure of ecological disruption or changing harvesting practices (e.g. Asch and Asch 1979; Yarnell 1974).

Sample variation is described here using the following ratios: seeds/bucket of sediment (Table 10.13), light fraction density (Figure 10.13, Table 10.14), plant food density (Figure 10.14, Table 10.14), and seeds/g plant food (Figure 10.15, Table 10.14). Division of the excavated deposit into three zones was apparent in the Carlston Annis unit C flotation series. Units C1 and C13 are quite consistent and can be divided into three vertical zones:

Zone I: Levels 11 through 3 have a high ratio of acorn to hickory. This ratio generally increases to the top of the midden. Little acorn occurs below level 13. Total remains density is relatively low. Squash rind was found only in this zone except for the small fragment in level 20.

Zone II: Levels 17 through 12 contain mainly hickory nutshell. Seed concentration and type variety is high. Total density is high. Seed clusters and weed seeds are common.

Zone III: Levels deeper than level 17 have few plant food remains and little seed variety. The plant remains are mainly hickory nutshell (Crawford 1982:209).

A fourth zone, the shell-free midden, was not detected in unit C, but overlies much of the shell midden including unit D and is quite deep toward the river side of the mound. Wagner (this volume, Chapter 11) describes the shell-free midden contents.

The light fraction densities are relatively low in Zones I and III and relatively high in Zone II. At the Bowles shell mound in Unit A3, a middle zone of higher light-fraction density occurs in levels 14 through 8.

The seed/g plant food ratio is higher in Zones I and II at Carlston Annis and higher in the upper levels at Bowles as well. The highest ratio of seeds/g plant food is in levels 11 and 10 of Zone II at Carlston Annis.

Plant food density at Carlston Annis is relatively low in Zone I of units C1 and C13. A similar pattern is not evident at Bowles. Seed density tends to be highest in the middle layers of both shell mounds.

Higher seed densities and seeds/g plant food ratios are indicators of increased seed harvesting and the increased productivity of local, disturbed habitats. I argue elsewhere (Crawford 1982) that a trend toward increased ecological disruption at the shell mounds is not clearly evident. Disruption may have been greatest in Zone II, but I am not entirely satisfied with this interpretation. If one excludes levels 10 and 11 of units C1 and C13, seeds/g plant food ratios are highest in the *upper* levels. An argument could be made either for increasing disruption or against it. If light-fraction density is assumed to be an index of intensity of occupation, then the middle layers of the shell mounds evidence a period of greater activity. I suggested (1982) that this was symptomatic of a terminal Archaic, settlement system shift. An alternate argument would involve a lateral shift of garbage deposition over time rather than a continuation of deposition in the same location that results in vertical accumulation only. The data from unit A4, except for seed density, are evidence for a depositional history somewhat different from that of other units. Wagner's data (this volume, Chapter 11) from below the shell-free midden, unit D in particular, correlate well with the zonation recognized in unit C. The main contrast in Wagner's flotation series is the inclusion of samples from the shell-free midden.

The Peter Cave samples (Tables 10.13 and 10.14) show considerable variation between units A and B. No good explanation is apparent for the variation. The sample density is much higher than that from the shell mounds, probably because the Peter Cave data include heavy fractions. This may account for higher plant food densities in unit A, but unit B is similar to the shell mound data. The seeds-per-g-plant-food ratio at Peter Cave is within the same range as that of the shell mounds. No substantial differences between the upland Peter Cave samples and the shell mounds are discernible at this level of the analysis.

Table 10.12. Calculations of Pearson Correlation Coefficients (R): Flotation Sample Volume Correlations with Selected Variables.

Variable	R	Significance Probabililty	N
CARLSTON ANNIS UNITS C1, C13, A4, A3, Misc.; PETER CAVE UNITS A, B			
Sample Weight	0.298	.011	72
Wood Charcoal Weight	0.387	.001	72
Plant Food Weight	-0.044	.715	72
Seed Weight	-0.259	.028	72
Seed Number	0.333	.028	72
Taxa Number	0.332	.004	72
CARLSTON ANNIS UNITS D14-2, D15, D16, E12, E16, J			
Wood Charcoal Weight	0.324	0.032	44
Plant Food Weight	0.362	0.016	44
Seed Number	0.487	0.001	44
Taxa Number	0.609	0.0001	44

Further corroboration of the vertical, and presumably temporal, zonation at the shell mounds can be seen in the changes in four variables through time in units C1 and C13: the ratio of acorn to hickory nutshell, the percentage of shell, and the percentage of wood charcoal and plant food (Figures 10.1 and 10.2). Samples from unit A3 at Bowles show similar variation except for plant food percentages (Figure 10.4). The shell-free midden, the most recently deposited stratum, has low acorn to hickory ratios (Wagner, this volume, Chapter 11). This appears to be anticipated in the unit C flotation series where a decline in acorn to hickory ratios in the shallowest levels is evident after this ratio peaks. The vertical patterns evident in C1, C3, and A4, except for the decrease in plant food percentage from the bottom to the top of the midden, are evident in the miscellaneous samples as well when they are ordered according to stratigraphic position (see discussion below). Unit A4 (Figure 10.3) samples vary little from levels 9 through 3 and contrast with the percentages of sample constituents in all of the other units, evidencing some horizonal variation in the mound.

Several archaeological contexts were independently sampled at Carlston Annis. Ten of the samples represent contexts outside the float squares. Only one or two buckets of sediment were floated from most of these contexts. Sample content of C1-16-1, C1-16-3, and C13-16-1 are included in the flotation unit summary figures and tables. The other miscellaneous samples are summarized in Tables 10.5 and 10.6. Comments on each of the samples follow.

