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NEW PERSPECTIVES ON A WILD GOURD IN EASTERN NORTH AMERICA

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ABSTRACT.— Free-living *Cucurbita pepo* gourds have been documented in different areas in the temperate eastern woodlands since the first few decades of the 19th century. Until recently, however, little attention has been afforded these populations, and their potential role in the evolution of domesticated forms of *pepo* squashes has been obscured. This paper focuses on the botanical history of these free-living gourds, examines the availability of cultivar ornamental gourds to 19th century American gardeners, and summarizes habitat information for contemporary populations in several areas in the East. Important morphological measurements from both contemporary free-living and cultivar *pepo* gourd populations as well as archaeological specimens are compared. Combined, these data suggest that free-living *Cucurbita pepo* gourds are ancient members of an eastern flora, and could well be the progenitors of some domesticated squashes.

RESUMEN.— Desde las primeras décadas del siglo XIX se ha documentado la existencia de calabazos no cultivados de la especie *Cucurbita pepo* en diferentes áreas de los bosques templados del este de los Estados Unidos de Norteamérica. Sin embargo, hasta hace poco se les había otorgado poca atención a estas poblaciones, y su papel potencial en la evolución de las formas domesticadas de la calabaza *pepo* ha sido difícil de discernir. Este trabajo se enfoca a la historia botánica de estos calabazos no cultivados; examina la disponibilidad de cultivares de calabazos ornamentales para los jardineros norteamericanos en el siglo XIX, y resume la información sobre el hábitat de las poblaciones contemporáneas en varias áreas del oriente de los Estados Unidos. Se comparan mediciones morfológicas importantes tanto de poblaciones contemporáneas cultivadas y no cultivadas de calabazos *pepo,* como de especímenes arqueológicos. Estos datos combinados sugieren que los calabazos no cultivados de *Cucurbita pepo* son miembros antigous de la flora del este de Norteamérica, y bien podrían ser los progenitores de algunas calabazas domesticadas.

RÉSUMÉ.— L'existence des gourdes sauvages *Cucurbita pepo* a été documentée dans plusieurs endroits des régions boisées tempérées de l'Est depuis les premières décénies du 19ème siècle. Jusqu'à récemment toutefois, on a prété peu d'attention à ces populations locales, et leur rôle possible dans l'évolution des formes cultivées de la courge *pepo* n'a pas été suggéré. Cet essais est consacré à l'histoire botanique de ces gourdes sauvages. Il examine l'accès des jardiniers américains du 19ème siècle à la forme cultivée des gourdes ornementales, et synthétise les informations sur l'habitat des populations contemporaines dans plusieurs régions de l'Est. D'importantes mesures morphologiques des espèces sauvages et des populations cultivées de la gourde *pepo* contemporaine ainsi que des specimens archéologiques sont comparés. Vues dans leur ensemble, ces données suggèrent que les gourdes *Cucurbita pepo* sauvages sont des ancients membres de la flore orientale, et pourraient parfaitement avoir été les progéniteurs de certaines espèces de courges cultivées.

> . . . Is this Texas cucurbit a garden escape as suggested by Gray, or is it the prototype from whence came the numerous cultivated forms of *Cucurbita pepo*? Is it an indigene or a foreigner?
>
> (A.T. Erwin 1938:253)

INTRODUCTION

In a little recognized and rarely referenced article, A.T. Erwin first posed a question that remains of central importance in documenting eastern North America as an independent center of plant domestication. As might be expected, the question has become more complex and has expanded in scope over the intervening years, but it still involves the status of the Texas wild gourd and related free-living gourds of eastern North America as wild plant versus garden escape, and their possible role as a progenitor in the independent domestication of *Cucurbita pepo* in the eastern woodlands.[1]

The Texas wild gourd grows today along rivers and streams in eastern Texas, and related free-living populations of gourds (able to survive outside of cultivation) are being documented in increasing numbers in other areas of eastern North America. In addition, since the 1980s, rind fragments and seeds of a similar gourd have been recovered from archaeological deposits in eastern North America that predate the earliest evidence of domestication of indigenous seed plants by 2500 years (Smith et al. 1992; Cowan 1990). Over the past decade both these present-day and prehistoric gourds have been the topic of considerable discussion. Do the early *Cucurbita pepo* gourds of the East that predate the circa 4500–3500 B.P. domestication of local plants represent a wild plant indigenous to the region, or an early domesticate introduced from Mexico? If these pre-4500 B.P. gourds can be traced back to Mesoamerica, then agricultural developments in the East might be considered derivative rather than independent, since a tropical crop plant would have arrived in advance of domestication of local species. On the other hand, if these early cucurbits represent an indigenous wild gourd, then there can be little doubt that eastern North America could have been an independent center of plant domestication. The debate regarding these early gourds has added new significance to a long-standing discussion of present-day free-living *C. pepo* gourd populations in eastern North America: do they represent an indigenous wild gourd, or the recent escape from cultivation of a domesticate that ultimately originated in Mesoamerica?

Intertwined with and overlaying these questions is the possibility that *C. pepo* was independently domesticated in eastern North America a full 5000 years after it was first domesticated in Mexico (Flannery 1986). Based on available archaeological evidence for the earliest clearly domesticated *C. pepo* in the East (4000–3000 B.P.), this second episode of domestication would have occurred at the same time as other seed crops were brought under domestication.

Recent biochemical analyses of cultivar and wild populations of *Cucurbita pepo* lend support to the role a wild eastern squash may have had in the domestication process. Isozyme studies indicate two distinct lineages characterize *C. pepo* (Decker-Walters 1990; Decker 1988; Decker and Wilson 1986, 1987; Wilson 1990). One of these seems to have evolved in Mexico, the other in eastern North America. The Mexican lineage contains the marrows and pumpkins while the eastern counterpart includes the crooknecks, acorns, and most cultivated ornamental gourds. The free-living gourds from various areas in the southeast are also part of this lineage. And like many other domesticated members of the lineage, the free-living gourds are vining, monoecious annuals that produce large insect pollinated flowers. They are easily recognizable in the wild by their distinctive sinuously lobed leaves, yellow flowers, and ivory or green striped fruits.

Elsewhere (Smith et al. 1992) we have summarized the theoretical arguments of the proponents of a single Mesoamerican origin for *C. pepo* and those who believe *C. pepo* squash may have been domesticated separately in Mexico and eastern North America. Our purposes in this paper are fourfold: (1) to document the geographical distribution of modern free-living gourd populations in the East; (2) to establish the historic time depth of these gourds; (3) to describe their niche and habitat preferences in the Ozarks of Missouri and Arkansas; and (4) to describe the morphological characteristics of fruits of these populations. The following discussion will make it clear that wild gourds are not limited in distribution to Texas, that the more widely distributed gourd represents an ancient member of an eastern flora, and that the ancestral relationship of this wild gourd to cultivated forms of *Cucurbita pepo* can be partially untangled by a comparison of modern and archaeological collections (see also Decker-Walters et al. and Newsom et al. this volume).

DOCUMENTING THE GEOGRAPHICAL RANGE OF FREE-LIVING GOURDS IN THE MIDWEST AND SOUTHEAST

Free-living populations of *Cucurbita* gourds in eastern North America have been collected for over 150 years. In addition to those in eastern Texas recognized in the 1830s, specimens were also collected in the 1840s as far north as St. Louis, Missouri. Although the specific status of the plant is uncertain, wild gourds may also have been identified in peninsular Florida near the beginning of the last quarter of the nineteenth century (see below). By and large, however, with the exception of discussions of the Texas wild gourd (*Cucurbita pepo* ssp. *ovifera* var. *texana*) these populations have been afforded little importance by most professional botanists. Until recently, their role in the evolution of cultivated forms of *Cucurbita pepo* has been assumed to be negligible.

Until the mid-1980s relatively little attention was focused on *C. pepo* gourd populations outside of Texas, likely because they were assumed to be ephemeral escapes from cultivation (Asch and Asch 1985:157; Heiser 1985:16–17). Julian Steyermark appears to have played an important role in establishing that free-living *C. pepo* gourds outside of Texas were a legitimate target for collection. He collected specimens from southwest Missouri in the 1950s, distributed herbarium sheets of the plants to other institutions, and included a distribution map and plant illustration in his landmark publication *Flora of Missouri* (Steyermark 1963). Steyermark's inclusion of this gourd seems to have encouraged other botanists to collect it, and led to its addition to other state floras. In Illinois, for example, it is absent from a 1955 survey (Jones and Fuller 1955) yet is documented as present in seven counties in the next published atlas (Mohlenbrock and Ladd 1977). Similarly, while it goes unmentioned in earlier surveys, "*C. pepo* ssp. *ovifera*" is recorded in 10 Arkansas counties in Edwin Smith's 1978 state atlas (E. Smith 1978, 1988), with many of the relevant herbarium specimens collected in the mid-1970s.

Another important impetus to the collecting and documentation of free-living gourd populations outside of Texas came in the mid-1980s when Decker-Walters included gourds from Illinois, Arkansas, and Alabama in her dissertation research on the taxonomy and evolution of *C. pepo* and proposed that these var. *texana*-like geographical outliers might represent relict populations of a wild indigenous gourd (Decker 1986). As a result of Decker-Walter's inclusion of these specimens, Heiser added them to his distribution map for var. *texana*, expanding it to encompass the "distribution of *C. texana* and plants approaching *C. texana*" (Heiser 1989:473). Similarly, Michael Nee included eastern free-living outliers recorded for Missouri (Steyermark 1963), Illinois (Mohlenbrock and Ladd 1977), Arkansas (E. Smith 1988), and Alabama on his geographical range map for var. *texana*, with the caption note that "some dots outside of Texas may represent feral *C. pepo*" (Nee 1990:61). Decker-Walter's research, and the subsequent mapping efforts of Heiser and Nee, marked an important shift in that they considered both Texas and "outlier" populations of var. *texana* and began to chart the full geographical distribution of free-living *Cucurbita pepo* gourds in the southern and eastern United States.

Building on these studies, we began a more concerted effort in the fall of 1990 to establish the range of free-living *Cucurbita pepo* gourds. Herbaria were canvased regarding accessions of "escapes" of *Cucurbita* (often listed as *C. pepo* ssp. *ovifera*), colleagues were questioned regarding sightings of free-living gourds, and an initial survey of drainages in the eastern Missouri and Arkansas Ozarks was conducted in November of 1990, complementing the surveys carried out by Michael P. Hoffman and his students in the western Ozarks over the past several years (see Smith et al. 1992). The initial results of this distributional study are shown in Fig. 1 and summarized in Table 1. Outside of Texas, 26 county records were added to the 29 previously documented, and fruits were collected from over 30 locations in seven states (Table 1). Within Texas, gourd populations were documented in 20 counties.

Based on our survey, the primary present-day geographical range of free-living *Cucurbita pepo* gourds west of the Mississippi River extends in a broad north-south band from south-central Texas to central Illinois. Stretching for more than

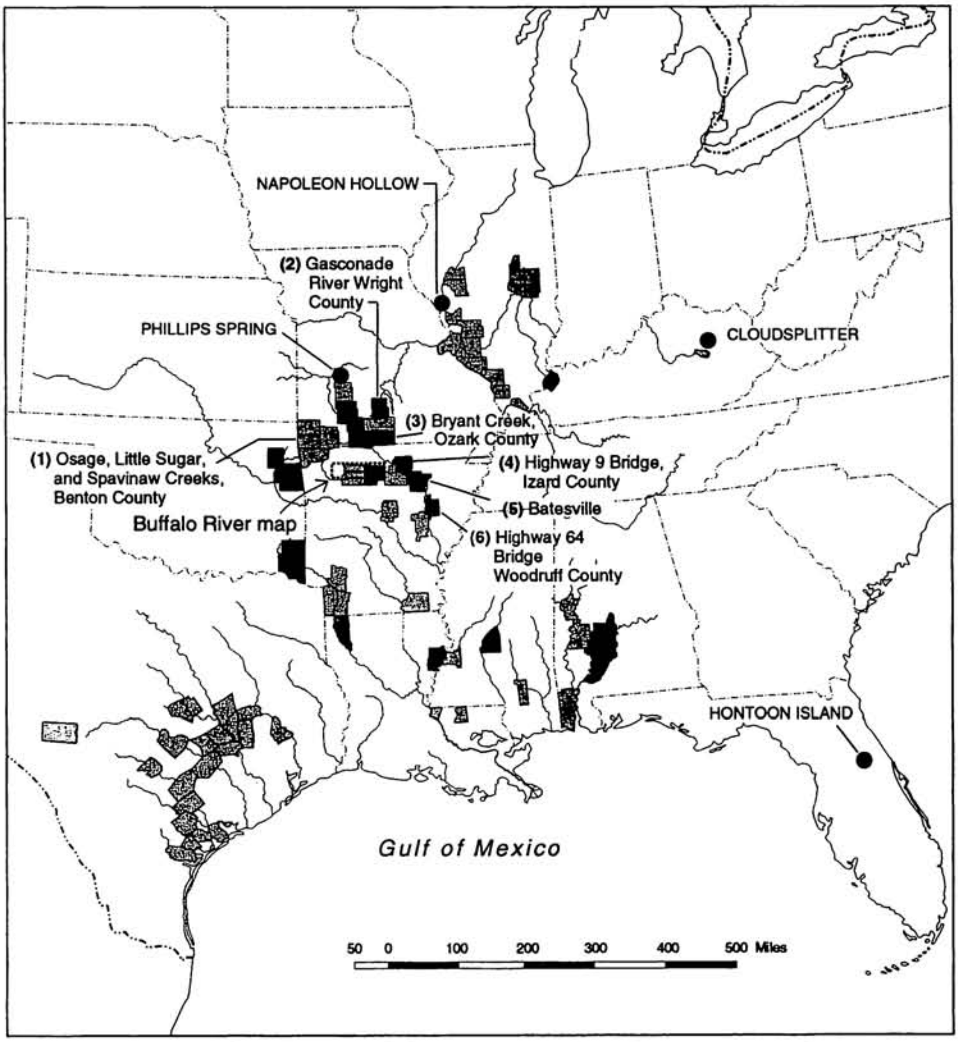

FIG. 1.—Current distribution of free-ranging *Cucurbita pepo* gourds in eastern North America based upon field studies and herbaria records. Dark shaded areas denote counties where field collections were made in 1990–91. Lighter shaded areas denote counties where herbaria records exist.

