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INFERRED DATING OF OZARK BLUFF DWELLER OCCUPATIONS BASED ON ACHENE SIZE OF SUNFLOWER AND SUMPWEED

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ABSTRACT.—Samples of cultigen sunflower and sumpweed achenes recovered from archaeological sites in eastern North America gradually increase in average size during the last 3000 years of prehistory. Although there are apparent exceptions, achene collections from the same general time period fall within a relatively restricted mean size range. Achene samples of both sunflower and sumpweed have been recovered from several Ozark Bluff Shelters, but the dating is highly problematical. The sumpweed samples fall into 2 distinct size categories which indicate that they derive from 2 separate time periods, one during Mississippian times and the other during early Late Woodland times. The sunflower samples display a more continuous mean size variation and seem less reliable as chronological indicators.

INTRODUCTION

Seeds and achenes of cultigen sunflower (*Helianthus annuus* var. *macrocarpus* Ckll.) and sumpweed (*Iva annua* var. *macrocarpa* Jackson) have been recovered from many archaeological sites in eastern North America ranging in age from about 1500 B.C. to late prehistoric times. Sunflower husbandry has continued to the present, but there are no reports of historic sumpweed husbandry. The prehistoric record of these plants has been extensively reported by Asch and Asch (1979), Black (1963), Heiser (1951, 1955), Struever and Vickery (1973), Yarnell (1972, 1979), and others. What is of concern here is the gradual increase in size of achenes as a result of domestication during the last 3000 years of prehistory as indicated by more than 30 series of measurements each for archaeological sunflower and sumpweed.

DISCUSSION

Sunflower achenes apparently increased in mean size from approximately 6 x 3 mm up to about 12 x 7 mm, while sumpweed achenes increased from 3.5 x 2.5 mm up to 7.5 x 5 mm. Taking into account an apparent doubling of thickness, the overall increase in sumpweed achene size was approximately eight-fold, while sunflower achene size increased twice that much. Overall increase in sumpweed achene size from the wild progenitor appears to have been approximately twelve-fold, which again is only half the comparable increase for sunflower.

These increases can be interpreted as having been more or less regular and continuous through time even though the available data are still less abundant than preferred, even though there are exceptions to the expectations. The summary data portrayed in Table 1 present a preliminary indication of the patterns of size increase of sunflower and sumpweed achenes. (See Yarnell 1972 and 1979 for more detailed data and sources.) It shows that the average of means of achene length times width gets progressively larger from Terminal Archaic through Early Woodland, Middle Woodland, and early Late Woodland to Mississippian times.

Sunflower and sumpweed achenes from the Ozark Bluff Dwellings and from Newt Kash Hollow shelter in eastern Kentucky are not clearly placed chronologically. Neither are the sunflower achenes from the Mammoth Cave vestibule or the sumpweed achenes from Cloudsplitter and Hooton Hollow shelters in eastern Kentucky. In addition, sample size is too small to be reliable for 8 sites with sunflower and 4 sites with sumpweed. This leaves 17 sumpweed samples (N = 11 to 879) and 11 sunflower samples (N = 9 to 1000) which were used

TABLE 1.—*Average size of sumpweed and sunflower achenes from different time periods as compared to Ozark Bluff Shelter achenes.*

SUMPWEED			SUNFLOWER	
no. of pop. means averaged	**average of means in mm**	**Time Period**	**average of means in mm**	**no. of pop. means averaged**
6	4.2 x 3.2 = 13	Terminal Archaic-Early Woodland	7.4 x 3.2 = 24	4
8	5.6 x 3.8 = 21	Middle and Early Late Woodland	7.8 x 4.0 = 31	3
		(without Boyd, MI)	(8.0 x 4.4 = 35)	(2)
3	7.2 x 4.9 = 35	"Mississippian"	11.4 x 6.1 = 70	4
		(without Wilford, MI)	(11.9 x 6.7 = 80)	(3)
		Ozark Bluff Shelters		
2	5.5 x 3.9 = 21	smaller achenes	10.1 x 5.4 = 55	2
		intermediate	10.8 x 6.3 = 68	2
4	7.3 x 4.9 = 36	larger achenes	11.6 x 7.7 = 89	2
no. of achenes	mean size		mean size	no. of achenes
300	5.5 x 3.9 = 21	Edens - 1706	9.7 x 5.2 = 50	12*
300	5.5 x 3.9 = 21	Craddock 66 - 380	10.3 x 5.9 = 61	17
		Craddock 66 - 186	10.7 x 6.3 = 67	32
		Craddock 66 - 384	10.9 x 6.3 = 69	150
		Craddock 67 - 548	11.3 x 7.2 = 82	14
		Brown Bluff - 78	11.9 x 8.1 = 96	56
56	7.1 x 5.0 = 36	Craddock - 552		
91	7.3 x 4.8 = 35	Alred - 103		
250	7.4 x 4.8 = 36	Alred (32-4-156)		
45	7.5 x 5.1 = 38	Edens - 980a		