C15-3-0/1: One flotation sample is from a probable pit in unit C15 level 3. The contents of the sample are not unusual: shell, wood charcoal, hickory nutshell, and 2 seeds.

B4-4-1 and B4-4-2: Two flotation samples are from unit B4, level 4. Nothing unusual was found.

C3-5-2/1: One sample is from a charcoal concentration in the southeast corner of unit C3, level 5 at an elevation of 100.64 to 100.57 m. A radiocarbon date on wood charcoal from this sample is 3330 ± 80 B.P. (UCLA-2117B). Very little plant food and no seeds were found.

C16-7-1: One flotation sample is from a burned shell and charcoal concentration in unit C16, level 7 at an elevation of 100.58 m. No seeds were found.

C3-8-1: One sample is from a possible post mold. The sample contents were not unusual.

C13-8 to 11: One sample is from a shell concentration extending from levels 8 to 11. Only 4.7 gm of remains, primarily shell, are present in the sample. Only 2 seeds, including one knotweed, were found.

A1-12: The sample from unit A1, level 12 is very small, totaling less than 1 gm of hickory, acorn, wood charcoal, and shell.

C1-13-1/1: This is a single sample from post mold #4. The bottom of the feature was at 99.87 m. Negligible amounts of plant food remains are present. The sample is mostly wood charcoal.

C2-13-0/2: A burned area was sampled in level 13 of unit C2. The contents are almost all wood charcoal. One honey locust and one grape seed are present.

C3-13-1: One sample from a layer of charcoal contained mostly wood charcoal and a little hickory nutshell and shell. Two seeds, one identified as honey locust, are present.

C3-14-0: Two samples from level 14 of unit C3 were taken. The sample is not unusual.

C3-15-3: One sample from a burned shell area in the

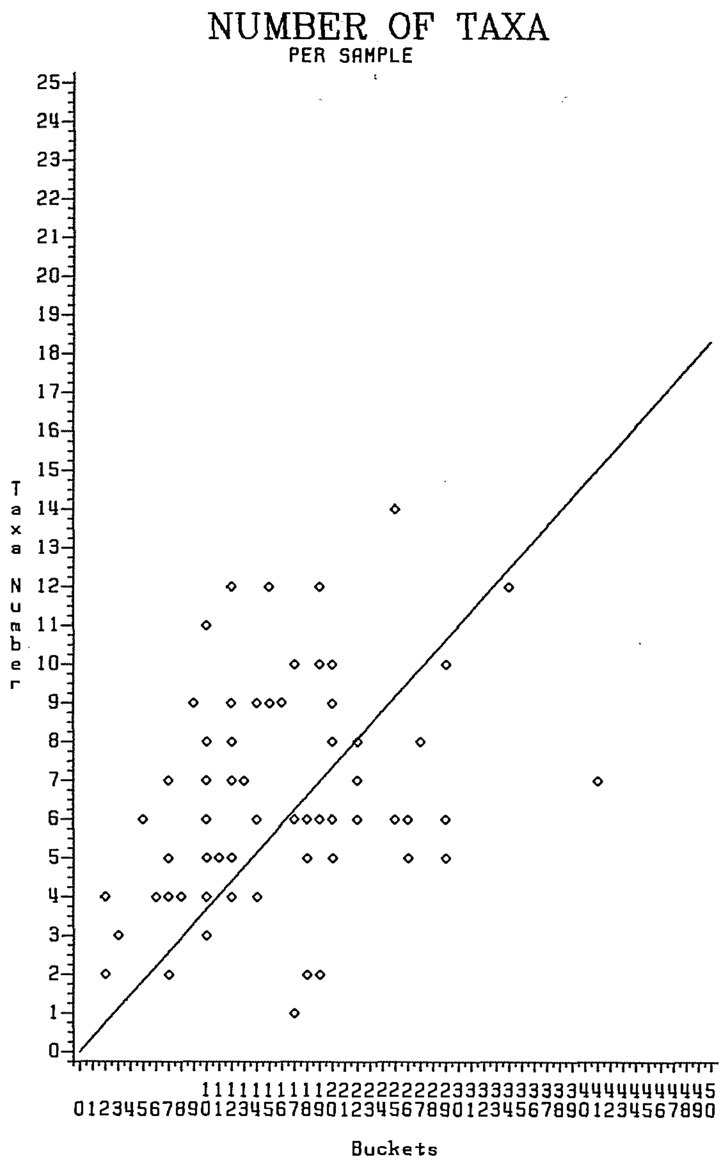

Figure 10.12. Plot of number of taxa per sample compared to the soil sample volume (in buckets). Regression line is indicated.

southwest corner of unit C3, level 15 was taken. Only 0.6 g of remains was recovered.

C1-16-1: Seven samples are from a dense charcoal concentration in the west-central part of unit C1, level 16. The sample contents are similar to the contents of 34 other samples from the same unit and level. Only 3 kinds of seeds were found in the C1-16-1 sample whereas 7 kinds were found in the rest of level 16. The 3 taxa in C1-16-1 (bedstraw, persimmon, and honey locust) were among the taxa found in the other level 16 samples.

C13-16-1: Ten samples are from a small pit. Most of the plant food is hickory nutshell (99 percent), as it is in the other 10 samples from C13 level 16 outside the pit. Plant food, wood charcoal, and shell comprise similar percentages in both groups of samples. The pit does, however, have a concentration of seeds (24 belonging to 10 taxa). Only 5 seeds of 3 taxa were found in the non-pit samples from level 16, unit 13.