1,400 kilometers (900 miles) this north-south band appears to be divided into five subareas. In the large Texas subarea populations are documented throughout much of the drainage catchment of the eastern part of the state, occurring in all of the southeastern flowing rivers that enter the gulf of Mexico between Corpus Christi and Galveston (the Nueces, San Antonio, Guadalupe, Colorado, Brazos, and Trinity rivers). An absence of populations to date from the Neches and Sabine drainages separates the Texas subarea from populations documented along the Red River and lower Ouachita River in Arkansas. A similar absence of recorded populations within the Ouachita mountains of west-central Arkansas separates

TABLE 1.—Geographical distribution, by county, of free-living *Cucurbita pepo* gourds in eastern North America.[1]

County	Collector	Year	Herbarium	Reference
ALABAMA				
Dallas	C. Sheldon	1988		this study
Greene	M.L. Roberts	1982	Alabama	
Greene				Decker 1986
Marengo				Decker 1986
Mobile	R. Deramus	1966	Alabama	
Monroe	C. Sheldon	1988		this study
Wilcox	R. Haynes	1978	Alabama	
Wilcox	C. Sheldon	1988		this study
ARKANSAS				
Ashley				Smith 1988
Benton	M. Hoffman	1990		this study
Benton	D. Dickson	1990		this study
Benton	E. McCollum	1990		this study
Faulkner	D. Oliver	1975	Arkansas	Smith 1988
Hempstead	S. Harrison	1976	Arkansas	Smith 1988
Independence				Smith 1988
Independence	Smith and Cowan	1990		this study
Izard				Smith 1988
Miller				Smith 1988
Newton				Decker 1986
Prairie	D. Oliver	1975	Arkansas	Smith 1988
Searcy	B. Hinterthuer	1977	Arkansas	Smith 1988
Searcy	Smith and Cowan	1990		this study
Stone				Smith 1988
Woodruff	Smith and Cowan	1990		this study
ILLINOIS				
Cass				Mohlenbrock and Ladd 1977
Coles				Mohlenbrock and Ladd 1977
Douglas	G. Jones	1966	Illinois	
Douglas	G. Jones	1966	Florida	
Jackson				Mohlenbrock and Ladd 1977
Jersey	G. Fritz	1990		this study
Madison				Mohlenbrock and Ladd 1977
Massac	R. Mohlenbrock	1986		
Morgan				Mohlenbrock and Ladd 1977
Piatt				Mohlenbrock and Ladd 1977
Randolph				Decker 1986
St. Clair?	W. Welsch	1862	Illinois	
St. Clair	H. Eggert	1875	Missouri	
St. Clair	H. Eggert	1876	Texas	
St. Clair	H. Eggert	1892	Missouri	
St. Clair	H. Eggert	1893	Harvard	
St. Clair	H. Eggert	1893	Missouri	
St. Clair	J. Kellogg	1901	Missouri	
Union				Mohlenbrock and Ladd 1977

County	Collector	Year	Herbarium	Reference
KENTUCKY				
Powell	W. Booth	1990		this study
LOUISIANA				
Bossier	L. Baker	1990		this study
St. Helena	C. Allen	1971	LSU	
Tensas	G. Fritz	1990		this study
W. Feliciana	A. Martin	1972	LSU	
MISSISSIPPI				
Claiborne	K. Rogers	1978	Tennessee	
Forrest	K. Rogers	1971	Tennessee	
Rankin	S. Jones	1970	Georgia	
MISSOURI				
Barry	J. Steyermark	1955	Missouri	Steyermark 1963
Christian		1990		this study
Douglas	J. Steyermark	1957	Georgia	Steyermark 1963
Greene	Smith and Cowan	1990		this study
Howell				Steyermark 1963
McDonald				Steyermark 1963
Newton				Steyermark 1963
Ozark	Smith and Cowan	1990		this study
Polk	Smith and Cowan	1990		this study
St. Louis	G. Engelmann	1846	Missouri	Steyermark 1963
St. Louis	G. Engelmann	1846	Missouri	
St. Louis	Muehlenbach	1961	Missouri	
St. Louis	Muehlenbach	1964	Missouri	
St. Louis	Muehlenbach	1972	Missouri	
Taney		1990		this study
Texas	J. Steyermark	1956	Harvard	Steyermark 1963
Wright	Smith and Cowan	1990		this study
OKLAHOMA				
Adair	M. Hoffmann	1990		this study
Cherokee	B. Meyer	1990		this study
Mayes	D. Dickson	1990		this study
TEXAS				
Bell	Mahler 1988			
Brazos	D.S. Correll		Texas	
Brazos				Decker 1986
Burleson				Decker 1986
Calhoun	Harman and Smith		Texas	
Comal	Lindheimer		Texas	
DeWitt	D.S. Correll	1962	SWLS	
DeWitt	D.S. Correll		Texas	
DeWitt	Tharp		Texas	
Fayette				Decker 1986
Goliad				Decker 1986
Gonzales				Decker 1986
Gonzales				Decker 1986
Grimes				Decker 1986

TABLE 1.—Geographical distribution, by county, of free-living *Cucurbita pepo* gourds in eastern North America.[1] (continued)

County	Collector	Year	Herbarium	Reference
TEXAS (continued)				
Lee				Decker 1986
Madison				Decker 1986
Refugio				Decker 1986
Robertson				Decker 1986
San Jacinto				Decker 1986
San Patricio				Jones 1975
Sutton	Reed		Texas	
Travis	A.T. Erwin	1938		Erwin 1938
Travis	Barkley		Texas	
Travis	Tharp		Texas	
Travis	Strandtmann		Texas	
Washington				Decker 1986

[1]Requests for information regarding free-living *C. pepo* specimens were sent to the following herbaria: University of Alabama, Auburn University, University of Arkansas, University of Florida, Florida State University, University of Georgia, Emory University, University of Illinois, Southern Illinois University, University of Kentucky, Indiana University, DePauw University, Louisiana State University, Southwest Louisiana State University, Harvard University, University of Mississippi, University of Missouri, Missouri Botanical Gardens, University of North Carolina, Duke University, University of Cincinnati, The Charleston Museum, The University of Tennessee, The University of Texas, Virginia Tech University, The University of West Virginia, National Museum of Natural History, Smithsonian Institution.

the as yet little surveyed Red River subarea from a major subarea located in the Ozark Plateau of southern Missouri and northern Arkansas. Within the Ozark Plateau, populations have been documented in small western trending streams and larger southern flowing rivers of the drainage system of the Arkansas River, as well as in north-flowing streams of the Osage and Gasconade systems, and along the east-southeastern flowing Buffalo-White River drainage system. About 150 kilometers separates the Ozarks subarea from the northernmost, Illinois subarea, which encompasses the lower Illinois River, the upper reaches of the Kaskaskia River, a 250 kilometer (150 mile) portion of the Mississippi River, and a small section of the lower Ohio River. A fifth subarea can be recognized along the central coastal plain of the Gulf of Mexico, with populations recorded along a number of major and minor drainage systems emptying into the Gulf, including those of the lower Mississippi, Pascagoula, Pearl, Mobile-Tombigbee, and Alabama Rivers.

While it is not possible to ascertain the degree to which these apparent internal subdivisions are real as opposed to simply reflecting an absence of active survey and collection, planned field research in these intervening areas, along with ongoing comparative genetic analysis of the populations of different subareas (see Decker-Walters et al., this volume), will provide a clearer picture of the degree of extant geographic and genetic separation that does exist. It would be fairly safe to predict, however, even given the nonuniform distribution of documented populations, that this eastern free-living *Cucurbita pepo* gourd today has a largely unbroken distribution in river systems from south Texas as far north as central Illinois, and along the Gulf coastal plain from Corpus Christi to Mobile.

CURRENT EXPLANATIONS FOR THE DISTRIBUTION OF FREE-LIVING *Cucurbita pepo* GOURDS

The time depth of the gourd in different areas of its current range is difficult to determine with certainty. Although gourds were observed in 1835 in Texas, their presence was not noted in the Ozarks until the mid-1950s, they seemingly went unrecorded in Illinois and along the Gulf coastal Plain until the mid-1960s, and were only documented along the Red River in the mid-1970s.

The distribution of gourd populations and the sequence of their initial collection (Table 1), are considered by some to indicate a rapid spread of a specialized agricultural weed associated with the post-World War II increasing importance of soybeans (Asch and Asch 1992). In this model, feral gourd populations are seen as occupying an extremely narrow niche—that of cultivated floodplain fields—in highly specialized agroecosystems.

There is little question that *Cucurbita pepo* gourds have become a problem weed in floodplain fields in the southeast and midwest. The extent to which they have become a pest in Arkansas and Louisiana is detailed by the publications describing efforts to control them (Oliver et al. 1983; Boyette et al. 1984). A recent study of herbicide effectiveness reported density counts ranging from 32 plants per square meter at Fulton, Arkansas, to 43 per square meter at Conway, Arkansas, to 129 plants per square meter at Garland, Arkansas (Oliver et al. 1983). In late November, 1990, thousands of free-living *pepo* gourds were observed in an "infested" bottomland cotton and soybean field located between the levee and Mississippi River near St. Joseph, in Tensas Parish, Louisiana (Gayle Fritz, personal communication, 1991). On a much smaller scale, several dozen gourds were collected in November of 1990 from fallow floodplain fields along Willow Chute, an old channel of the Red River just north of Shreveport (Bossier Parish) in northwest Louisiana (Frank Schambach, personal communication, 1990). In Kentucky, a free-living *Cucurbita pepo* gourd known locally as "Johnny Gourd" has grown in the Ohio and Green river floodplain fields of corn and soybeans of Union and Henderson Counties for years. When questioned about the age of the "Johnny Gourd" in this portion of Western Kentucky most farmers interviewed by the senior author scoffed at the idea of it being a recent phenomenon. Most indicated that free-living gourds were present long before World War II.

In our view a likely explanation for the seemingly shallow time depth for free-ranging *Cucurbita pepo* gourds outside of Texas may be explained by: (1) a lack of interest by botanists, and (2) the plant may be aggressively re-establishing itself in drainage systems that it had previously occupied, particularly east of the Mississippi River.

The Asches (1992) have also suggested that Texas wild gourd may have expanded its range to the east and north over the past 40 years as the result of agricultural commerce, dispersal by gourd hobbyists, or in packets of ornamental gourd seeds. These potential human vectors of dispersal, along with other possibilities, could well be involved in the continuing expansion of the range of free-living *pepo* gourds in eastern North America. The suggestion that seeds of the wild Texas gourd were packaged and sold as ornamental gourds does, in fact, provide a context for the subsequent "escape" of an "ornamental gourd" across the East, but such events, if they occurred, would clearly have to be considered human mediated range extension of a still wild plant, rather than the escape of a domesticated plant. A related and intriguing question involves the possible existence of long established relict populations of *Cucurbita pepo* gourds outside Texas in areas minimally disturbed by humans and agroeconomies. Does the ongoing range extension of a wild gourd in the East have its origins only in Texas populations, or are there other source areas where relict populations have existed, largely unnoticed, for a long period of time?

In addition, the Asches discount the idea that a wild cucurbit might have been overlooked by nineteenth century plant explorers in the Mississippi Valley, suggesting that the showy vines and fruits would have been difficult to miss. In fact, there is ample reason to understand why botanists would have ignored the plants. As long as they were considered an "escape" from cultivation, there was little reason to study free-living gourds. There is, in addition, at least one other precedent from the East where a completely indigenous cucurbit remained unknown to the botanical world for hundreds of years. The Okeechobee gourd (*Cucurbita okeechobeensis*) was not formally described until the first few decades of this century (Small 1918, 1922, 1930). While Bartram described a seemingly wild gourd in northern Florida in 1774 (Harper 1958), it is impossible to determine whether this was the Okeechobee or the Texas gourd (Walters and Decker-Walters 1993). The fact that this plant escaped the attention of professional botanists is probably also a reflection of the entrenched belief that wild cucurbits simply do not exist in the East.

There are three straightforward tests of whether this ongoing range expansion of *Cucurbita pepo* gourds involves the radiation and re-establishment of a wild gourd in previously occupied territory, or the spread of a new weed into a narrow and recently created habitat of the agroeconomy. The first focuses on the Asches' (1992) new narrow niche floodplain field weed explanation. Especially significant in this regard are any indications that gourds were present beyond Texas prior to the post-World War II appearance of the soybean field agroecosystem habitat into which the ornamental gourds hypothetically escaped. Presence of free-living gourds in eastern North America prior to the late 1940s would clearly undermine the new soybean field habitat hypothesis.

An interrelated test focuses on availability of domesticated forms of ornamental gourds (*Cucurbita pepo* ssp. *ovifera*) to American gardeners. The Asches (and others before them) assert that contemporary free-ranging gourds in the Southeast and Midwest are garden escapes that have become naturalized. While suggesting this occurred after World War II, they do not specify which ornamentals escaped. It is important, then, to understand (1) when ornamental gourds began to be widely available to home gardeners, (2) what types were marketed, and (3) the context of their cultivation. If it can be shown, for example, that numerous ornamental gourd varieties were available to American gardeners for generations before World War II, and that the context of their use was extremely limited, then multiple early records of free-living gourds might be regarded as evidence of a truly wild *Cucurbita pepo* gourd population in the East long before the advent of highly mechanized farming.

