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INFORMAL PLANTING OF SQUASHES AND GOURDS BY RURAL FARMERS IN SOUTHWESTERN TAMAULIPAS, MEXICO, AND IMPLICATIONS FOR THE LOCAL ADOPTION OF FOOD PRODUCTION IN PREHISTORY

J. Kevin Hanselka

Present-day small-scale farmers near Ocampo, Tamaulipas, Mexico demonstrate behaviors that have broader implications for prehistoric human ecology. Common incidences of casual, informal cultivation of squashes and gourds take place around routine seasonal activities, often kilometers away from homes and conventional agricultural plots. These observations elucidate prehistoric subsistence behaviors in a region known for archaeological evidence of low-level food production. Such activities may serve as analogies for behaviors characterizing the extended period following the arrival of cultigens in Ocampo about 6,500 years ago, until the establishment of the first settled agricultural villages around 3,500 years ago. They demonstrate that domesticated squashes and gourds are sufficiently resilient to be left unattended for months at a time and still produce viable fruits to be collected and used when the cultivators return. Thus their use is compatible with a nomadic settlement system, and their adoption did not necessitate a drastic reduction in mobility. Contemporary cropping strategies illuminate how some plants that were fully domesticated by the time they arrived in Ocampo could have been successfully integrated into an otherwise hunter-gatherer lifestyle without major economic disruptions.

Key words: *Prehistoric Mexico, Tamaulipas, agricultural origins, low-level food production, squashes and gourds*

Actualmente, los granjeros que siembran en pequeña escala en el área de Ocampo, Tamaulipas, México demuestran comportamientos con amplias implicaciones sobre la ecología humana prehistórica. Las incidencias usuales del cultivo casual e informal de calabazas y calabazas vinateras ocurre junto con la rutina de actividades estacionales, muchas veces a varios kilómetros de sus hogares y parcelas agrícolas convencionales. Estas observaciones elucidan comportamientos prehistóricos de subsistencia en una región históricamente conocida por su evidencia arqueológica de una producción de alimentos de baja escala. Tales actividades pueden servir como analogías del comportamiento que caracteriza el período extendido que sigue después que llegan las plantas cultivadas en el área de Ocampo hace unos 6,500 años, hasta que hay asentamientos de las primeras aldeas agrícolas hace unos 3,500 años. Demuestran que las calabazas y calabazas vinateras domesticadas son suficientemente resistentes de ser desatendidas por meses a la vez, y sin embargo producen las frutas viables que se cosecharan al regreso de los cultivadores. Así que su uso es compatible con un sistema de una población nómada, y que no requiere una reducción drástica en movilidad. Las estrategias contemporáneas de cultivo discutidas en este artículo iluminan cómo algunas plantas que, desde el momento que llegan al área de Ocampo, ya estaban domesticadas y como se habrían podido integrar con éxito en un modo de vida de cazador-recolector sin alguna interrupción económica de gran importancia.

Introduction

Archaeological evidence indicates that domesticated plants arrived in southern Tamaulipas, Mexico at least 6,150 cal BP,[1] long before the appearance of the first agriculturally dependent villages at approximately 3,600–3,000 B.P.

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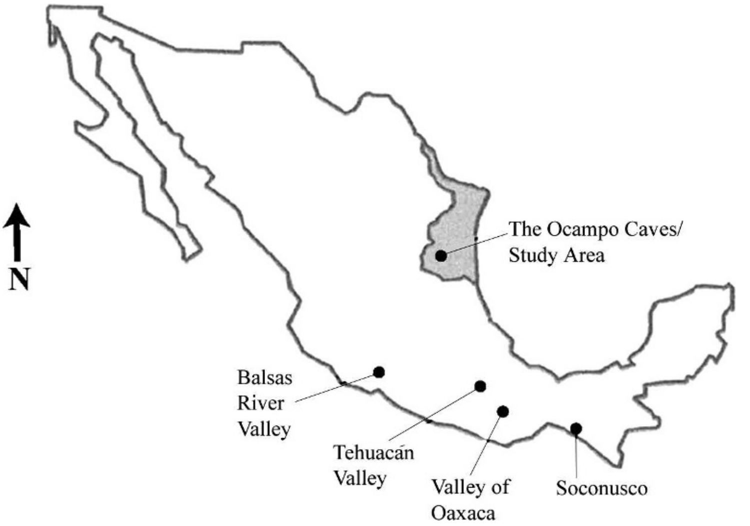

FIGURE 1. Map of Mexico showing the location of Tamaulipas (shaded), the Ocampo caves/study area, and other sites mentioned in the text.