C2-10-1, 11-1, and 12-0: The only notable material from these three contexts was a small tuber from the level 10 sample.

Two sets of samples are not summarized in the tables. These are from a series of burials from both shell mounds. Samples from burials 3, 5, and 6, and a dog burial from Carlston Annis contained a total of 38.24 g of light fraction. Their composition is 63 percent shell, 24 percent wood charcoal and 10.4 percent plant food. The plant food is 63 percent hickory, 1.2 percent acorn shell and 31.6 percent acorn meat. Five taxa of seeds were found: tick-clover (2), honey locust (1), erect knotweed (1), bramble (2), and cleavers (1). Burials 2 and 4 at Bowles have 8.73 g of light fraction. They are mostly wood charcoal (43 percent) and plant food (41 percent). The remainder is mainly shell. Hickory is 34.8 percent of the plant food as is acorn meat. Acorn shell is 14.5 percent of the plant food. One possible honey locust and one Type 1 knotweed were found.

In addition to these flotation samples, small amounts of plant remains that are not included in any of the figures and tables total 3.60 g. Most of this is hickory nutshell from unit C2, levels 3, 4, 7, and 8, and unit A1, level 3. About 0.10 g of walnut shell was taken from unit C2, level 8. One plum seed was found in unit C3, level 14.

DISCUSSION

Over twenty years ago, I remarked on the relatively consistent patterns at the shell mounds (Crawford 1982). Food production probably played a role in the changing settlement system at the end of the Archaic. Early Woodland sites, particularly Salts Cave and Cold Oak Shelter (Gremillion 1993; Yarnell 1974) in the uplands to the east have abundant evidence of agriculture. Ecological disruption, a characteristic associated with most human settlements and one that amplifies with a turn to food production, did not seem particularly pronounced at the shell mounds when I first considered the data.

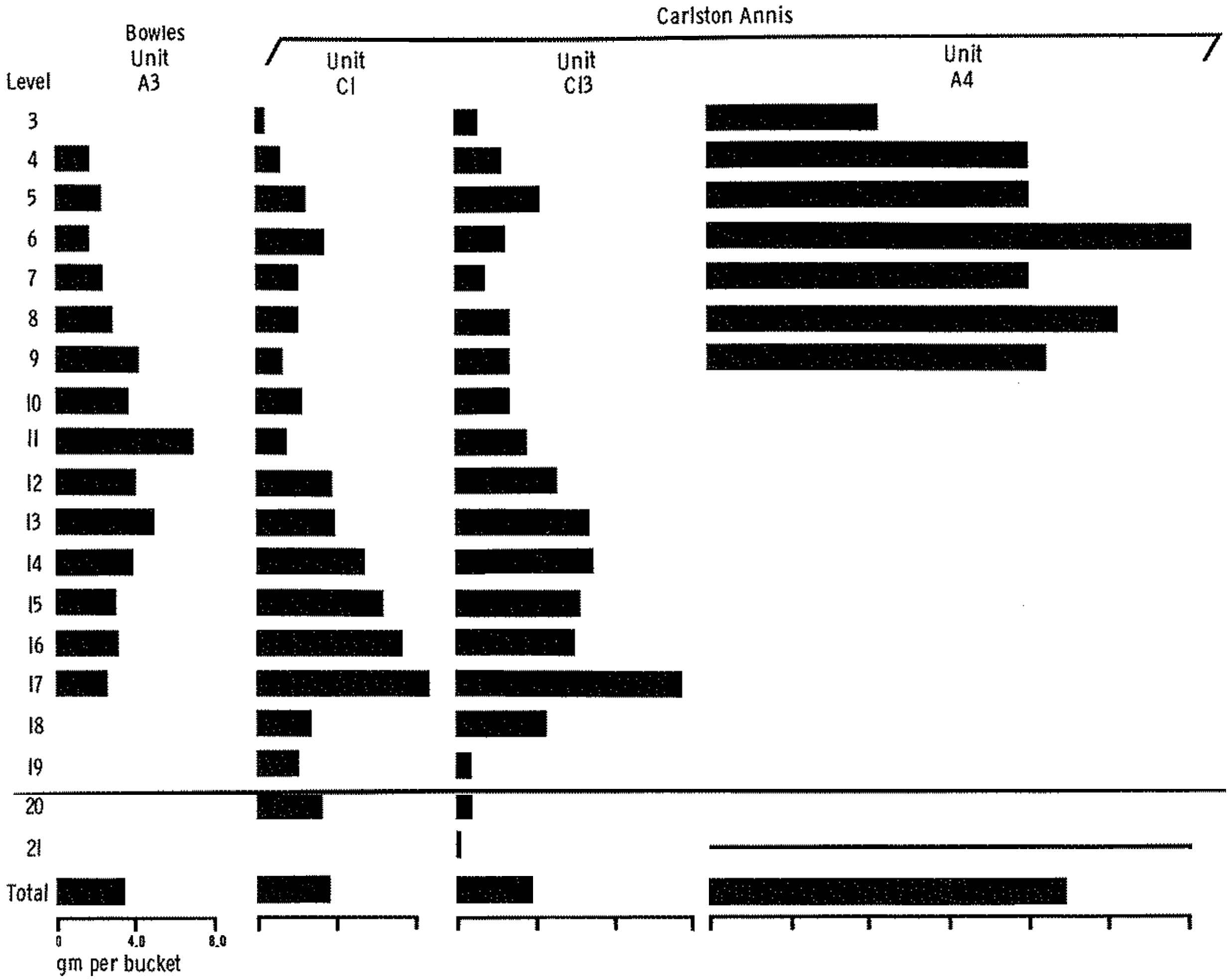

Figure 10.13. Bowles and Carlston Annis flotation samples: Densities of total light fractions.