A third test focuses on how tightly modern gourds are restricted to agricultural settings. Are they narrowly adapted weeds restricted to soybean field settings as proposed by the Asches? Are they tightly tied to a companion weed role for domesticated *C. pepo*? Or are they more generally adapted weeds of the agroecosystem? Do these gourds occur only in human-disturbed habitats, or do they also exist in natural settings, either close to or far removed from gardens and agricultural fields? Obviously, the further removed from agricultural contexts that such gourds grow, the stronger the case for the range extension of a wild gourd. Conversely, the more tightly tethered they are to specific soybean field habitats of the agroecosystem, the stronger the case for an escaped ornamental.

DOCUMENTING THE HISTORIC TIME DEPTH OF THE WILD *Cucurbita* GOURD IN THE EAST

While the Asches (1992) devote considerable attention to establishing the absolute pre-World War II absence of noncultivated *pepo* gourds in eastern North America, a growing body of archaeobotanical data suggests a wild morphotype *Cucurbita pepo* gourd was present in numerous places in the Southeast and Midwest as early as 12,000 years ago, to as late as 200 years ago.

We have already noted the ancient presence of a morphologically wild cucurbit in eastern North America. This evidence places a thin-walled, brittle-shelled, small seeded *Cucurbita pepo* gourd in Florida by 12,000 B.P. (Newsom et al., this volume), in west-central Illinois by 7000 years ago (Conard et al. 1984), in eastern Tennessee 6990–5300 B.P. (Crites 1991), in south-central Missouri and eastern Kentucky by 4500 years ago (Kay et al. 1980, Cowan 1990), and as late as A.D. 800–1750 in eastern peninsular Florida (Decker and Newsom 1988). As yet undated, but morphologically wild cucurbits have also been recovered from several Ozark rockshelters (e.g., Gilmore 1931, Plate 24a). Unequivocal evidence of domesticated forms, indicated by an increase in rind thickness and seed length, does not seem to occur in the East until sometime after 4000 B.P. (Cowan 1990; Smith 1992).

In addition to the archaeological presence of a wild gourd in Florida for at least 12,000 years, and across the Midwest and Southeast for the past 7000, our herbaria survey produced records of a wild morphotype *Cucurbita pepo* in the St. Louis area between 1846–1901 (Table 1). These collections—housed in the herbaria of the University of Texas, Harvard University, the Illinois State Museum, and the Missouri Botanical Garden—provide dramatic evidence of how botanists have struggled over the past 150 years with the taxonomic puzzle represented by the wild gourd.

Collections from the St. Louis area are especially important. As the gateway to the west in the mid-nineteenth century, and the largest city between the Mississippi and the Pacific, St. Louis was a center of science and culture. It was also the staging area for every important scientific exploration of the western territories, and was in every sense of the word, on the edge of civilization.

Perhaps because of its strategic location, St. Louis was also a center of scientific botany in the nineteenth century. The Missouri Botanical Garden, founded in 1859, was the focus of much early botanical research, and contains significant collections that have a direct bearing on the history of *Cucurbita* evolution in the East. Three of the earliest collections of an eastern *Cucurbita pepo* gourd are curated at the Garden. All were deposited by George Engelmann, a St. Louis physician, amateur botanist, and the Garden's long-time chief curator. Engelmann published dozens of articles dealing with botany and was considered an authority on several genera. Today, his botanical notes occupy 60 "large books," which are part of the Garden's collections (Spaulding 1909:128). Engelmann focused a great deal of attention collecting plants in St. Clair county, Illinois in that portion of the Mississippi River floodplain known as the American Bottom (Yatskievych, personal communication, August, 1990).

Engelmann's pressed *Cucurbita* specimens include two grown in St. Louis from seeds collected in Texas. One (MO-3265655) was identified by Engelmann as "*Cucurbita ovifera* Lin. var. *pyriformis*," and was collected in September, 1846 from a French plant collector, Nicholas Riehl (the specimen label reads "Cult. from Texas seeds by N. Riehl, St. Louis"). A specimen collected in July, 1848 (MO-3265676) is simply identified as "*Cucurbita*" and carries the inscription "From Texas seeds cult. in St. Louis." The third specimen (MO-3265373) is perhaps the most significant. Labelled only "*Cucurbita*" with the note "Naturalized, St. Louis along fences and fields," this specimen was collected in September, 1846, the same year and month Engelmann collected MO-3265655—the plant grown from seeds identified as "*Cucurbita ovifera* var. *pyriformis*." The fact that he did not identify the "naturalized" plant to species level, and chose not to designate it as *C. ovifera* var. *pyriformis*, perhaps indicates his caution regarding the taxonomic placement and wild versus cultivated status of the plant.

If Englemann's "naturalized" specimen was the sole record of a potentially wild *Cucurbita pepo* gourd growing in St. Louis it would be reasonable to consider it a likely "escape." However, there also exist eight other collections of potentially wild *Cucurbita* gourds from St. Clair County, Illinois made between 1875 and 1893. Five of these were made by Heinrich (Henry) Eggert, an amateur botanist who moved to St. Louis in 1874, and resided in the American Bottom in East St. Louis until his death in 1904, at which time his personal herbarium of more than 23,000 specimens was purchased by the Missouri Botanical Garden. During his active career Eggert ". . . collected assiduously all around St. Louis for a considerable distance, and his collection probably represented the flora of this district better than any other ever made" (Spaulding 1909:252).

Although considered an expert on the flora of the St. Louis area, Eggert published only one brief 16-page pamphlet. His *Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of the Vicinity of St. Louis, Missouri*, published in 1891, however, has a particularly interesting entry. Eggert lists nearly 1,100 plants as being indigenous to the area, and as late as 1909 his inventory was considered "by far the most complete list of our plants which has yet appeared" (Spaulding 1909:252). Among the plants he lists as native is *Cucurbita ovifera* var. *pyriformis*.

Eggert's labels from his "Herbarium Americanum" contain few specific locality data, but labels for three of the five specimens of *Cucurbita* gourds do list habitat information. These include: "lowland" (MO-768398), "waste places" (MO-3265660), and "prairies and waste places" (Harvard-Eggert s.n.).

Eggert identified three specimens as "*C. ovifera* var. *pyriformis*" (MO-768398, TX-Eggert s.n., Harvard-Eggert s.n.), one as "*C. ovalis*" (MO-739055), and one as "*Cucumis*" (MO-3265660). The remaining specimens were simply identified as "*Cucurbita*."

Two specimens—one collected in July, 1875 (MO-768398) and another in August, 1893 (Harvard-Eggert s.n.)—contain small (< 8 cm in length), pyriform, green-striped fruits. In terms of fruit and seed size, both appear strikingly similar to the wild morphotype gourds collected during the present study (see below).

In addition to these nineteenth century collections, at least one specimen was collected in the American Bottom just after the turn of the century (MO-883257). This specimen, originally labelled "*C. ovifera*," was collected by John Kellogg in woods adjacent to Fish Lake in October, 1901. Fish Lake is a large cut-off meander lake in the American Bottom.

Annotations of these early collections made by subsequent scholars provide some indication of the broader taxonomic caution that has obscured the possibility of a wild *Cucurbita pepo* gourd being present in the East. Interestingly, L.H. Bailey examined the Eggert specimen ("*C. pepo* var. *pyriformis*" housed in the University of Texas Herbarium and proclaimed it to be *C. texana*. Taxonomic reassessments of the Missouri Botanical Garden specimens were recently examined and annotated by Thomas C. Andres of the L.H. Bailey Hortorium between 1989–1990.

It is often difficult to distinguish between the different domesticated and wild forms of *C. pepo* based solely on herbarium specimens, where only a small portion of the plant might be present. As a consequence, contextual information supplied on the label is often considered, as is the identity of the collector. Plants collected in the railroad yards of St. Louis and identified as "escapes" by Hugh Cutler, a noted cucurbit researcher, were accepted by Andres, for example.

Applying current nomenclature, Andres annotated Engelmann's specimens grown from Texas seed and originally labelled *C. pepo* var. *pyriformis*, as *Cucurbita texana*. The specimen Engelmann described as "*naturalized* along fence rows and waste places" (emphasis added) and identified as *Cucurbita*, was assigned to *C. pepo* by Andres. This is particularly interesting when the specimens collected by Eggert from the same area a few years later are considered. Sometime after the Garden acquired Eggert's collection, the specimen he identified as "*Cucumis*" and listed as growing in "waste places in East Carondolet," was re-identified by an unknown researcher as a domesticated ornamental gourd ("*C. pepo* var. *ovifera*"). This same specimen was *re-identified* in 1989 by Andres as "*C. pepo* ssp. *texana*."

In spite of the fact that the remaining nineteenth century *Cucurbita* specimens in the Missouri Botanical Garden all bear habitat descriptions indicating collection outside of contexts of cultivation (i.e., "waste places," "fence rows," "low ground," "prairies"), and one contains a mature fruit that falls within the wild morphotype, Andres was sufficiently hesitant regarding their taxonomic status to identify each only as *C. pepo*.

We would argue that earlier recognition of an indigenous eastern North American *Cucurbita pepo* gourd has been hindered by the absence of an appropriate taxonomic category and label. Engelmann and Eggert employed the taxonomic label "*C. pepo* var. *pyriformis*" based on the pear-shaped fruit to refer both to plants grown from Texas seeds and plants found growing outside of cultivation in St. Louis. Subsequent annotation of these specimens has either assigned them to the Texas wild gourd (*C. pepo* var. *ovifera* ssp. *texana*), or more cautiously, *C. pepo*. We propose a different reading of this early herbarium evidence.

By 1846 (11 years after its discovery in Texas), botanists in the St. Louis area were collecting a seemingly wild morphotype gourd indistinguishable from *C. pepo* ssp. *ovifera* var. *texana*, and later Eggert included it as a member of the local flora. Similar collections were made throughout the remainder of the nineteenth and first few years of the twentieth centuries. Rather than simply representing "escapes" from local gardens we believe these early specimens were of an indigenous, wild *C. pepo* gourd.

Our herbaria survey, along with archaeologically recovered gourds, provide strong support for the long-term presence of an indigenous wild gourd in eastern North America long before modern field agriculture. These data provide the first link in our argument countering the position that the weedy infestations of gourd in floodplain fields in the East represents a post-World War II escape into a narrow agricultural weed niche. An examination of the availability of cultivated forms of *Cucurbita pepo* ssp. *ovifera* to eastern North American gardeners provides another.

HISTORY OF THE AVAILABILITY OF ORNAMENTAL GOURDS TO GARDENERS IN EASTERN NORTH AMERICA

A recent examination of more than 500 pre-1870 seed catalogues in the National Agricultural and National Horticultural Libraries provides a solid baseline against which the availability of ornamental gourds (*C. pepo* ssp. *ovifera*) to the American gardener can be measured. Descriptions of ornamental gourds in these catalogues also help establish both the context of their recommended cultivation as well as a time horizon for any supposed "escape" that might have occurred.

While William Bartram circulated hand-written lists of seeds and plants available for distribution in the late eighteenth century, seed catalogues did not become widely available until after the Civil War. They proliferated as the nineteenth century came to a close. The earliest printed catalogue we examined is Bernard M'Mahon's *Catalogue of American Seeds*, dated 1804.[2] In it are listed four cucurbits: *C. pepo*, *C. verucosa*, *C. melopepo*, and *C. ovifera* (M'Mahon 1804:20). *C. ovifera* is listed as the "egg-shaped gourd." Significantly, no other fancy gourds are offered. There is no further mention of the "egg" gourd in seed catalogues until the mid-1860s. In the interim, numerous almanacs and catalogues advertised ornamental gourds. They are touted as early as 1819 (M'Mahon 1819:369) as useful for covering arbors, trellises, walls, and fences. Two varieties are invariably offered in the earliest catalogues: "bi-colored," and "orange" (cf. William Prince and Sons 1834–35:19; Hovey and Co. 1845:6; B.K. Bliss 1860:19).

By the end of the Civil War, the number of ornamental gourd varieties listed in catalogues increased dramatically. Both Vick's *Illustrated Guide and Floral Catalogue for 1866*, as well Hiram Sibley's *Garden, Field and Flower Seed Catalogue for 1879*, for example, list seven *Cucurbita pepo* gourds. James Vick's *Fifth Annual Catalogue of Seeds* (1866) is especially significant. In addition to offering a variety of fancy gourds, he offered a gourd described as "Egg-formed, like the fruit of White Egg plant, very beautiful and *new*" (Vick 1866:43, emphasis added). A nearly identical description is found in M. O'Keefe and Sons catalogue for 1868 (pg. 29). By 1871, companies in Illinois, Ohio, and New York were offering the egg gourd, along with other varieties, almost always listing them as mainly useful for their climbing ability and for covering trellises and arbors.

While the "egg" variety is listed in many catalogues in these decades—often with the description "like the fruit of a white egg plant"—in the 1880s several catalogues began providing a separate, lengthy description for this ornamental. Burpee's *Farm Annual* for 1883 is typical of this new status. Listed as the "White Egg-Formed Gourd" (1883:18) it is also called the "Japanese Nest-Egg Gourd." The fruits are illustrated and described as:

> . . . they exactly resemble, in color, size, and shape the eggs of hens, and do not crack, and are uninjured by the by cold or wet, they make the very best nest eggs

Although hardly used today, before the advent of electronic incubation artificial "nest eggs" were often placed in a nest to encourage the hen to lay more eggs and remain on the nest until they hatched. Glass eggs were typically used by those who could afford them. The egg gourd seems to have been marketed as an inexpensive alternative.