*This includes 3 achenes collected by Dellinger, measured by Heiser, and identified as "University of Michigan Lab. No. 276-12800(15478H - Ark. (E 1706)" (Heiser 1953).

in order to derive an average achene size for each of 3 broad perhistoric periods: Terminal Archaic and Early Woodland, Middle Woodland and early Late Woodland, and "Mississippian" (including Fort Ancient). The number of usable samples is minimal, but the results are generally supported by data from the smaller samples and by analyses of Asch and Asch (1979) and Andrea B. Shea. In addition, there are indications that the reconstruction factors for estimating original achene size from carbonized sumpweed seed and achene size tend to underestimate the mean size of larger achenes (Asch and Asch 1979; A.B. Shea, personal communication). It is suspected that the same is true for sunflower.

The product of length and width in mm is taken to be a reliable indication of achene size for purposes of comparison. For sumpweed these figures are 13, 21, and 35 for the 3 broad periods from earliest to latest. The comparable figures for sunflower samples are 24, 31, and 70. Two sunflower samples from the Yazoo Basin in western Mississippi are exceptionally small for their age. Achenes from the Boyd Site with an estimated date of A.D. 500 (John Connaway, personal communication) average the same size as sumpweed achenes from the same site (see Table 2), and achenes from the Mississippian period Wilford Site have a mean length times width of only 41. It appears that these sunflowers, grown at the southern margin of the prehistoric sunflower belt, perhaps in damp soil, produced smaller achenes than those produced elsewhere at the same time. If we delete these 2 samples, the size progression for sunflower becomes 24, 35, and 80 through the 3 periods. This seems nearer to the reality of prehistoric evolution of sunflower achene size under domestication. It also is a better indication of the vast increase in sunflower achene size during Late Woodland and Mississippian times.

If we compare the sizes of sumpweed and sunflower achenes from Newt Kash Hollow (21 and 29; see Table 2) to the size progression portrayed in Table 1, they seem to fit best into Middle Woodland to early Late Woodland times; but they may have a mixed composition. This age seems about right for the Hooton Hollow sumpweed also, but the initial Cloudsplitter sumpweed collection fits well into the Early Woodland size category. The Mammoth Cave Vestibule sunflower, collected by Nelson and measured by Heiser, is much too large for an Early Woodland assignment but accords well with a Late Woodland designation.

On the basis of a limited series of measurements, I had assumed until recently that all of the sunflower and sumpweed from the Ozark Bluff shelters were Mississippian in age, probably not earlier than A.D. 1100 to 1200. Early in 1978 the University of Arkansas Museum graciously allowed access to collections there in order to select samples of Arkansas

TABLE 2.—*Sumpweed and sunflower from the same source.*

SUMPWEED			SUNFLOWER	
no. of achenes	mean size		mean size	no. of achenes
309	3.7 x 2.7 = 10	Salts Cave J IV: 4 - 11	7.4 x 3.3 = 24	57
40	4.0 x 3.1 = 12	Mammoth Cave cadaver	7.0 x 3.1 = 22	80
879	4.2 x 3.2 = 13	Salts Cave feces	7.4 x 3.2 = 24	1000
74	5.5 x 3.9 = 21	Newt Kash Hollow, KY	8.6 x 3.4 = 29	14
20	6.1 x 4.2 = 26	Boyd, MI	7.3 x 3.4 = 25	10
13	5.7 x 3.9 = 22	Hooton Hollow shelter, KY	9.0 x 4.0 = 36	4
74	6.0 x 4.2 = 25	Haystack shelter, KY	9.0 x 4.0 = 36	2
19	6.2 x 4.2 = 26	Rogers shelters, KY	8.6 x 4.1 = 35	11
300	5.5 x 3.9 = 21	Edens - 1706	9.7 x 5.2 = 50	12
300	5.5 x 3.9 = 21	Craddock 66 - 380	10.3 x 5.9 = 61	17
19	7.0 x 4.5 = 32	Paul McCulloch, MO	12.6 x 6.6 = 83	1000

Bluff Dweller sunflower and sumpweed achenes for study. With the generous assistance of museum personnel I was able to locate 6 collections of sunflower achenes and 6 of sumpweed, only 2 of which contained both species.

Measurement of the sumpweed achenes revealed that the samples fall distinctly into 2 size categories. Four samples from Craddock, Alred and Edens shelters average 7.3 x 4.9 mm = 36. This is approximately the size expected for all of the Ozark Bluff Dweller samples. However, 2 samples from Edens and Craddock 66, both of which have mean sizes of 5.5 x 3.9 mm = 21, are clearly outside of the expected Mississippian period size range. In fact, they are the same size as the Newt Kash Hollow sumpweed and fall between the Middle Woodland and early Late Woodland expected sizes. This suggests that they should date to around the fifth century A.D. Yet, data included in Tables 1 and 2 indicate that the mean sizes of sunflower achenes from these collections occupy intermediate positions between the early Late Woodland size, on the one hand, and the mean sizes of good Mississippian period collections and the other Ozark collections, on the other hand. Thus it would appear that the 2 Ozark samples with smaller sumpweed and sunflower achenes should date to approximately the seventh century A.D. This assumes that there was no contamination of the sample by larger sunflower achenes from a later deposition.