A statistic that is useful for comparing abundance of plants inhabiting open, sunny areas and forest edges with total plant food (mainly nutshell) is seeds per gram plant food. Seeds per g plant food ratios (or seeds per g nuts) are usually less than 2.0 for the Late Archaic including Peter Cave and less than 4.0 for the terminal Archaic (Table 10.15, and Yarnell and Black 1985) indicating the relative importance of nuts during this stage. At the Middle Woodland Macoupin site in the Illinois Valley, the seeds per g plant food ratio is 38 times that calculated for the Middle Archaic horizons 6 and 8 at Koster (Asch, Ford, and Asch 1972). At Salts Cave Vestibule the ratio increases in the upper levels, reflecting an intensification of plant husbandry and a greater reliance on non-nut plant food (Yarnell 1974:117, 121). The same pattern holds true in North Carolina, Tennessee, Alabama, Georgia, Mississippi, and Louisiana where seeds per g nutshell increase significantly only after 2500 B.C. (Yarnell and Black 1985). A few levels at Carlston Annis have seed per g plant food ratios greater than 20; the higher ratios are generally in the upper levels (Zone 1). This suggests some increase in ecological disturbance, but still not what one would expect if gardening were a major activity.

Even without food production in the Late Archaic, some degradation of local habitats would be associated with the long-term use of the shell mounds and their immediate environs. Tools such as adzes, axes, and celts that were probably used in land clearance are common at the shell mounds and are technological evidence for the creation of forest openings (see Yarnell 1982:6). Weedy annuals commonly associated with gardening and open, sunny habitats, are not abundantly represented in our samples. Rather, the taxa identified, with the exception of wild rice, are associated with forest edges and clearings, or are more productive in such areas. This is also true for acorn, hickory, and walnut. Nut trees are far more productive on forest edges or in openings than in mature forests. Persimmon, common in rich bottomlands, is an invader of open fields and flourishes in open woods. Cowan (1985:219) points out that both plum and persimmon are rare in archaeological assemblages until the Late Woodland and Mississippian when ecological disturbance due to agriculture was extensive. Anthropogenic communities are represented in the Green River data, but their extent is difficult to quantify. The gastropods in the middens, especially *Inflectarius inflectus*, support the hypothesis of open habitats and

Table 10.13. Seed Density as Number of Seeds per Bucket of Sediment.

Level**	BOWLES	CARLSTON ANNIS			PETER CAVE	
	A3	C1	C13	A4	A	B
2	*	*	*	*	0.3	0.5
3	*	0.6	0.3	–	0.6	0.3
4	0.1	2.0	0.1	0.4	1.7	1.3
5	0.4	0.3	0.6	1.3	0.5	1.2
6	0.5	0.2	0.2	0.6	0.4	–
7	0.5	0.2	0.1	0.4	0.8	0.5
8	0.4	–	0.1	0.8	–	0.6
9	0.7	0.2	0.6	0.5	*	*
10	0.5	0.4	0.8	–	*	*
11	1.1	0.8	0.5	*	*	*
12	0.4	0.4	0.7	*	*	*
13	0.7	0.8	2.0	*	*	*
14	0.6	0.9	0.8	*	*	*
15	0.4	1.1	0.8	*	*	*
16	0.8	1.0	1.0	*	*	*
17	0.2	1.8	0.9	*	*	*
18	*	0.6	1.1	*	*	*
19	*	0.2	–	*	*	*
20	*	0.6	–	*	*	..
21			–	*	*	*
Average per unit	**0.6**	**0.6**	**0.5**	**0.6**	**0.6**	**0.6**

* not sampled
** These are excavated levels, or "spits"; hence, level ("spit") designations at one site or one unit are not equivalent to those at another site or another unit

secondary growth in the vicinity of the shell mounds (Baerreis, this volume, Chapter 12).

The three zones underlying the shell-free midden at Carlston Annis are delineated by quantitative changes in types of gastropods and types of plant remains. Baerreis (this volume, Chapter 12) cites evidence for a period of aridity in a middle zone corresponding to Zone II followed by a moister period coincident with Zone I in which acorn to hickory ratios are highest. An earlier moist period, according to the gastropods, coincides with Zone III but is not associated with high acorn to hickory ratios, so factors besides moisture seem to affect the nut ratios.

Reconstruction of local vegetation during this period is complicated by the diverse mosaic of deciduous and evergreen forest types producing a gradient in vegetation composition in the Southeast (Delcourt 1979:277). The shell mounds were occupied at approximately 4000 B.P. at the end of the Hypsithermal or Atlantic climatic episode. Vegetation in the Southeast underwent significant changes during the period from 8000 to 4000 B.P. (Delcourt and Delcourt 1981:150). This period is marked by a drier episode characterized by an oak-hickory maximum about 7000 B.P. The prairie peninsula reached its maximum extension from 8700 to 5000 B.P. in neighboring Illinois (King and Allen 1977).