Nest egg gourds continued to be advertised in late nineteenth and early twentieth century catalogues. As commercial poultry hatcheries developed, however, their status began to change. The D.M. Ferry & Company (later the Ferry-Morse Seed Company), provides a good example of the evolution of this transformation. During the first three decades of this century, Ferry lists and illustrates no less than six ssp. *ovifera* gourds, including the "Japanese nest egg." By 1933, however, these distinct varieties began to be subsumed under the single heading "mixed" gourds. While continuing to tout the general utility of all forms of gourds for covering trellises and arbors, in the 1937 catalogue (p. 57), the "small fruited mixed" listing suggests that these are of "An assortment of interesting shapes suitable for table decoration and other ornamental purposes." This is the use for ssp. *ovifera* cultivars today, and marks the first time this specified usage appears in seed catalogues.

To summarize, our examination of seed catalogues suggests that ornamental gourds have a lengthy history in North America. While the egg gourd was advertised as early as 1804, it did not become intensively marketed until the 1880s. Throughout the period 1800–1880, the egg gourd was only one of a number of gourds advertised for sale. Of these, the bi-color, and orange ball are the most frequently mentioned ornamentals until about 1870. After 1870, there is a dramatic increase in the number of *Cucurbita pepo* gourd types offered.

Before the 1880s, ornamental gourds were generally marketed for their ability to cover trellises and arbors. There is no indication they were marketed for any other use. This places the context of their cultivation in areas immediately adjacent to the home with no evidence that they were cultivated commercially. During the 1880s, the so-called egg gourd was often described separately from other ornamental gourds. While still advertised as an ornamental, this particular variety was marketed primarily as an egg mimic. As home production of eggs waned, the egg gourd fell out of favor. By the 1930s *pepo* gourd cultivars were advertised for their usefulness as ornaments.

How does this review strengthen or weaken the "recent escape" hypothesis advanced by the Asches and others? Ornamental *Cucurbita pepo* gourds have been commercially available for nearly 200 years; seven different varieties have been marketed since the 1870s. Clearly, there have been opportunities for all to "escape" into the wild. In spite of this, however, only two fruit types predominate in the free-ranging populations of the Southeast and Midwest (see below). The so-called egg gourd is the more common, though a green and white striped form also occurs. If these free-ranging populations represent escapes, why didn't other varieties do the same? Why don't warty, crown of thorns, orange, bi-color, and spoon varieties also occur outside of cultivation? Our seed catalogue survey suggests these more showy varieties were available longer and were aggressively marketed through the first half of the nineteenth century. We believe the absence of these fancy gourds in natural settings is significant evidence arguing against the possibility that *Cucurbita pepo* gourds frequently "escape" from cultivation. Examining the niche and preferred habitat of free-ranging egg and green-striped gourds provides further evidence relative to this issue.

THE NICHE AND HABITAT OF FREE-RANGING GOURDS

Few detailed descriptions of the niche and habitat of *Cucurbita pepo* ssp. *ovifera* var. *texana* and related free-living populations are available. Most habitat information regarding these plants consists of brief field observations, often in the form of locational descriptions on herbarium sheets. To augment these records, we studied gourd populations in the field. The following observations are based upon studies of free-ranging gourd populations in the Missouri and Arkansas Ozarks in November, 1990, and in Western Kentucky during November, 1991.

Efforts were concentrated in the Missouri and Arkansas Ozarks since (1) this area was noted by Steyermark (1963) as containing county records of a free-ranging cucurbit; (2) a large portion of the Ozark Plateau is densely wooded and sparsely populated; and (3) a number of river headwaters are located in the Ozarks, and if cucurbits were located in their upper reaches, they might be found in more distant, downstream areas.

Studies in western Kentucky were concentrated in Union County, in the Ohio River floodplain several miles below the confluence of the Ohio and Wabash rivers. Union County was chosen because of the senior author's strong consanguineal ties and familiarity with the area. Cowan was afforded access to property and local informants that proved invaluable in the search for free-ranging gourds.

The Ozarks.—Collections were made along the Gasconade River in Missouri and the White and Buffalo Rivers in Arkansas. In addition, collections made by Hoffman and students in the western Ozarks were studied. Descriptions of these collections have been documented elsewhere (Smith et al. 1992). The Buffalo River populations, however, provide a typical example of the types of habitats free-ranging *Cucurbita pepo* gourds occupy, and an opportunity to measure their success outside modern agroecosystems.

There are few areas in eastern North America that compare with the Buffalo River in terms of assessing the ability of free-living *pepo* gourds to exist in natural floodplain settings far removed from agricultural habitats. The Buffalo River valley, and the Ozarks in general, also represent an excellent potential heartland and refuge area where a wild indigenous gourd could have grown in relative obscurity until Steyermark collected it in the 1950s.

For the past 20 years the entire main valley corridor of the Buffalo river (388 square kilometers) has been almost free of human habitation, much less agricultural fields. While there are small family farms along the tributaries of the Buffalo River today, the river's watershed of 555 square kilometers is heavily forested and remains one of the least populated regions in Arkansas, with Newton County averaging 18 persons per square kilometer (Pitcaithley 1987:89). The history of human occupation of the Buffalo River valley has been well documented (Pithcaithley 1987), and provides a picture of sparse population and limited agricultural development. The area did not witness a post-World War II boom in soybean cultivation, and throughout its history would have provided few opportunities for survival of a narrow agricultural niche *pepo* weed. Because of its relative isolation and limited human occupation, the Buffalo River valley does, on the other hand, provide an opportunity to establish the presence (perhaps long-term) of populations of an indigenous wild gourd far removed from agricultural settings.

The Buffalo River valley also provides an opportunity to consider the general habitat requirements of the free-living *Cucurbita pepo* gourd. The town of Pruitt marks a transition point for the river as it widens from a narrow rocky valley floor with swiftly flowing water into a broader floodplain having reduced water velocity and a meandering channel with associated sand and gravel bank, bar, and island formations. Extensive survey above Pruitt yielded no evidence of the plant, while populations were common on the sand and gravel bars, banks, and islands in the areas surveyed below the Nars (Fig. 2). Gourd populations were noted in diverse settings within these general habitats. Typically, plants were rooted on the floor of lightly shaded riparian forests dominated by sycamores, maples, and willows. Vines climbed as much as 3–4m into the overstory trees, or grew laterally towards less shaded areas where they assumed a procumbent habit or overtook herbaceous annuals such as ragweed and cockleburr.

The populations encountered in the Ozarks also provided information on dispersal mechanisms for free-living *Cucurbita pepo* gourds. No evidence of predation of gourds by birds, mammals, or insects was observed in our survey, suggesting dispersal was largely, but not completely, accomplished by other means. Ample evidence of dispersal of dried, buoyant gourds by spring and winter floodwaters, however, was noted. All phases of the floating gourd dispersal process were observed along each of the Ozark stream and river courses we surveyed. We observed gourds resting well within the reach of spring floodwaters. In at least one location last year's gourd crop was also observed in transit, floating within an abandoned navigational lock chamber at Batesville, Arkansas. We also saw gourds in a wide variety of locations where they had been carried by floodwaters, such as caught against bushes or other floodwater "filters," trapped inside hollow stumps, lying on the ground where they were left by receding floodwaters, deposited along roadside ditches and bridge approaches adjacent to river and stream valleys, and frequently in piles of wood and other debris deposited by powerful floods.

This last depositional context, which often places the gourds in juxtaposition with objects discarded by humans, is likely the source of occasional observations that this plant grows in "dumps" and "waste places," and the conclusion that it therefore likely represents an escape from cultivation. The river or stream valley

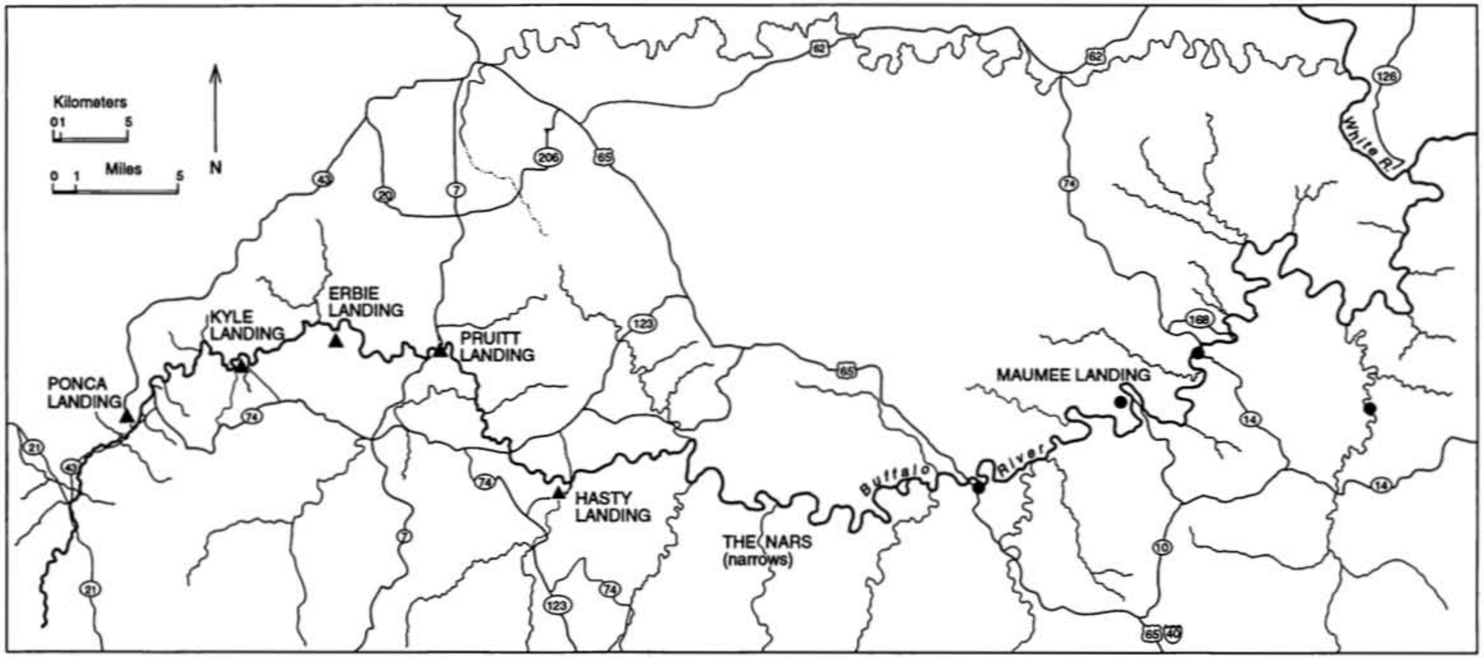

FIG. 2.—Collection localities along the Buffalo River. Triangles indicate localities where wild gourds did not exist in November, 1991; circles localities where wild gourds were collected.

location and taphonomic context of such deposits identifies them as an inherent component of floodplain environments, rather than directly resulting from human disposal activities. Bringing the process of seed dispersal full circle, vines of plants in a number of locations originated in the fragmented remains of dry brown gourds deposited by floodwaters of the previous spring.

Western Kentucky.—In Union and Henderson Counties, Kentucky, free-living *Cucurbita* populations, known as "Johnny Gourds," have been growing for years. Most farmers indicated they have always been present in the floodplain of the Ohio River, but have become a much greater problem with the draining and opening up of formerly forested floodplain areas.

Typically, "Johnny Gourds" emerge in the spring from the forest lining the bank of the Ohio, or from drainage ditches far removed from the river. As the growing season progresses, the vines aggressively invade fields where, unless controlled, they overtake corn and soybean crops. They can be checked by pre-emergent and broadleaf herbicides, but are virtually impossible to eradicate. Collections made near DeKoven, Kentucky, provide a good example of this problem: a drainage ditch had been sprayed at least twice but we collected dozens of gourds from both the bottom of the ditch and the field margin.

This cultivated field habitat is far different than that we encountered during our Ozark survey, and accounts for the origin of the "recent escape" hypothesis. In addition, all Union County fruits showed evidence of introgression with other cultivars. Both the Asches (1992) and Wilson (1990) made similar observations about collections from a modern agroecosystem on Kaskaskia Island, Illinois. On the other hand, local informants suggest that while "Johnny Gourd" populations have become more abundant in the past 30 to 40 years, they have been present far longer. The fact that these western Kentucky populations exhibit extensive introgression with cultivar *pepo* varieties is the logical outcome of their frequent exposure to garden crops along the populated Ohio River.

MORPHOLOGICAL CHARACTERISTICS OF MODERN *Cucurbita* GOURDS AND THEIR RELATIONSHIP TO ARCHAEOLOGICAL CUCURBITS

The combined information from our herbaria survey and field observations provides strong support for the argument that contemporary eastern *Cucurbita pepo* gourds are not simply "escapes" from cultivation or recently introduced agricultural weeds, but are rather part of an indigenous flora. Viewed in this light, the wild gourds are the closest, and most logical ancestors for the eastern lineage of *C. pepo* isolated by Decker in her isozyme studies (see Decker-Walters et al., this volume). If these contemporary gourds represent the basal stock from which other cultivars of *C. pepo* ssp. *ovifera* evolved, it is important to examine the metric characteristics of these populations, and compare them with their cultivated counterparts and collections from pre-4000 B.P. contexts in eastern North America.

Morphological information related to this issue was collected from the following sources: (1) a sample of wild morphotype fruits collected from the Ozarks in 1990, (2) a sample of cultivated varieties of *C. pepo* ssp. *ovifera* grown in a field setting in Hamilton County, Ohio in 1991, and (3) samples of cultivated and wild *Cucurbita* populations reported by Decker and Wilson (1986). Metric information from archaeological samples at Hontoon Island, Florida was provided by Lee Newsom of the Florida Museum of Natural History, while that from Phillips Spring, Missouri was provided by Smith.