(MacNeish 1958, 2001). As in other parts of Mexico, the intervening period was inhabited by *low-level food producers* (Smith 2001a, 2005a), societies that were neither exclusively foragers nor firmly agricultural, yet utilized a growing assemblage of domesticated plants. Such groups differentially and successfully incorporated domesticated food and utilitarian plant species into economies still strongly dependent upon wild resources, long before agriculture became the primary means of survival. This scenario poses important questions regarding settlement and mobility: how compatible is a relatively mobile lifestyle with the use of crops that require some form of human maintenance? Could previously hunting and gathering populations maintain their traditional seasonal rounds after the adoption of introduced domesticates, or did this shift necessitate a drastic reduction in mobility?

My recent fieldwork in Tamaulipas permitted the direct observation of present-day cultivation strategies that have implications for these issues. Common incidences of casual, informal cultivation of cucurbits (family Cucurbitaceae) occur around other routine seasonal activities, often miles away from homes and customary agricultural plots. These behaviors may serve as analogies for low-level food production prior to the first appearance of settled village agriculture in this region. They demonstrate that some cultivated plant species could have been successfully incorporated into the local mobile, otherwise hunter-gatherer lifestyle without necessitating a major immediate shift in the subsistence economy.

The Ocampo Caves and the ''Era of Incipient Agriculture''

The Ocampo region of southern Tamaulipas (Figure 1) was made famous in 1953–54 by Richard MacNeish's (1958, 1992) excavations in three local sheltered sites: Romero's (Tmc 247), Valenzuela's (Tmc 248), and Ojo de Agua (Tmc 274)

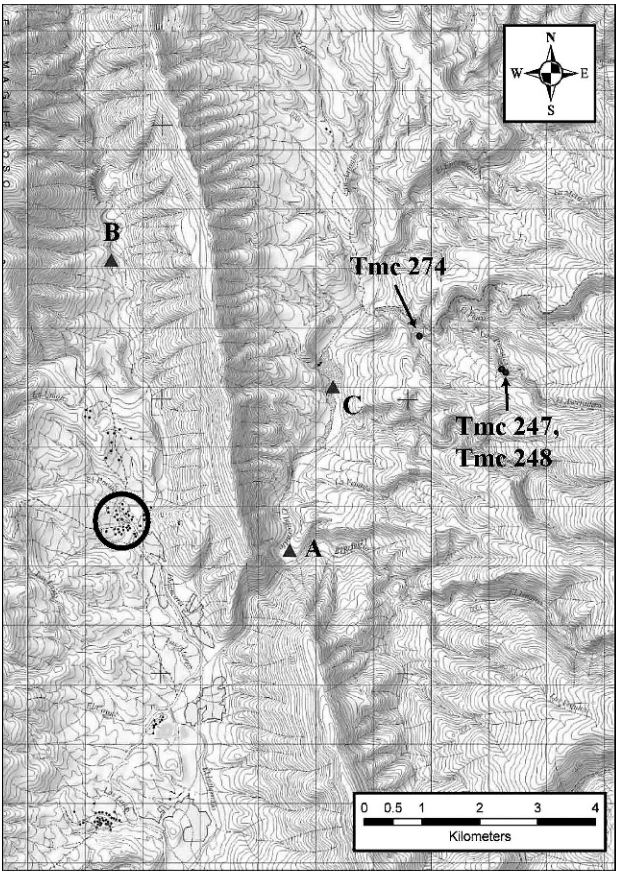

FIGURE 2. Map of the study area, showing the location of the Ocampo caves and present-day casually sown plots (A, B, C); *ejido* San Lorenzo las Bayas is encircled (modified from INEGI 2002).

caves (Figure 2). By conventional radiocarbon dating of wood charcoal found within the stratigraphic layers, these investigations resulted in a regional sequence of nine distinct cultural phases and yielded abundant evidence for early food production in the form of the desiccated remains of domesticated plants (Table 1).

These data demonstrated the sporadic local adoption of various exotic cultigens, including cushaw (*Cucurbita argyrosperma* subsp. *argyrosperma* Huber, formerly *C. mixta* Pang.), butternut (*C. moschata* Duchesne), and pepo (*Cucurbita pepo* L. subsp. *pepo*) squash; bottle gourd (*Lagenaria siceraria* ([Molina] Standl. subsp. *siceraria*); sieva (*Phaseolus lunatus* L.) and common bean (*P. vulgaris* L.); and maize (*Zea mays* L. subsp. *mays*) (Kaplan and MacNeish 1960; Mangelsdorf et al. 1964; Mangelsdorf et al. 1967; Whitaker et al. 1957). Recent applications of the more precise Accelerator Mass Spectrometry (AMS) dating method directly to the supposedly oldest cultigen specimens from the caves have resulted in substantial revisions to the original sequence (Table 1), yet still support the intermittent arrival of various domesticated plant taxa (Kaplan and Lynch 1999; Smith 1997a).