The importance of nut resources during the Archaic in general and the increased significance of acorns through time at the shell mounds are likely to have an anthropogenic component (see Gardner 1987 for a detailed discussion of nut trees and anthropogenesis). As the climate became moister after the driest episode at about 7000-6500 B.P., oak gradually declined from as much as 70 percent of the pollen to 40-50 percent by 4000 B.P. (e.g., Bernabo and Webb 1977; Watts 1971; Whitehead 1965). Acorn remains are found in varying proportions in Late Archaic Illinois and Kentucky, but nowhere are they as relatively common as in the upper levels of the shell mounds (Table 10.15). Acorn appears to become common in the shell mounds sequence at a time when oaks were becoming less common, at least regionally. Local oak succession may explain this apparent contradiction. An increase in acorn, similar to that at the shell mounds but less pronounced, is noted at Salts Cave (Yarnell 1974:116). The Salts Cave Vestibule deposits date to the third millennium B.P. (Gardner 1987) so the increase occurs later than at the Green River sites. Oak pollen increases to a maximum of 27 percent in JIV, level 4, Salts Cave Vestibule (Schoenwetter 1974). The acorn and oak pollen increases may be a result of local oak succession after human disturbance.

Table 10.14. Peter Cave Summary Ratios for Excavation Units A and B.

Level*	Sample Density (gm/bucket)		Plant Food Density (gm/bucket)		Seeds/gm Plant Food	
	A	B	A	B	A	B
2	1.59	0.14	0.96	0.01	0.3	3.4
3	1.94	0.36	8.90	0.05	0.1	5.5
4	3.51	2.06	8.10	0.30	0.2	4.4
5	1.58	1.70	4.00	0.81	0.1	1.4
6	2.41	3.22	4.08	1.06	0.1	1.4
7	2.32	0.98	4.16	0.54	0.2	0.9
8	2.77	2.30	18.33	1.37	–	0.4
Average per unit	**2.30**	**1.54**	**6.93**	**0.59**	**0.1**	**2.3**

* These are excavated levels, or "spits"; hence, level ("spit") designations at one site or one unit are not equivalent to those at another site or another unit.

One reason for the occupation-specific timing of the change in relative abundance of acorn and a few other species may well be the human use of fire. At Cliff Palace Pond, the pollen and charcoal profiles indicate that people increased the relative abundance of fire-tolerant trees such as oak and black walnut (Delcourt et al. 1998:276). Anthropogenic fire was a component of the food production regime that was well established by 3000 B.P. on the plateau at sites such as Cold Oak Shelter (Gremillion 1993). Techniques for plant and land management evident on the Cumberland Plateau only 50 km east of the Big Bend were probably developed and used much earlier by the shell mound occupants. The abundance of acorn in the later levels at the shell mounds is consistent with a model of fire-induced succession. The fire tolerant black walnut is rare at the shell mounds but is generally only recovered from later levels too.

Contrasts between the Green River Archaic and the Salts Cave Vestibule serve to emphasize the distinctions between the mainly foraging Archaic peoples and the more horticultural Salts Cavers. Significant similarities and contrasts have been outlined elsewhere (Crawford 1982:210-211; Watson 1985:125-6). The major qualitative and quantitative distinctions are in the upper levels of the Salts Cave Vestibule deposits, when plant husbandry was intensifying. The plant taxa occurring exclusively in the Salts Cave samples, and absent from the Green River samples (Table 10.16), are most abundant in the upper levels. These plants (amaranth, maygrass, ragweed, blueberry, sumac and pokeweed, gourd, and sumpweed) are good indicators of anthropogenic habitats. Cultigens were important from 3000 B.P. on. Hickory is abundant at both sites and nuts comprise a similar proportion of the total plant food remains. No acorn meat occurs in the Salts Cave Vestibule samples.

Some of these differences may be attributable to physiographic contrasts between the two areas. The shell mounds are on extensive bottomland where hackberry, honey locust, walnut, hickory, and oak are relatively common. These all occur in Mammoth Cave National Park, but extensive bottomlands are not found in the Mammoth Cave - Salts Cave vicinity. Only hawthorn, wild rice, and the three identified knotweed species at the shell mounds are missing from accounts of the Park vegetation (Faller 1975). The Green River Archaic plant remains are consistent with the interpretation that they represent an early phase of a continuum leading to intensive plant husbandry at the end of the Salts Cave sequence.

The Green River Late Archaic plant remains are also, on the whole, consistent with plant remains of similar age from Tennessee and from Cloudsplitter Rockshelter and Cold Oak Shelter in eastern Kentucky. Intensified plant husbandry is present by the third millennium B.P. and involves bottle gourd and *Cucurbita* as well as sunflower, sumpweed, chenopod, maygrass, and giant ragweed. Two others, *Polygonum erectum* and *Hordeum pusillum* (little barley), are probably cultivated by Middle Woodland times, according to data from the Illinois River valley (Asch and Asch 1985). Early Woodland archaeobotanical data are lacking from the Illinois River valley; paleofecal and flotation sample series from Mammoth Cave National Park, and archaeobotanical remains from Cloudsplitter as well as other eastern Kentucky rockshelters are still the best Early Woodland plant assemblages available (Gremillion 2002).