The following discussion is based upon measurements of 15 fruits collected during our Ozark survey, each from an individual plant. Fruit size, rind thickness at various points, peduncle diameter (when available), and seed length and width were measured (Fig. 3, Table 2–3). Statistical information from other contemporary and archaeological *Cucurbita* populations are listed Tables 4–5.

Fruit size, shape, and color.—Fruits from our Ozark sample are small and exhibit a limited number of shapes (Fig. 4). Maximum height ranges from 3.9–10.0 cm (mean 5.9 cm) (Table 2). Maximum fruit diameter is less variable than height and averages 4.6 cm (range 3.2–5.5 cm). Fruit shape varies from nearly circular, to oblate, to pear-shaped with most assuming a slightly prolate form (Fig. 4). This geometry can be expressed as a ratio which incorporates both maximum fruit height and maximum fruit diameter where *Fshape* = *maxht/maxdia*. In this expression, *Fshape* is a measurement of the circularity of the fruit; in a circular fruit this ratio is one. The closer the ratio is to one, the more globular the fruit. As can be seen in Fig. 5, this objective classification yields results which confirm our subjective observations: most fruits are slightly prolate. The two specimens greatly exceeding one are classified as pear-shaped.

Two distinct fruit colors were noted in the Ozark sample. By far the majority were ivory; immature fruits of this type were pale green. A small number of fruits were pale green to ivory with dark green stripes. When stripes occurred, they were invariably 10 in number. Striped and unstriped fruits were never noted growing on the same plant, although plants producing the two fruit colors were found on the same sand or gravel bar.

The epidermis of the fruits was almost always smooth and unlobed. Although a few fruits did possess minor epidermal warts, these were infrequent, and seemed to have developed as the result of some injury to the fruit wall as it was maturing. The lack of wartiness and lobing is significant for it suggests these gourds have not experienced extensive introgression with cultivars. We specifically noted a lack of introgression with two common edible cultivars—the yellow crookneck and the acorn squash. Crookneck cultivars are often strongly warty and yellow in color; acorn cultivars are invariably strongly lobed and dark green. Warty ornamentals of the yellow-flowered gourd (*C. pepo* ssp. *ovifera*) might also be expected to be grown in the Ozarks, but no evidence of their contaminating presence was noted in our collections. In the two instances of introgression we did note, fruit shape and coloration suggest hybridization with other *Cucurbita* cultivars. One of these, collected from a driftwood pile on the Gasconade River in Wright County, Missouri, seems suggestive of crossing with butternut (*C. moschata*); genetic analysis (Deena Decker-Walters, personal communication, 1992; see Smith et al. 1992, Fig. 4.12) supports this. In addition, two fruits were collected from a plant in the White River valley of Searcy county, Arkansas, that were yellow-orange with pale yellow stripes.

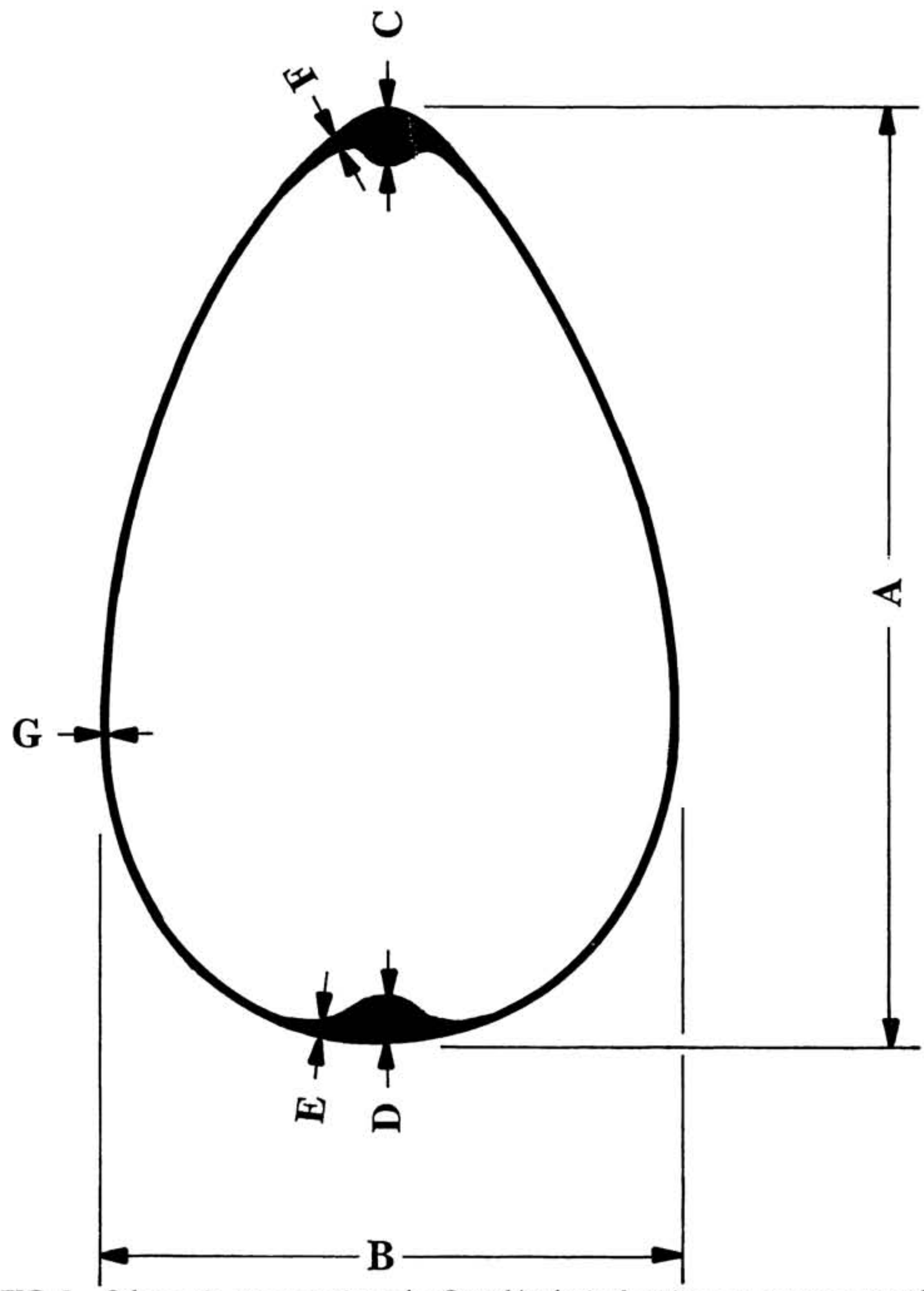

FIG. 3.—Schematic cross-section of a *Cucurbita* fruit showing measurements collected. A: maximum fruit height; B: maximum fruit diameter; C: peduncle "knob" thickness; D: corolla, or blossom, "knob" thickness; E: thickness adjacent to corolla "knob"; F: thickness adjacent to peduncle "knob"; G: thickness at maximum fruit diameter.

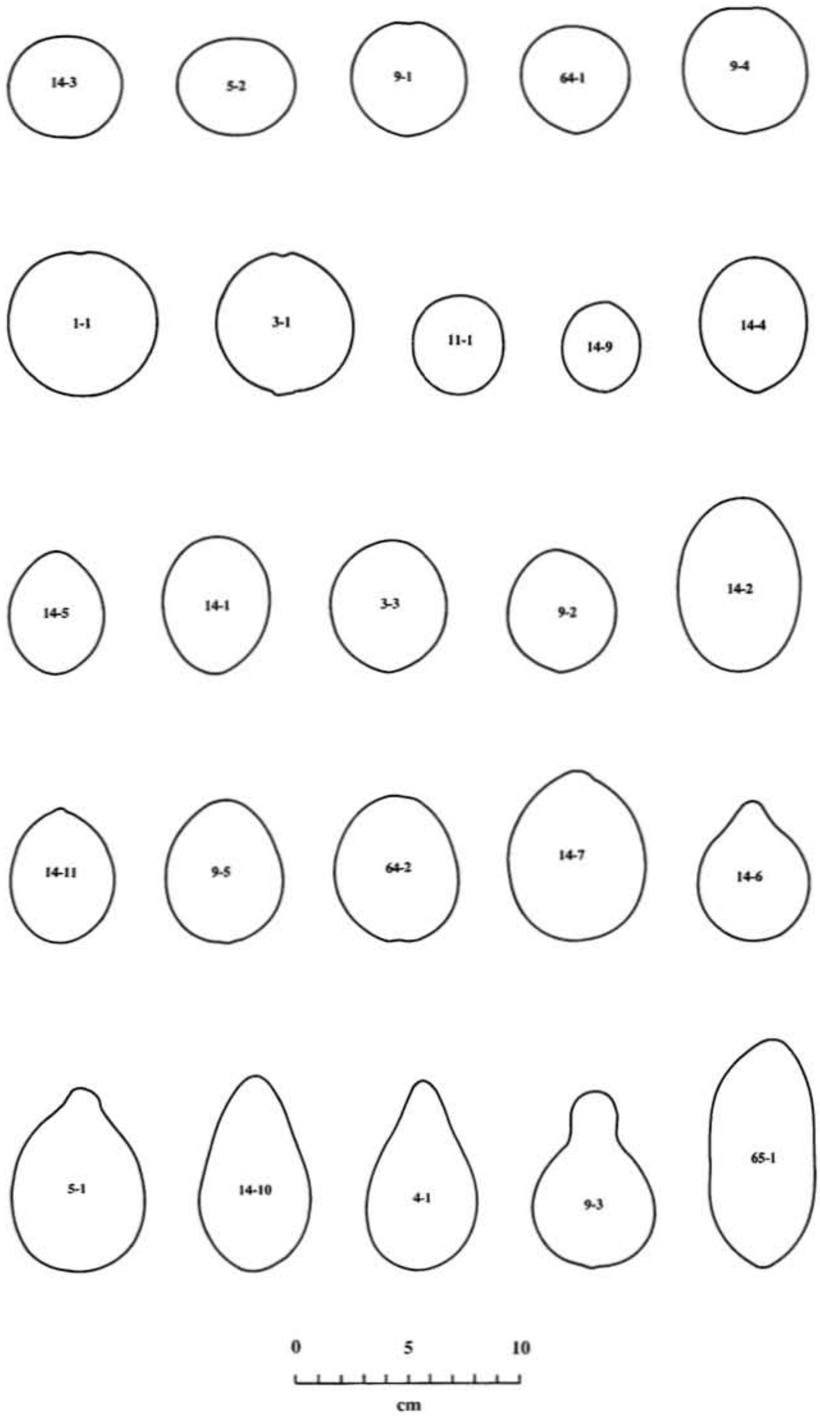

FIG. 4.—Fruit shapes for selected Ozark cucurbit fruits. Numbers correspond to field specimens.

TABLE 2.—Measurements of fruit size, shape, and rind thicknesses for selected Ozark cucurbits.

Field/ Lab No.[1]	Max Hght[2]	Max Dia	Fshape	Thk 1	Thk 2	Thk 3	Ped Thk	Blos Thk
3-1	6.1	5.1	1.19	1.6	1.3	1.5	4.9	4.9
4-1	8.3	4.7	1.76	1.8	1.5	1.9	3.8	4.4
5-1	4.0	5.2	0.76	0.9	0.8	0.9	4.0	3.7
9-2	5.2	4.6	1.13	2.0	1.1	1.4	5.6	3.2
9-4	5.3	5.3	1.00	2.0	2.0	2.0	5.8	6.0
11-1	4.2	4.0	1.05	1.4	1.1	1.2	4.9	5.0
14-1	6.0	5.0	1.20	1.6	1.4	1.9	4.7	4.4
14-3	4.3	4.9	0.87	1.6	1.2	1.6	5.1	3.2
14-5	5.3	4.1	1.29	1.9	1.2	1.9	4.7	4.6
14-6	6.1	4.7	1.29	1.9	1.2	2.2	4.5	6.2
14-9	3.9	3.2	1.21	2.0	1.1	1.4	5.6	3.2
14-10	8.4	5.2	1.61	1.5	1.0	1.3	3.5	6.2
14-11	5.7	4.5	1.26	1.8	1.9	1.9	7.7	6.0
64-2	6.1	5.5	1.10	1.5	1.0	1.4	5.0	4.8
65-1	10.0	4.4	2.27	1.5	1.3	1.3	4.8	3.8

[1]Key to Field/Lab No: 3-1 Wilbur Allen Wildlife Refuge, Wright County, Missouri; 4-1 Hodgson Mill, Ozark County, Missouri; 5-1 Batesville, Independence County, Arkansas; 9-2, 4 Highway 9 Bridge, Woodruff County, Arkansas; 11-1 Manes, Wright County, Missouri; 14-1,3,5,6,9,10,11 Highway 14 Bridge, Searcy County, Arkansas; 64-2 Highway 64 Bridge, Woodruff County, Arkansas; 65-1 Highway 65 Bridge, Searcy County, Arkansas.

[2]See Figure 3 for these measurements. MaxHght = maximum height; MaxDia = maximum diameter; Fshape = fruit shape (MaxHght/MaxDia); Thk1–3 = rind thickness 1–3; PedThk = peduncle thickness; BlosThk = Thickness of rind at blossom. All measurements in cm.

Rind thickness.—It has been argued that rind thickness is an important factor in determining when cultivar squash first appeared in gardens in eastern North America. Smith (1987) argues that archaeological squash rind less than 2 mm in maximum thickness and dating before 3000 B.P. can not be used as evidence for domesticated forms, since rind of this thickness falls within the size range of wild morphotype gourds. Our Ozark collections provide additional information on this point.