TABLE 1. The Ocampo Caves: cultural chronology, original cultigen sequence, and subsequent AMS revisions.

Cultural Phase	Age range (in calibrated years B.P.)[a]	Cultigen sequence (as originally formulated in the 1950s)[b]	Revised sequence based on direct AMS dates (in calibrated years B.P.)	Major local prehispanic events
San Antonio	500–200			Spanish arrival (A.D. 1522)[h]
San Lorenzo	1100–500			
Palmillas	1900–1100	*Cucurbita argyrosperma*[c] *Phaseolus lunatus*[d]	*P. vulgaris* (1285 B.P.)[f]	
La Florida	2400–2000			
Mesa de Guaje	3600–3000		*C. moschata* (2750 B.P.)[g]	Earliest known ceramics[h] Earliest known sites with evidence of substantial habitations[i]
Guerra	4400–3600	*C. moschata*[c]		
Flacco	5200–4400	*Zea mays*[e]	*Zea mays* (4405 B.P.)[g] *C. argyrosperma* (5035 B.P.)[g]	
Ocampo	6000–5200	*P. vulgaris*[d]	*C. pepo* (6030 B.P.)[g] *L. siceraria* (6150 B.P.)[g]	
Infiernillo	9000–7600	*Lagenaria siceraria*[c] *C. pepo*[c]		

REFERENCES: [a] MacNeish 2001; [b] Mangelsdorf et al. 1964; [c] Whitaker et al. 1957; [d] Kaplan and MacNeish 1960; [e] Mangelsdorf et al. 1967; [f] Kaplan and Lynch 1999; [g] Smith 1997a; [h] MacNeish 1958; [i] MacNeish 1992

Data from the Ocampo caves and similar sheltered sites excavated during the 1960s in the Tehuacán Valley by MacNeish (Byers 1967) and in the Valley of Oaxaca by Flannery (1986) contributed to a general scenario for the origins and spread of agriculture in Mesoamerica that is widely upheld to this day (Figure 1). The model maintains that through deliberate human selection, major domesticated crop plants originated in divergent areas and times, and were incorporated into local foraging systems as they spread throughout Mexico. Their use gradually increased over time at the expense of wild resources as domesticates became more productive and more reliant on humans, due to genetic alterations that hampered their ability to reproduce independently (Flannery 1968, 1973, 1986; Mangelsdorf et al. 1964; Smith 1997a).

Following terminology by Steward (1949), MacNeish (1964) applied the name ''Era of Incipient Agriculture'' (or EIA) to the extended period between initial domestication and the eventual founding of agricultural villages in Mexico. Alongside increasing dependence on domesticated plants, there were corresponding gradual changes in settlement and group organization in which the typical mobile, single-family foraging unit (*microband*) gave way to more frequent and longer aggregations of multi-family groups (*macrobands*). With the support of larger cultivated fields and more investment in their tending, some camps eventually came to be occupied year-round (MacNeish 1964). The culmination of the EIA was this shift to permanently inhabited farming villages largely dependent on maize, beans, and squash. The duration between the first use of domesticated plants and the earliest agricultural settlements varied regionally but lasted some 5,500 years in Mexico as a whole (Smith 2001a:25).

The presence of such long-term mixed foraging-food-producing economies in the archaeological record demonstrates that there was not so much a global

''Agricultural Revolution'' (Braidwood 1960) as there was an array of adaptations into local subsistence niches divergent from pure hunting and gathering. Often these developments made no immediate drastic economic impact, and ranged from the active management and encouragement of useful wild resources through burning and weeding to actual cultivation and domestication of target plant species (Smith 2001a). Such notions have led some researchers to write about ''The Slow Birth of Agriculture'' (Pringle 1998) and to replace broad, dichotomous economic classifications (e.g., ''hunter-gatherer,'' ''agriculturalist'') with adaptive concepts more amenable to specific case studies (Smith 2001a, 2007a, 2007b).