Polygonum erectum is rare in Koster and Napoleon Hollow Archaic contexts. The Riverton knotweeds are not *P. erectum* (Table 10.17). The same can be said for the Green River Archaic where *P. erectum* is only 16 percent of the knotweeds. Nevertheless, its absence on mudflats and preference for anthropogenic habitats (Asch and Asch 1985:184-185) suggests that this knotweed was related to human occupation in the Kentucky Late Archaic as well as in the Illinois River valley Archaic. Little barley is rare before 2000 B.P. in Illinois, with the exception of the Terminal Archaic occupation at the Gardens of Kampsville site (Asch and Asch 1985). Its presence at Carlston Annis is noteworthy, but it is only a single specimen. The only plant (besides *Cucurbita*) that both eventually reaches cultigen status in the east and is present in the Green River Late Archaic is *Chenopodium*. It is a minor food plant in the west-central Illinois Archaic, although it is relatively common in the Late Archaic

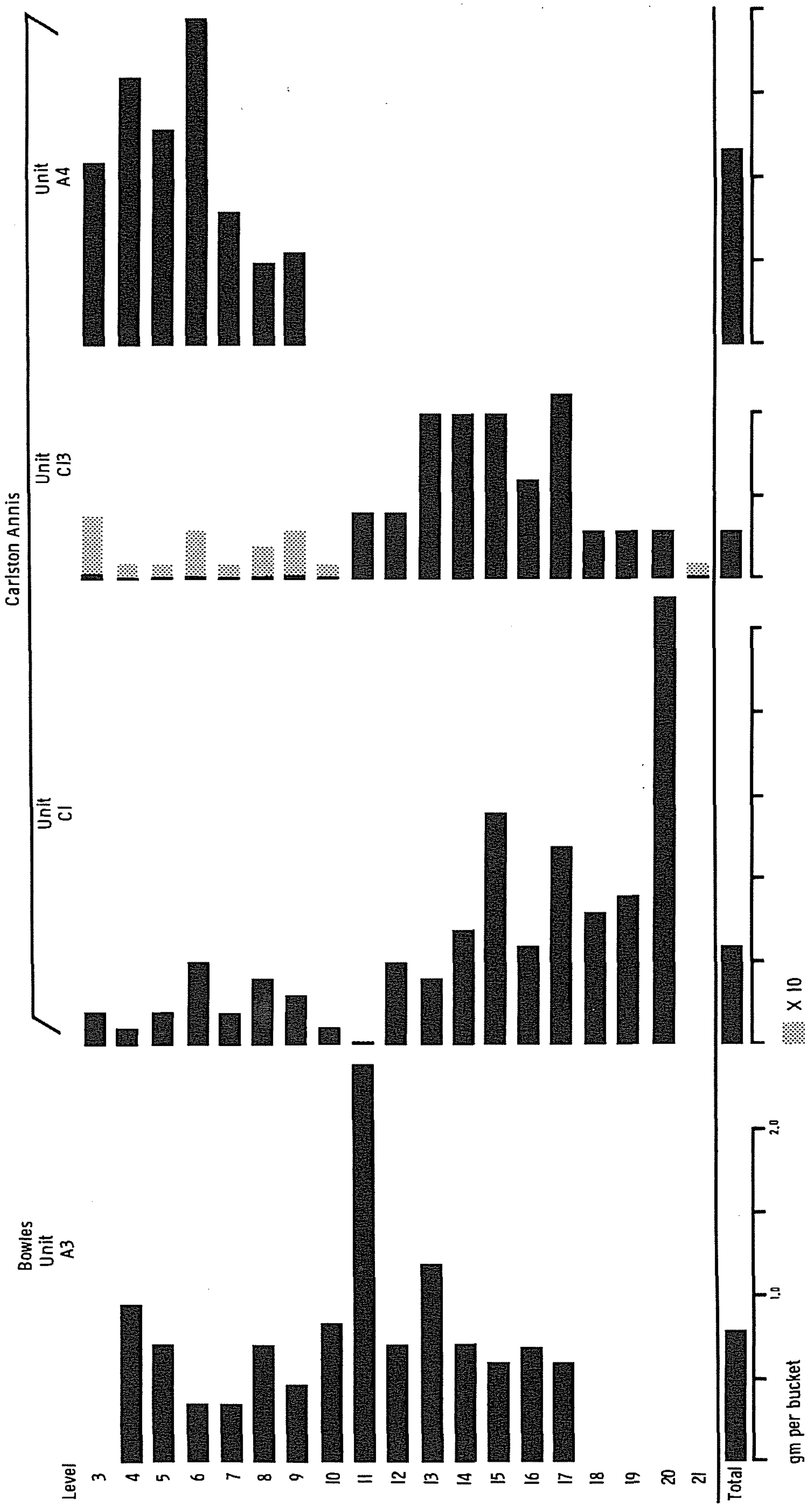

Figure 10.14. Bowles and Carlston Annis flotation samples: Densities of plant food remains.