Rind thickness was measured in five areas on each of fifteen fruits (Fig. 3, Table 2). Rinds of all fruits were thicker at the peduncle and blossom (corolla) ends, where a corky "knob" often forms in the fruit cavity. Thickness of these internal "knobs" ranges from a mean of 4.9 mm (range 3.5–7.7 mm) at the peduncle end to 4.6 mm (range 3.2–6.2 mm) at the blossom end. With the exception of these two areas, rind thickness elsewhere exceeded 2 mm in only one of the fruits measured (Table 2). Rind is thinnest at the point of greatest maximum deflection. Variability in thickness, as expressed by the coefficient of variation (CV) (Simpson et al. 1960), is quite low, suggesting that this morphological characteristic is conservative, and the Ozark population fairly homogeneous (Table 2).

Rind thickness in cultivated forms of *Cucurbita pepo* squash in contrast, *can* be

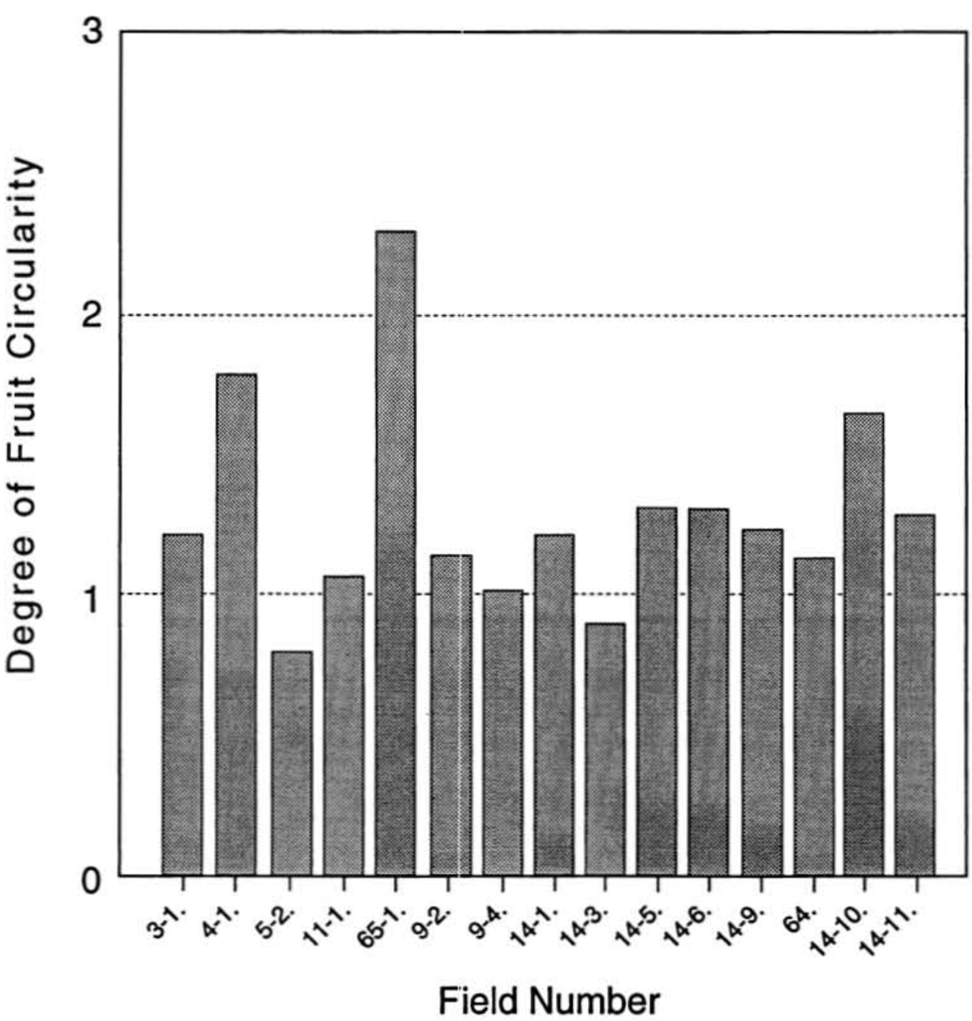

FIG. 5.—Bar graph of Ozark fruit shapes. Note the number of fruits falling close to 1, indicating a relatively circular shape. Spikes indicate pear-shaped fruits.

quite variable. Differences in rind thickness among pumpkins, acorns, and crooknecks seems to be related to variation in wall thickness associated with lobing and wartiness. Since gourd-like forms invariably have a non-textured epidermis, rind thickness is fairly uniform from one place on the fruit to the next.

Based upon these observations, we believe it is possible to use the 2 mm rind thickness cutoff for identifying clearly domesticated archaeological *Cucurbita* in the East. Once domestication occurs, there is an initial trend towards increasing rind thickness, which is accompanied by variability in epidermal characters, including lobing and wartiness (Cowan 1990). The well-preserved pre-4000 B.P. rind fragments from Cloudsplitter and Phillips Spring less than 2 mm thick are smooth textured, with no evidence of lobing or wartiness, suggesting that they are not the domesticated form.

TABLE 3.—Measurements for Ozark gourd seeds.

Field/No.[1]	Mean Lngth[2]	Range	Std. Dev.	Mean Wdth	Range	Std. Dev.
3-1	9.8	9.0–10.6	.43	6.4	6.0–6.9	.26
4-1	9.1	7.9– 9.6	.52	5.8	4.9–5.8	.43
5-2	9.3	8.6–10.0	.41	6.0	5.7–6.4	.20
9-2	9.0	8.3– 9.4	.34	5.7	5.3–6.0	.19
9-4	9.2	9.0– 9.9	.23	5.9	5.6–6.3	.19
11-1	9.4	8.9– 9.9	.29	6.7	6.6–7.0	.14
14-1	9.1	7.7– 9.8	.45	5.9	5.3–6.5	.27
14-3	9.4	8.7–10.2	.41	6.1	5.8–6.4	.17
14-5	9.5	8.2–10.2	.49	6.4	6.0–7.1	.37
14-6	8.2	7.6– 8.6	.24	4.9	4.7–5.2	.13
14-9	7.8	7.0– 8.3	.34	5.2	4.8–5.7	.24
14-10	9.2	8.5– 9.5	.25	5.7	5.5–6.0	.14
14-11	8.7	8.3– 9.0	.21	5.6	5.2–6.0	.20
64-2	10.1	9.5–10.9	.40	6.5	6.2–7.0	.18
65-1	9.2	8.2– 9.9	.46	5.9	5.6–6.3	.18
Sample Mean	9.2	Sample Mean		5.9		

[1]See Table 2 for key to field numbers.

[2]MeanLngth = mean length; Std.Dev. = standard deviation; MeanWdth = mean width. All measurements in mm.

The 2 mm maximum thickness baseline we suggest as a useful marker for clearly domesticated forms works best when sample size is fairly large. A rind fragment greater than 2 mm can probably be safely assigned domesticated status, unless it comes from the blossom or peduncle portion of the fruit. However, it is important to keep in mind that thin walled rind fragments (<2 mm thick), might possibly represent domesticated fruits. In other words, while rinds thicker than 2 mm are good markers for domesticates, rinds thinner than 2 mm do not prove wild status. In the latter case domestication simply cannot be established.

Seed size and characteristics.—A sample of 20 seeds was selected from each fruit and seed length and width measured (Table 3). Mean length of seeds was 9.2 mm (range 7.8–10.1 mm); mean width 5.9 mm (range 4.9–6.7 mm). The coefficients of variation were quite low, suggesting a fair degree of conservatism in seed size within the population. Not surprisingly there is a positive relationship between seed length and width ($r = 0.85$). Seed size (measured by length × width), however, appears unrelated to fruit size (measured by height × diameter) (Fig. 6).

Comparing seed size of the Ozark fruits with archaeological specimens from pre-4000 B.P. (Cloudsplitter, Kentucky and Phillips Spring, Missouri) and late prehistoric (Hontoon Island, Florida) contexts, the Texas gourd, and contemporary commercial ornamental gourds (Decker 1986), produces interesting results (Table 4, Fig. 7). When archaeological samples are compared with recent collections, two factors stand out. First, there is considerable overlap in the standard

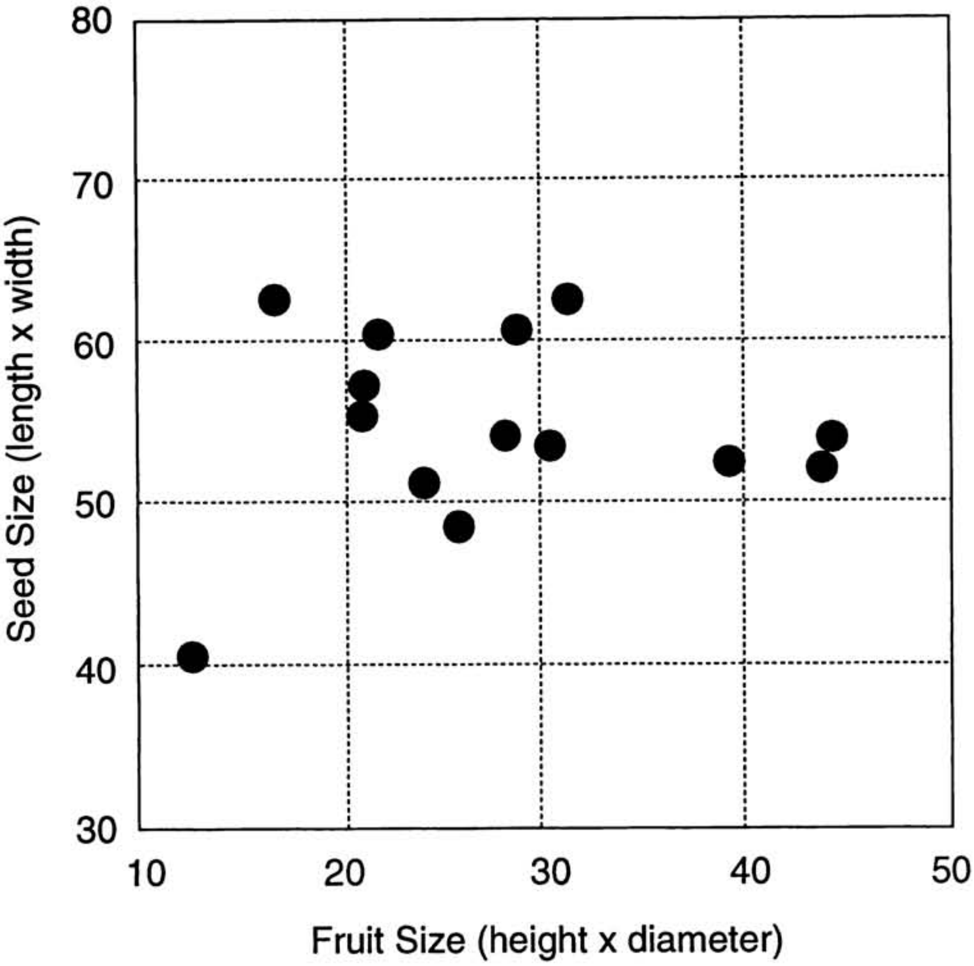

FIG. 6.—Bivariate plot of the relationship between seed size (length × width) and fruit size (fruit height × fruit diameter). The random scatter of the points suggests little relationship between seed and fruit size.

deviations of the lengths and widths of the seeds of these populations (e.g., Fig. 7). In general, seed width is far less variable than length. This variation is most noticeable in the cultivars and in the archaeological population from Phillips Spring. Using coefficient of variation as a measure of relative homogeneity produces a second, and perhaps more revealing result (Fig. 8). The free-living Ozarks populations occupy an intermediate position between most archaeological cucurbits and modern cultivars of *C. pepo* ssp. *ovifera*, while the Hontoon Island, Cloudsplitter, and modern *C. pepo* ssp. *ovifera* var. *texana* samples represent relatively homogeneous populations. Both the modern cultivars and the Phillips Spring population possess larger coefficients of variation. In part the large CV value for modern cultivars is the result of pooling varieties with radically different fruit morphologies. As such, the large CV value from Phillips Spring may indicate that

TABLE 4.—Summary statistics for various *Cucurbita* seed populations.

Population	N[1]	Mean Length	CV	Mean Width	CV
Ozarks	300	9.2	5.4	5.9	6.6
Texana	60	9.6	2.1	6.2	3.7
Cultivars	70	9.3	9.0	5.8	6.8
Cloudsplitter	2	8.7	1.6	5.4	5.1
Phillips Spr.[2]	49	10.2	8.7	6.9	9.1
Hontoon Is-SN	149	8.8	3.5	5.8	5.3
Hontoon Is-SH	868	9.0	2.2	6.0	1.5
Hontoon Is-1	1,094	8.9	3.0	5.9	3.8

[1]N = numbers of seeds measured; CV = coefficient of variation; Ozarks = pooled sample of seeds from 15 fruits; Cultivars = pooled sample of *C. pepo* ssp. *ovifera* reported by Decker and Wilson 1986; Texana = *C. pepo* ssp. *ovifera* var. *texana* reported by Decker and Wilson 1986; Cloudsplitter = Cloudsplitter shelter, Kentucky, seeds measured by Cowan; Phillips Spr. = Phillips Spring, Missouri, seeds measured by Smith; Hontoon Island-SN = "Snail Midden" complete seeds; Hontoon Is-SH = "Mussel Midden" complete seeds, Hontoon Is-1 = combined proveniences, including a shell-free midden. Hontoon Island measurements provided by Lee Newsom.

[2]In her landmark study, King (1985) had a larger collection of seeds available for study than was considered here. As a result, she obtained slightly larger mean length (10.5 mm) and mean width (7.0) values from a sample of 65 Phillips Spring seeds.

more than one type was present at this locale (see King 1985, who reached a similar conclusion).