''Low-Level Food Production''

Smith (2001a) recently refined our perceptions of the EIA by proposing an economic classification between foraging and farming, which he refers to as ''low-level food production.'' His detailed justification includes several major points relevant to the circumstances in Mexico:

- Low-level food producers differentially and creatively incorporate wild and cultivated foods into highly successful economies;
- The adoption of domesticated plants into a local foraging system does not always and inevitably lead to full ''agriculture;''
- Archaeological evidence has demonstrated that mixed foraging-farming economies can remain stable for millennia.

Central to the concept of low-level food production is the role of domestication (Smith 2001a:14). ''Domestication'' results when, ''Human societies cause either physical or genetic changes or a combination of both, in target species of plants and animals such that these new domesticates are no longer viable without continued human protection and care'' (Smith 2001a:14). Such processes are difficult to trace in prehistory, but appropriate archaeological and genetic techniques are continuously evolving (Zeder et al. 2006). For example, domestication of Mexican pepo squash was accomplished through size selection for edible seeds and is therefore archaeologically recognized on the basis of seeds exceeding 12 mm in length (Smith 2006). We recognize archaeological bottle gourd as domesticated from its presence outside the native range of its wild ancestor in Zimbabwe, Africa (the result of human-aided diffusion) as well as ''a substantial increase in fruit rind thickness and associated fruit durability'' (Erickson et al. 2005:18,316). Stronger fruit rinds provide better containers and reduce natural seed dispersal. Maize has a number of attributes that hamper its survival in the wild, including firmly attached grains that require a human hand for propagation; these characteristics contrast greatly with those of its immediate wild ancestor, annual Balsas teosinte (*Zea mays* subsp. *parviglumis* Iltis & Doebley) (Benz 2001).

Diverse mixed economies and the time lag between the initial domestication or regional arrival of cultigens and entrenched village agriculture across Mexico indicate that the EIA was peopled by low-level food-producing societies who operated under wide-ranging environmental and cultural contexts, and locally integrated assorted wild and managed foods and a growing number of domesticated plants to varying degrees over a very long time span (Smith 1997a:379, 2001a, 2001b). Low-level food producers can exist either as non-agricultural societies that utilize domesticates to some degree, or as groups that intercede in the life cycles of species that never become technically domesticated. The Ocampo populations discussed in this article are clearly characterized as the former. However, it is important to note that the people of the EIA most likely did not draw dramatic distinctions between food classifications as we often do today, but rather recognized a continuum of plant resource procurement strategies requiring varying degrees of investment.

Mesoamerican prehistory holds many pertinent cases of low-level food production, only a few of which will be discussed here (Figure 1). Domesticated Mexican pepo squash presumably originated in the southern Mexican highlands; it is directly dated at Guilá Naquitz rock shelter in the Valley of Oaxaca to about 10,000 years ago, where it was the only cultigen used in an otherwise successful foraging system until the adoption of maize about 6,200 years ago (Flannery 1986; Piperno and Flannery 2001; Smith 1997b, 2000). Based on molecular evidence, maize likely originated in the Central Balsas River Valley of southwestern Mexico (Doebley 2004). Recent archaeological and microfossil (starch grain, phytolith) data from this region seem to indicate its presence alongside a domesticated squash (possibly cushaw) as early as 8,700 years ago; the initial cultivators of these plants probably engaged in a variety of subsistence pursuits (Hastorf 2009; Piperno et al. 2009; Ranere et al. 2009). Maize and other domesticates diffused widely from their points of origin across the landscape where local ecology permitted, and were differentially adopted into diverse low-level food production systems. Maize arrived in the Soconusco region in Chiapas on the Pacific coast of southern Mexico by 5,000 years ago, but for over 2,000 years remained only a minor component in a dietary strategy otherwise emphasizing foraging and possibly the cultivation of non-domesticated plants (Kennett et al. 2006:103).

Most relevant to the present article, fully domesticated bottle gourd (6,150 B.P.) and pepo squash (6,030 B.P.) appeared in the Ocampo region of Tamaulipas during the Ocampo phase, followed by cushaw squash (5,035 B.P.) and maize (4,405 B.P.) during the Flacco phase (Table 1; Smith 1997a). These cultigens were adopted into local economies otherwise dominated by wild resources. The earliest known Ocampo ceramics were found in deposits attributed to the Mesa de Guaje phase, and village agriculture is apparent to MacNeish (1992:105) during this period based on archaeobotanical assemblages and the appearance of larger open air sites with ceramics and circular house platforms. Thus the available data indicate that in Ocampo, pre-village low-level food production lasted some 2,500 years.