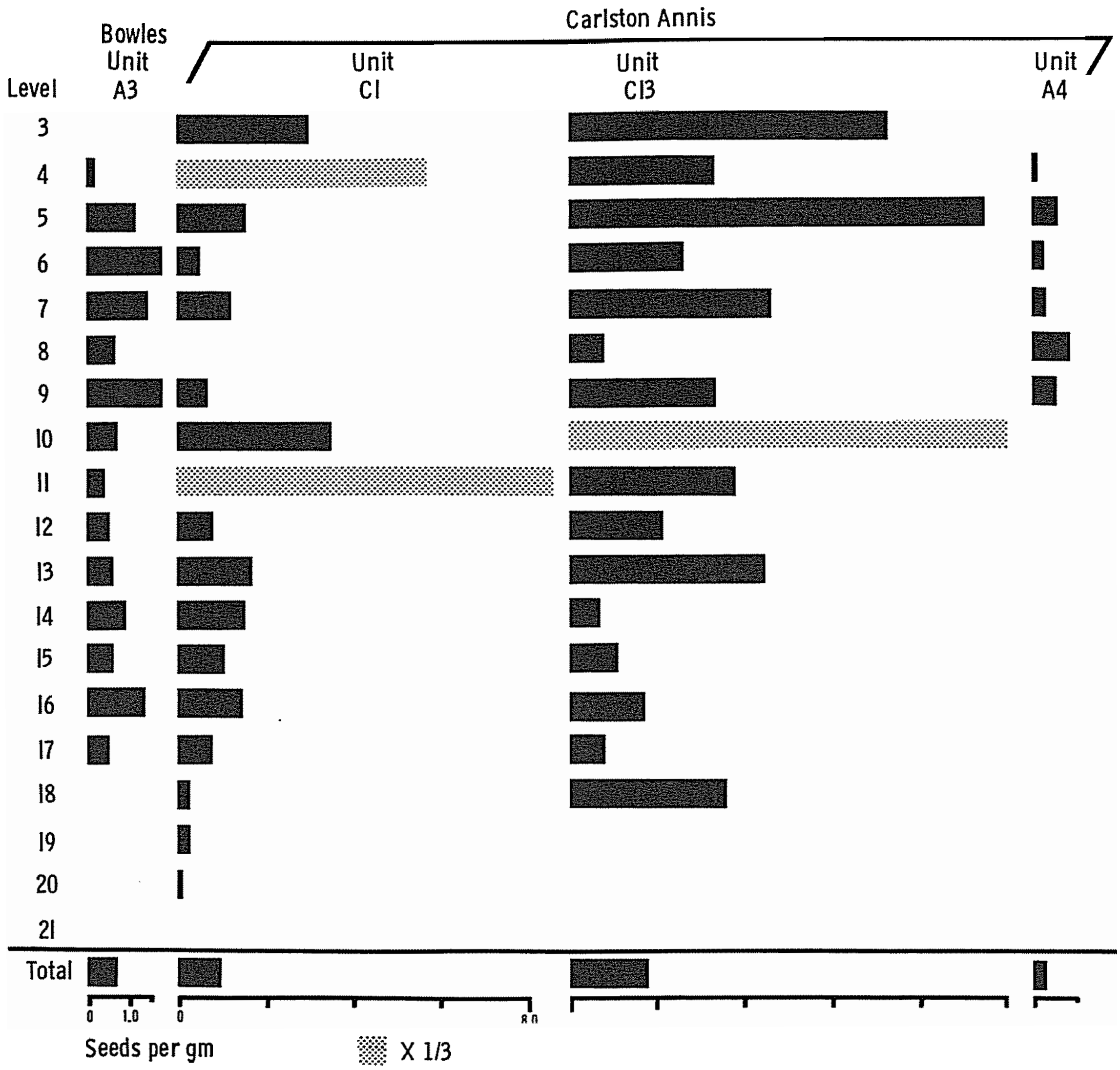

Figure 10.15. Bowles and Carlston Annis flotation samples: Number of seeds per gram of plant food.

(4000 B.P.) Titterington Phase (Asch and Asch 1985:171; Brown and Vierra 1983:175). It is also rare at Carlston Annis and Peter Cave, and does not appear at Bowles. Cowan believes that the chenopod in 3000 B.P. deposits at Cloudsplitter is intrusive from later levels (1985:238), but its presence in Kentucky during the Late Archaic and its abundance at Salts Cave suggest that this is not necessarily the case.

There is one major contrast between the Late Archaic plant remains in Illinois and Kentucky. *Iva* (sumpweed) domestication appears to be underway by 4000 B.P. in the Illinois River valley (Asch and Asch 1985:159). It is an important component of Salts Cave Early Woodland crops (Yarnell 1974) but is conspicuously absent from the Green River Late Archaic, nor is *Iva* present at Cloudsplitter before 3000 B.P. (Cowan 1985). Cowan (1985) cites two stands of *Iva* growing in Kentucky today as evidence that domestication of the plant could have begun in any number of areas (presumably including Kentucky). The current status of *archaeological Iva* data from Kentucky still favors a more prudent suggestion: that *Iva* domestication was not being initiated in Kentucky, at least in the Archaic when its domestication was beginning in the Lower Illinois Valley.

In this chapter I have examined the technical details of the plant remains (identifications, taxonomies, and so forth), the status of cultigens and plant husbandry, phases in the mound occupation that share similar flotation sample composition and their possible relationships with climate and anthropogenesis, and Archaic plant food subsistence patterns on the Green River. Since this research began, perhaps more questions have been raised than answered, and two very basic questions remain: first, under what circumstances and conditions did plant husbandry begin here, and, second, what is the explanation for changes in the archaeobotanical assemblages of the Green River Archaic shell mounds?

Table 10.15. Summary of Flotation Analyses from Selected Late Archaic Sites in Eastern North America.