Based upon these data, seed size alone does not allow one to distinguish the seeds of the present-day, *or* archaeological cultivated *pepo* gourds from those of the wild Texas gourd and Ozark populations of *Cucurbita pepo* gourds. While seed size of cultivated ornamentals seems more variable (as expressed by standard deviation and the coefficient of variation), this is hardly a useful measurement if dealing with archaeological collections of only one or a few seeds. Again, while it is possible to suggest that archaeological *pepo* seeds longer than 11 mm represent domesticates (Smith 1992:45), a single seed smaller than 10 mm in length might come from either a wild or domesticated fruit. In such cases, archaeological context and direct date play an important role in assigning wild versus domestic status.

Seed and rind bitterness.—Chemical compounds in both the rind and flesh of truly wild *Cucurbita pepo* gourds impart a bitter taste. These cucurbitacins probably serve to deter fruit predation by vertebrate and invertebrate fauna. They also render the fruits virtually inedible to humans. The fact that all cultivated forms of *C. pepo* as well as many cultivars of *C. pepo* ssp. *ovifera* possess nonbitter flesh implies that the domestication process involved loss of cucurbitacins.

With the exception of a few specimens that exhibited introgression with domesticated plants, and contained only a few large seeds, the more than 400 gourds collected during the present study contained large numbers of small seeds (100–200) that were usually bitter tasting because placental tissue adhered tightly to the seed

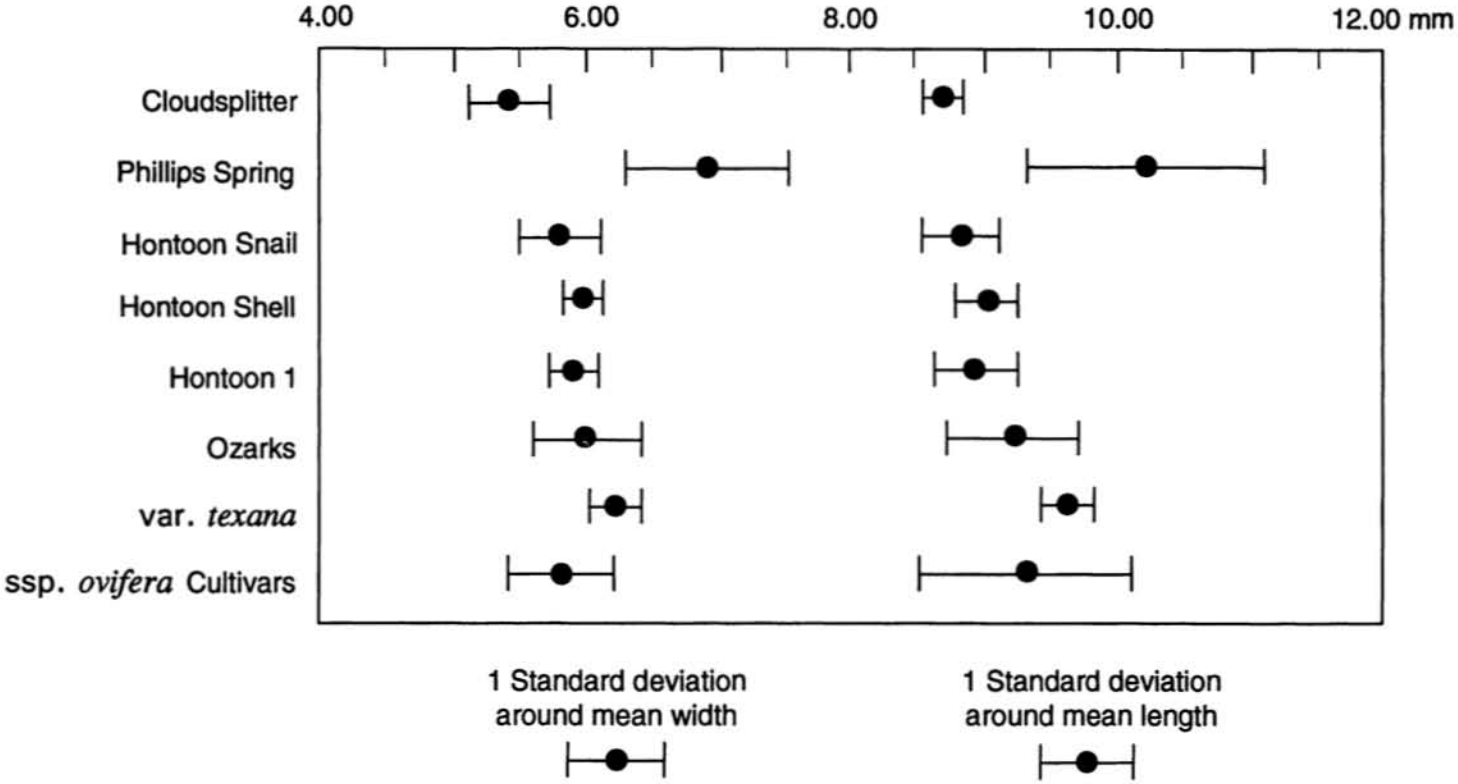

FIG. 7.—Mean seed length and width plotted with one standard deviation showing degree of overlap of distributions.

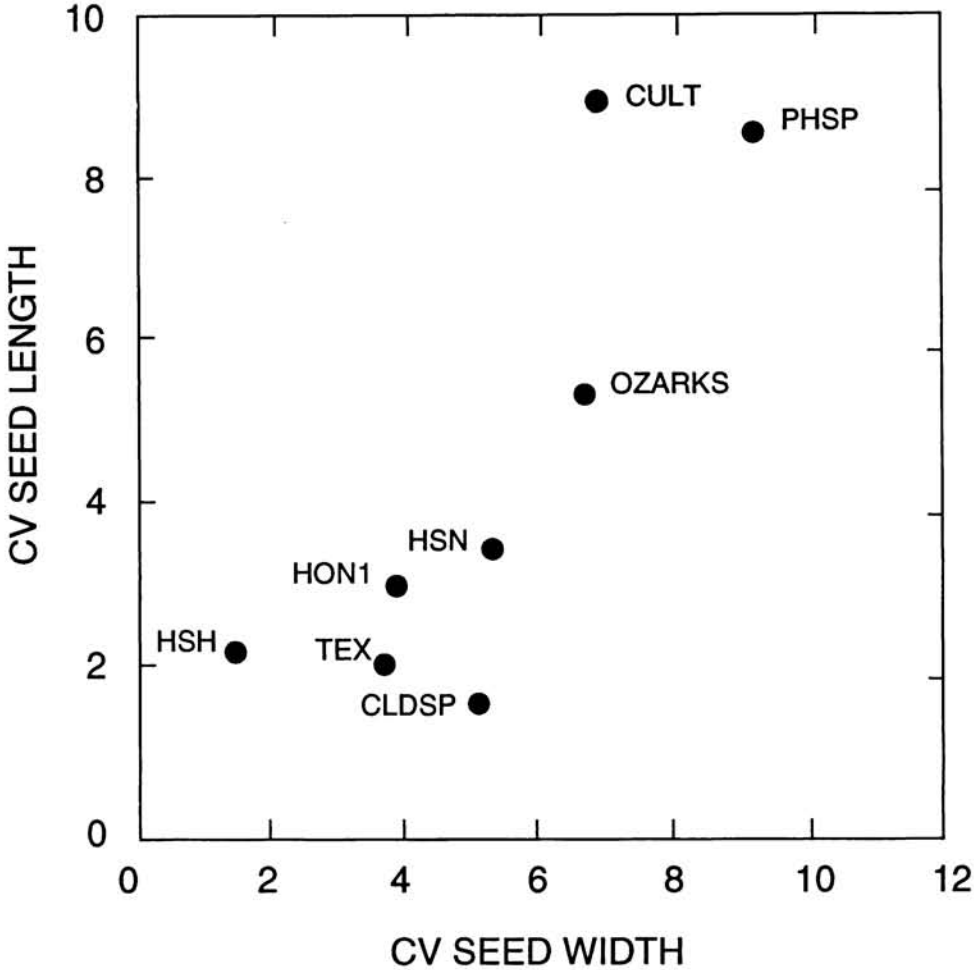

FIG. 8.—Bivariate plot of the relationship between coefficients of variation of seed length and seed width. Key to symbols: HSH (Hontoon Island shell layer), Hon1 (Hontoon Island), HSN (Hontoon Island snail layer). All measurements supplied by Lee Newsom; TEX (*Cucurbita pepo* ssp. *ovifera* var. *texana*, Decker and Wilson 1986, Table 3); CLDSP (Cloudsplitter Shelter, KY; measured by Cowan); OZARKS (free-living Missouri and Arkansas *Cucurbita pepo* gourds; this study); PHSP (Phillips Spring, MO; measured by Smith); CULT (modern cultivated *Cucurbita pepo* ssp. *ovifera*, Decker and Wilson 1986, Table 3), including "nest egg," "white egg," "flat striped," "bicolor pear," "striped pear," and "white pear").

coat. Production of a large number of bitter tasting seeds is contrary to the Asches' characterization of this plant as lacking these attributes of a successful pioneering species (Asch and Asch 1992), and is consistent with a successful adaption to natural floodplain environments. Of the fruits collected during our survey, and those sent to us by other collectors, only a handful produced nonbitter seeds. Interestingly, field observations at the time these fruits were collected led us to believe each was from a plant that had hybridized with domesticated *C. pepo*.

The fact that the overwhelming majority of free-ranging cucurbits we examined have extremely bitter flesh and seeds is another important component of the arguments favoring a truly wild status for these populations. When hybridization between wild and cultivated *pepo* squashes occurs, bitterness is lost. The lack of "sweetness" in our collections suggests little exchange of genetic material between domesticated and wild squashes.

Our survey also demonstrated the potential economic impact of wild gourds for human foragers. While it is virtually impossible to remove placental tissue from seeds, boiling the seeds for 5–10 min is sufficient to render them palatable. The implications of this simple processing technique are straightforward: wild gourd seeds can be added to a list of economically important annuals utilized in the East in the fourth millennium before the present.

As we have noted elsewhere, large "patches" of gourds can produce prodigious quantities of fruits. For example, a single patch on the Buffalo River covering about 200 square meters produced over 100 fruits containing 10,000–20,000 seeds (Smith et al. 1992:94). Under cultivated conditions, wild gourds could be expected to produce even greater quantities. Preliminary analysis of the nutritional qualities of wild gourd seeds suggests that more than 24% of their dry weight is high-quality protein (D. Smith 1992); this equals the protein content of domesticated sunflower (24%), and approaches that of sumpweed (32.25%) (Smith 1992, Table 9.3). Smith's analysis assayed the content of the entire seed (including the nondigestible seed coat); assay of the kernel only might be comparable to domesticated *C. pepo* (Smith 1992, Table 9.3).

Peduncle absciscence and diameter.—Whenever possible, peduncles were collected with each fruit, but most fruits had already abscised from the vines. In general, this seemed to be a function of latitude and altitude; more southerly, lower elevation collections were generally less mature, and fruits more likely to be retained on the plant. Even when fruits were found on the vine, however, it was difficult to remove both the fruit and peduncle from the vine without having the fruit detach from the peduncle. Fruits often abscised from the peduncle with the slightest tug. Andres (1987) has noted this peculiarity in var. *texana*, and suggests it represents an adaptive strategy that allows fruits to be readily dispersed during floods.

Recent collections of *C. pepo* ssp. *ovifera* and *C. pepo* suggest that absciscence among cultivated ornamental gourds and squashes and pumpkins is highly variable. Larger fruited forms of cultivated *C. pepo* (acorn squash, Connecticut field pumpkin) remain firmly attached to the vine long after fruits mature. On the other hand, absciscence in ornamental gourds varies from one variety to the next. In recent collections of mixed ornamentals, the senior author noted that forms such as "Green-striped pear" were most susceptible to falling free of the vine. Warty fruits were the most persistent; rarely could a fruit be collected without breaking the peduncle from the vine. Green striped, oblate, or cheese-shaped forms were intermediary between the "pear" forms and the "warty" ones.

Peduncles on Ozark gourds are uniformly five-angled, a common character of all varieties of *C. pepo*. In a sample of 20 fruits and associated peduncles, diameters (maximum distance between two points at the peduncle base) ranged from 5.3–8.6 mm, with a mean of 6.6 mm (standard deviation 0.79 mm) (Table 5). This measurement

TABLE 5.—Peduncle diameter and fruit size in free-living Ozark and cultivated Ohio *Cucurbita* gourds.

	Peduncle Diameter (mm)	Maximum Fruit Height (cm)	Maximum Fruit Diameter (cm)
Ozark Sample[1]			
33	6.1	5.5	4.7
39	6.7	5.6	4.8
40	5.6	5.0	4.2
42	6.5	5.4	4.8
44	5.9	5.6	4.5
48	6.2	5.5	4.8
123	6.6	8.9	5.2
124	5.3	7.6	4.5
125	5.9	5.2	4.6
133	6.3	5.7	5.3
166	7.6	5.0	5.0
167	7.6	5.3	4.5
168	7.3	4.6	4.5
285	6.4	5.7	4.7
286	6.3	5.1	4.4
288	5.8	4.0	3.9
301	7.3	4.9	5.4
309	6.6	5.0	5.2
389	8.6	6.6	6.7
399	6.9	6.0	5.8
	Sample Mean = 6.6	Std. Dev. .80	
Cultivar Sample[2]			
1	8.5	4.7	8.5
1	8.3	4.8	8.0
1	10.0	4.5	7.7
1	12.4	4.7	8.6
2	7.5	4.2	4.3
2	6.4	4.9	4.5
2	6.2	4.2	3.9
3	8.0	6.2	8.8
3	7.0	6.4	8.7
3	7.9	6.1	9.4
3	7.0	6.6	9.3
3	9.0	4.5	7.5
4	13.7	7.2	7.1
4	12.0	7.3	7.4
4	15.0	11.5	8.5
4	11.0	11.7	6.9
4	10.0	6.3	6.8
4	10.0	6.4	7.1
4	15.1	8.3	9.2
4	14.9	8.2	8.2

TABLE 5.—Peduncle diameter and fruit size in free-living Ozark and cultivated Ohio *Cucurbita* gourds. (continued)

	Peduncle Diameter (mm)	Maximum Fruit Height (cm)	Maximum Fruit Diameter (cm)
Cultivar Sample[2]			
4	13.0	8.0	8.2
4	11.3	7.1	7.2
4	10.0	6.4	7.2
4	12.9	5.2	8.7
Sample Mean =	10.3	Std. Dev. 2.9	

[1]Ozark Cat. Nos. 33–48 Spavinaw Creek, Benton County, AK; 123–133 Wilbur Allen Wildlife Refuge, Gasconade River, Wright County, MO; 166–168 Maumee Landing, Buffalo River, Searcy County, AK; 285–286 Highway 14 Bridge, Buffalo River, Searcy County, AK; 288–309 Highway 9 Bridge, White River, Izard County, AK; 389–399 Red River, Bossier Parish, LA.