Two collections of sunflower achenes from Craddock 66 shelter which average 10.8 x 6.3 mm = 68 may be early Mississippian in age, whereas 2 more collections of still larger achenes from Craddock 67 and Brown Bluff shelters should date to well within the Mississippian period. In fact there is a radiocarbon date of A.D. 1110 + 110 (M-1711) on materials with the same collection number (BR - 78) as the Brown Bluff sunflower (Crane and Griffin 1968: 92). These achenes have a mean size of 11.9 x 8.1 mm = 96 which is the largest of any prehistoric collection on record. Mean thickness of achenes in the Ozark sunflower collections is consistent with mean size as determined by length and width.

There is one additional sample of 10 sumpweed achenes, measured by Richard I. Ford (personal communication), with a mean size of 7.0 x 5.2 mm = 36. This is from the Proether shelter in southern Missouri and clearly falls in the Mississippian period size category. Heiser (1953) has measured 2 samples of sunflower achenes from unidentified Ozark shelters. A sample of 9 achenes recovered by M.R. Harrington (Heye Museum No. 11/7265) has a mean size of 9.3 x 4.8 mm = 45 and thus falls near the early Late Woodland size. Another sample of 10 achenes (University of Michigan, Museum of Anthropology No. 13250) with a mean of 11.4 x 7.0 mm = 80 is Mississippian in size.

The chronological indications resulting from determination of sunflower and sumpweed achene size in the Ozark shelter collections are that early Late Woodland and Mississippian occupations are represented, possibly with an early Mississippian component as well, occuring within an inferred time range of the seventh century A.D. or earlier to the twelfth century A.D. or later. These estimates are based exclusively on sunflower and sumpweed achene sizes and are presented with somewhat limited confidence. They were derived independently of the available radiocarbon dates which can be interpreted as providing a chronology that differs in some respects from the chronology based on achene size.

Crane and Griffin (1968: 88-93) have reported 17 dates from 8 Ozark shelters ranging from 40 B.C. to A.D. 1950. Since there is no historic record of giant sumpweed achenes, the 3 latest dates of A.D. 1670, A.D. 1810, and A.D. 1950 should be of no concern, certainly not the last 2. Also it seems unlikely that the date of 40 B.C. (M-1694) from Red Rock shelter is relevant to the sunflower and sumpweed remains. Except for an Edens shelter date of A.D. 630, the remaining dates form 2 clusters. The earlier cluster includes dates of A.D. 200, A.D. 360, and A.D. 370 from Edens, Breckenridge, and Red Bluff shelters. The latter 2 dates might be seen to indicate the age of the collections of smaller sumpweed from Edens and Craddock shelters were it not for the size of the associated sunflower achenes. The later cluster includes 9 dates ranging from A.D. 935 to A.D. 1430 and presumably dates the Mississippian period occupations. Four of these dates range from A.D. 1080 to A.D. 1160, and 7 range from A.D. 1080 to A.D. 1350. It is likely that the collections with large sumpweed achenes and those

with large sunflower achenes date from this period. In fact, as noted earlier, the Brown's Bluff collection containing large sunflower achenes has been dated to this period.

The single early Late Woodland date of A.D. 630 + 120 (M-1703 A) seems most likely to represent the age of the samples of smaller sumpweed achenes from Edens and Craddock shelters, but their actual age may be between this date and the date of A.D. 1080 + 110 (M-1702) which was determined on other materials from the same Edens provenience (Burial E-19). This would be approximately contemporaneous with the sumpweed of similar size from Stilwell and Newbridge in the lower Illinois Valley and some of the rockshelters in eastern Kentucky.

CONCLUSIONS

To summarize, conjecture, and conclude, I suggest that in general we can reasonably expect that the product of mean length times mean width in mm for sizeable collections of sumpweed and sunflower achenes to be approximately:

Sumpweed		Sunflower	
8 to 12	and	20 to 24	for Terminal Archaic samples
12 to 16	and	22 to 26	for Early Woodland samples
16 to 20	and	25 to 35	for Middle Woodland samples
20 to 26	and	35 to 60	for early Late Woodland samples, and
25 to 40	and	50 to 100	for Mississippian period samples.

These estimates are based on the available data and only minimally take into account the expectation that a certain amount of deviation from the norm will be encountered because of the operation of a variety of influencing factors. Currently the data indicate that greater deviation can be expected for sunflower, which might further indicate that greater varietal diversity had developed in sunflower. In any case, it appears 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 degree of accuracy of the estimated size ranges of achenes for each period will eventually be determined when we have an adequate set of measurements for additional collections of archaeological sumpweed and sunflower achenes which have been reliably dated.

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