SITE	Approximate Dates	Seeds per Gram Plant Food	Total Plant Food Weight (gm)	Percent Total Plant Food: Hickory	Acorn	Walnut	Hazel	Number of Samples	References
Higgs	900 B.C.	285.0	2.0	–%	65.0%	–%	–%	2	McCollough and Faulkner (1973)
Banks III	2000 to 1000 B.C.	–	6.7	76.9	–	22.7	–	4	McCollough and Faulkner (1976); Faulkner, Corkran and Parmalee (1976)
Icehouse Bottom	1170 B.C.	0.3	88.7	45.6	21.0	33.3	–	4 (1 feature)	Chapman (1973)
Riverton	1500 to 1000 B.C.	1.9	335.0	9.8	44.6	84.1	0.4	50	Table 17, this chapter
Iddins	1700 to 1250 B.C.	1.3	743.6	11.0	*	89.7	–	64	Chapman and Shea (1981)
n Bend	2440 to 1630 B.C	0.0	61.8	40.7	1.1	56.6	–	1	Chapman and Shea (1981)
Salts Cave, Op. I IV									
Levels 22-12	ca. Early Woodland	3.5	20.3	99.0	–	–	–	47	Corkran (1974)
Level 4		28.5	189.3	93.7	*	–	*	67	Yarnell (1974)
Bowles	ca. Late Archaic	0.7	147.2	91.2	7.1	*	–	225	Crawford (this chapter)
Carlston Annis									
C1	ca. Late Archaic	1.0	235.2	83.4	17.5	*	*	362	Crawford (this chapter)
C13		1.8	104.9	90.5	9.4	*	–	353	
A4		0.3	166.9	97.7	1.6	1.0	–	73	
Koster									
Horizon 6	5000 to 3000 B.C.	0.2	292.7	97.5	1.4	1.0	–	603	Asch, Ford, and Asch (1972)
Horizon 8		(?)	24.4	93.4	2.9	3.7	–		

* less than 1.0%

Table 10.16. Comparison of Plant Taxa Recovered from the Green River Sites.

Taxa Present at Shell Mounds, Peter Cave, and Salts Cave	Present Only at Shell Mounds and/or Peter Cave	Present Only at Salts Cave
	Nuts	
acorn hazel hickory	walnut	
	Grain Seeds	
chenopod (rare at shellmounds) knotweed type 2: *P. erectum* Paniceae grass	knotweed Type 1 knotweed Type 3 type 1 grass wild rice (rare) wild bean (rare) senna	amaranth maygrass ragweed (rare)
	Fleshy Fruit Seeds	
blackberry grape honey locust strawberry	elderberry hackberry hawthorn persimmon plum	blueberry sumac pokeweed
	Other Seeds	
purslane legumes	cleavers tickclover (?)	
	Cultigens	
squash		gourd, sumpweed

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Table 10.17. Riverton Site Flotation Samples: Plant Food Remains as Percentage of Total Plant Food Weight (gm) and Numbers of Carbonized Seeds (based on Winters and Yarnell 1968, Table 2)[a]

Sample	Total Plant Food Weight (gm)	PLANT FOOD COMPONENTS (% of Total Weight)							SEEDS (Count)					
		Walnut Shell	Hickory Nutshell	Acorn	Hazel Nutshell	Bitternut Shell	Butternut Shell	Unidentified	Chenopod	Elderberry	Knotweed	Sunflower	Persimmon	Unidentified
R/5	0.20	–	–	–	–	–	–	100.0	–	–	–	–	–	–
R/10	0.01	100.0	–	–	–	–	–	–	5	–	–	–	–	2
L9	0.04	–	–	25.0	25.0	–	–	50.0	1	–	–	–	–	–
L11	0.09	33.3	66.6	–	–	–	–	–	2	–	–	–	–	–
L14	0.21	33.3	–	19.0	–	–	47.6	–	–	–	–	–	–	g.
Unid.	6.65	1.5	0.1	46.6	–	51.1	–	–	–	–	–	–	–	–
A	0.23	56.5	26.1	–	–	–	–	17.4	1	–	–	–	–	–
Sift.	16.25	91.1	8.0	–	0.1	–	–	–	–	–	–	–	–	–
F1	31.63	87.7	9.2	*	1.4	0.1	3.2	–	105	4	–	–	–	g.
F1b	63.89	91.6	7.6	–	*	–	0.8	–	202	1	–	–	–	–
F4	1.99	5.0	72.9	1.5	20.6	–	–	–	1	–	–	–	–	g.
F6	17.40	6.3	93.7	–	–	–	–	–	3	–	–	–	–	–
F6a	–	–	–	–	–	–	–	–	200	–	–	–	–	–
F8	0.02	50.0	50.0	–	–	–	–	–	–	–	–	–	–	–
F8a	17.44	29.2	7.2	54.4	*	8.9	0.1	0.2	23	–	11	1	1	2
F11	0.08	–	–	–	12.5	–	–	87.5	–	–	–	–	–	–
F13a	160.90	98.3	0.2	0.6	–	–	0.6	0.3	30	–	–	–	–	–
F15	6.14	74.1	18.7	0.8	2.0	0.8	0.5	3.0	6	–	–	–	–	–
F16	0.10	40.0	50.0	–	10.0	–	–	–	9	1	–	–	–	–
F18	0.15	–	100.0	–	–	–	–	–	–	–	–	–	–	–
F25	0.06	–	100.0	–	–	–	–	–	–	–	–	–	–	–
F25N	2.69	24.2	4.8	59.5	–	10.8	–	0.7	4	–	–	–	–	–
F29	0.10	–	80.0	10.0	–	–	–	10.0	8	–	–	–	–	–
F32	3.24	4.9	79.0	4.3	10.2	0.6	–	0.9	3	–	–	–	–	–
Floor	5.32	97.7	0.7	–	–	–	1.5	–	–	–	–	–	–	–
An. 2	0.03	–	100.0	–	–	–	–	–	–	–	–	–	–	–
Total	334.86 gm	82.5%	9.8%	4.6%	0.4%	1.6%	8.2%	0.3%	603	6	11	11	1	7

[a]see also Winters (1969) and Yarnell (2004)
* less than 0.1 %
g. = 1 grass seed

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