[2]Cultivars (all from field of mixed ornamental *C. pepo* ssp. *ovifera* growing in Hamilton County, Ohio). 1 Green and white striped, with shallow lobes, oblate shaped; 2 yellow-striped, slightly warty and lobed; 3 dark green stripes on light green background, slighted lobed and slightly warty, oblate shaped; 4 yellow warted, oblate to pyriform shaped.

was significantly larger (mean 9.75 mm, range 6.2–15.1 mm, standard deviation 2.8 mm) in a sample of 23 peduncles of mixed cultivated *ovifera* fruits.

Peduncle diameter in *Cucurbita pepo* is clearly related to fruit volume. This is visually obvious when comparing the large fruits of some cultivated *pepos*, but is less so for cultivated ornamentals and free-ranging gourds. A comparison of individual peduncle diameters from cultivated ornamentals from southwest Ohio and free-ranging Ozark fruits serves as an objective measure of this relationship, and clarifies the utility of the peduncle in determining wild versus cultivated status of small *pepo* forms. As illustrated in Fig. 9, most free-ranging gourds produce peduncles and fruits that are smaller than cultivated *C. pepo* ssp. *ovifera*. While there is overlap in the size distributions, we believe peduncle diameter is probably useful for determining whether archaeological specimens are cultivated or wild if one has a collection of sufficient size. We suggest, for example, that *in general*, peduncles with diameters of 8 mm or less are probably from wild fruits, and those with diameters larger than this are likely domesticated. Since peduncle diameters of wild and cultivated forms overlap, however, this cut-off is best used with caution. And, like rind and seed measurements, archaeological sample size limits the utility of any peduncle diameter "index" in distinguishing between wild and early domesticated forms.

SUMMARY OF MORPHOLOGICAL CHARACTERISTICS AND THEIR INTERPRETIVE VALUE FOR ARCHAEOLOGICAL COLLECTIONS

Morphological characteristics of *Cucurbita pepo* gourd populations from the Ozarks provide baseline information useful in evaluating wild versus domesticated status of modern and archaeological specimens. In particular, these data suggest that the following characteristics can be used as markers of domestication:

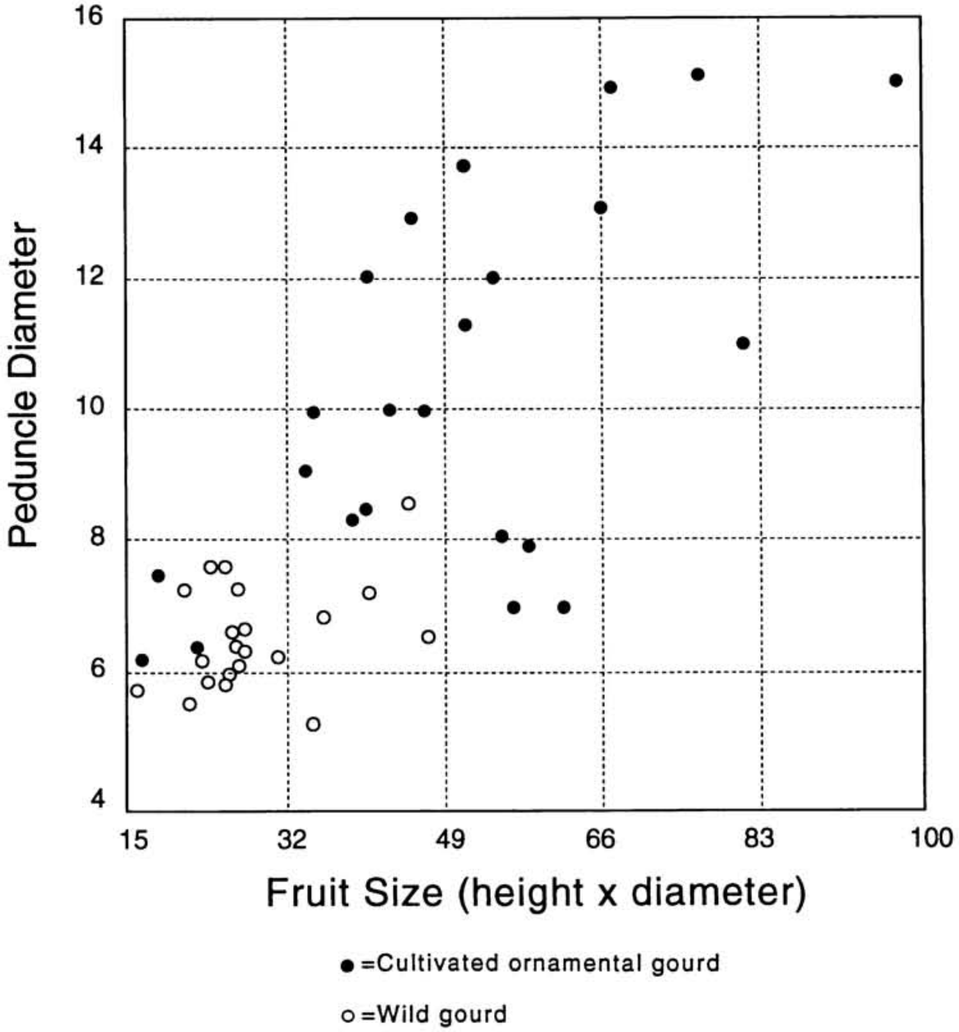

FIG. 9.—Bivariate plot of the relationship between peduncle diameter and fruit size (maximum height × maximum diameter), free-ranging Ozark (FG) *Cucurbita pepo* gourds and cultivated *Cucurbita pepo* ssp. *ovifera* (CO) fruits from a mixed population grown in Hamilton County, Ohio.

(1) rind thickness which exceeds 2 mm;
(2) epidermal lobing and/or warting;
(3) seed length greater than 11 mm; and
(4) peduncle diameter exceeding 8 mm.

These guidelines for identifying wild versus domesticated *pepo* do little to alter the current model of the appearance of truly domesticated *Cucurbita pepo* in eastern North America (see Smith et. al 1992, Chapters 3 and 4). After an unknown period of use of wild gourds similar, if not identical, to those growing in the

Ozarks today, domestication occurred sometime between about 4300–3000 B.P. The Phillips Spring assemblage (ca. 4300 B.P.) is important in this regard, in that it might represent an early stage of domestication. Length and width of Phillips Spring gourd seeds, and their range of variation, fall on the edge, or outside the range of wild forms, while peduncle diameter and rind thickness fall well below the boundary lines of domestication.

FREE-LIVING *Cucurbita pepo* GOURDS: SUMMARY

Based on limited published references, information from herbarium sheets, and field studies, an initial outline of the most obvious aspects of the niche and habitat of free-living *Cucurbita pepo* gourds can be offered.

The free-living *Cucurbita pepo* gourd of eastern North America exhibits a highly successful specific adaptation to stream and river valley floodplain habitats. These gourds are the first to occupy and grow in stream-side gravel and sand bar, bank, and terrace settings where few other plants match their colonizing abilities. The buoyant gourds are often trapped by weeds, bushes, and other floodwater "filters," or are deposited with other floodborne materials in debris piles. Whether the context of deposition is stream-side sand and gravel bars and hummocks, as documented along the smaller streams and rivers of the Ozarks, or the higher elevation sandy terraces and levee ridges of larger river valleys, gourds colonize open edge areas within the constantly reworked floodplain landscape. These sunny to partly shaded habitats constitute the annually disturbed habitat setting within which *Cucurbita pepo* gourds are strong and successful competitors. With rapidly growing vines that can extend for more than 30 meters along the ground and climb 3–4 m into trees and other vegetation, these gourds also exhibit impressive means of reaching sunlight and displaying their blossoms to pollinators.

Although sometimes occurring in concentrated populations, isolated plants can also be dispersed widely along floodplain corridors. With their capacity for self-pollination, isolated plants are not disadvantaged by wide floodwater dispersal. Contrary to the Asches' assertion, there is no evidence that var. *texana* (or any of the free-living *Cucurbita pepo* gourds) do not have the ability to self-pollinate (Deena Decker-Walters, personal communication, 1992).

These adaptational aspects of free-living gourds—buoyant, hard-walled fruit functioning for efficient seed dispersal by floodwaters, aggressive climbing and growth characteristics of vines, prolific gourd and seed production, and self-pollination—all suggest long-term evolution within, and adaption to, river floodplain environments. This adaption also proves advantageous for colonizing human-maintained floodplain habitats such as bridge approaches, drainage ditches, and agricultural fields. This plant's well documented ability to infest fields within the reach of floodwaters chronically certainly qualifies it as a floodplain agricultural weed of the first rank. But as indicated by the above habitat descriptions, it is a mistake to characterize the free-living gourds narrowly as agricultural weeds, and certainly in error to view them as closely associated with soybean cultivation. On the contrary, it is important to begin any characterization of free-living *Cucurbita pepo* gourds with a recognition of their successful adaptation to naturally disturbed floodplain environments, and to then view their success in anthropogenic contexts as the simple expansion of the plant into areas where human activities have expanded, sometimes dramatically, the habitat of the plant.

Based upon information collected from a survey of archaeological literature, herbaria holdings, and field and laboratory observations, we have been able to document the following:

(1) Archaeological evidence of a morphologically wild *Cucurbita pepo* gourd is present in broad areas of the East spanning a period of nearly 12,000 years.
(2) Historical evidence of this same plant can be traced from the discovery of *Cucurbita pepo* ssp. *ovifera* var. *texana* in 1835, and throughout the remainder of the nineteenth and early twentieth centuries in the central Mississippi valley where a wild morphotype gourd has been repeatedly collected since 1846.
(3) Contemporary free-ranging gourds scattered throughout the Southeast and Midwest differ markedly in morphology from cultivated ornamentals.
(4) Rather than narrow niche agricultural companion weeds, free-ranging gourds are well adapted members of riparian plant communities and thrive in habitats far removed from agricultural settings. Although the same gourds do invade cultivated fields, they are by no means tied to such human-maintained habitats.

While ongoing analyses of archaeological materials and contemporary collections will undoubtedly flesh out the relationships between cultivated forms of *C. pepo* ssp. *ovifera* and free-living *Cucurbita pepo* gourds of eastern North America, we believe there is little need to rely on Mexico as the "hearth" from which cucurbits diffused into eastern North America. Indeed, these data call into question the early radiocarbon dates associated with cucurbits in Mexico. The cucurbit collections from the central and northern Mexican cave and rockshelter sites should be radiometrically dated.

There is ample evidence that a wild indigenous gourd has existed in the East for thousands of years. We believe this gourd to have been the progenitor for many of today's *pepo* squashes. The companion article by Decker-Walters et al. in this journal issue provides further, and we think, compelling support for this position.

NOTES

[1]Taxonomy of *Cucurbita pepo* follows Decker-Walters (1990). We refer to *C. pepo* ssp. *ovifera* var. *texana* as the Texas wild gourd or var. *texana* in the text. We use the term *C. pepo* gourd to refer to the ornamental domesticated gourds (*C. pepo* ssp. *ovifera*) and the free-ranging varieties (Texas gourd and *C. pepo* ssp. *ovifera* var. *ozarkana;* see Decker-Walters et al., this volume).

[2]The following seed catalogues are cited in the text. All are on file at the United States Department of Agriculture, National Agricultural Library in Beltsville, Maryland.

BLISS, B.K. 1860. A Descriptive Catalogue Containing a Choice Collection of Flower, Vegetable, and Agricultural Seeds. Eighth annual edition. Springfield, Massachusetts.
BURPEE, W. ATLEE and COMPANY. 1883. Burpee's Farm Annual. Philadelphia.
FERRY, D.M. and COMPANY. 1909–1937. Market Gardener's Price List of Choicest Vegetable and Flower Seeds. Wooster, Ohio and Detroit.
HOVEY and COMPANY. 1845. Descriptive Catalogue of a Choice Collection of Flowers and Seeds. Boston.

M'MAHON, BERNARD. 1804. Catalogue of American Seeds. Philadelphia
__________. 1819. The American Gardener's Calendar. Philadelphia.
O'KEEFE, M. and SONS COMPANY. 1868. Catalogue of Seeds and Guide to the Flower and Vegetable Garden. Rochester, New York.
PRINCE, WILLIAM and SON'S. 1834–35. Annual Catalogue of Esculent Vegetables and other Seeds of the Choicest American and Imported Varieties.
SIBLEY, HIRAM COMPANY. 1879. Catalogue of Garden, Field, and Flower Seeds. Rochester, New York and Chicago.
VICK, JAMES. 1866. Vick's Illustrated Catalogue of Seeds and Guide to the Flower Garden. Rochester, New York.

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