The Study Area

In the spring and fall of 2005 and again briefly in 2007, I conducted an archaeological survey near the Ocampo caves in order to document a wider range of local archaeological site types and to bring the data from the excavated caves into the larger context of a prehistoric subsistence/settlement system. The study area is about 25 km north of the town of Ocampo on the eastern slopes of the Sierra Madre Oriental between 600 and 1,300 meters above sea level. It is a region characterized by high mountains, mesas, steep hills, and narrow valleys and canyons, and the karstic limestone terrain is riddled with caves, shelters, and sinkholes (Figure 2). Due to the rugged topography, actual foot-travel distance between points tends to be deceptively much further than as the crow flies.

Presently the study area receives approximately 900 mm of rainfall annually, most of which falls between June and August. There are distinct wet and dry seasons, and the winters can be quite cold (MacNeish 1992:83). This marked seasonality results in variable availability of resources throughout the year. The climate supports a rich mosaic of vegetation zones including tropical deciduous forest, thorn forest, grasslands, sub-montane thicket, oak-pine forest, and lowland tropical forest (Claudia Gonzalez-Romo, personal communication, 2006).

The three previously excavated cave sites are situated on the eastern edge of the study area, while the small farming community (or *ejido*) of San Lorenzo las Bayas is on the western edge (Figure 2). The *ejido* presently consists of about 50 related families of *mestizo* ancestry. The residents are economically dependent on a combination of wage labor, animal husbandry, and small-scale farming. Local agriculture is not irrigated, but entirely rain-dependent. At the onset of the summer rainy season, farmers plant crops of corn, butternut squash, cushaw squash, and common bean together in established and formally prepared, slash-and-burn plots (*milpas*). Broad floodplain valleys are almost non-existent in the study area, so *milpas* are typically placed on limited river terrace space in narrow valleys close to the *ejido* and on surrounding hill slopes. Farmers till with mule-drawn plows, and plant seeds by hand. The crops, which are harvested in November and December, are primarily for personal consumption. House gardens often contain some food and utilitarian plants, including the bottle gourd. Locals also procure tiny *chili piquin* (*Capsicum annuum* L.) peppers and other wild plants from surrounding mountain forests. Pigs, chickens, goats, mules, burros, and cattle are also kept for personal use or occasional sale. When available, men take on government-sponsored jobs, such as maintenance of local rural roads.

Casual Cultivation in San Lorenzo Las Bayas

Although most agricultural practices take place in the immediate vicinity of the *ejido*, some local residents utilize more distant canyons and mountain forests for cattle grazing and for gathering wild plants (Hernández Sandoval et al. 1991). As an added benefit, such expeditions also present opportunities for the casual, supplementary cultivation of domesticated plants. The taxa most often targeted include squashes and gourds, though my sources inform me that maize is sometimes similarly treated. Planting activities are highly flexible in that they may be completely spontaneous and opportunistic, or they may involve varying degrees of planning. For example, while on distant excursions into the surrounding canyons, individuals may carry small quantities of seed should the opportunity to plant them arise. On the other hand, when abandoned squash or gourd fruits are encountered along the trail, the seeds may be salvaged and planted on the spot. Sowing methods may involve simple dispersal of seeds across unprepared ground or accompany small scale, intentional burning events. In anticipation of future herding rounds, fires are occasionally set before the summer rains to clear small plots of land and encourage forage growth. Often this takes place at isolated locations kilometers away from the community. Once the surrounding brush is reduced to ash and the ground cools, desired seeds are either casually dispersed leaving subsequent rains to push them into the rich ashy soil, or they may be manually pressed into the earth. Typically they are not further tended. Mature fruits can be collected on future visits, such as when small groups of cattle are escorted into the canyons to graze at the previously prepared forage patches.

I directly witnessed several instances of such activities over the course of my fieldwork. Additional information was obtained over conversations held around many campfires and while trekking through the canyons in search of archaeological sites. My expert collaborators on this matter are Fermin Puente Castillo and his uncle Aquiles Puente Montalvo, two local farmers with extensive first-hand knowledge of the land surrounding their home. Their family has occupied the region for generations, and their present cultivation practices remain largely unchanged from those of their ancestors.

In March 2005 we encountered a large burned patch of land at the site of an abandoned historic corral on a river terrace in the Cañon Infiernillo, approximately 4.7 km by foot from the *ejido* (A, Figure 2). This location had been intentionally cleared and burned to prepare a future grazing area. Upon discovering a ripe, unburned butternut squash fruit among the ashes (apparently left behind by past visitors), my guides split it open, removed handfuls of seeds, and proceeded to push the seeds into the ashy soil at many locations across the site. They explained that any resulting fruits would be gathered in the months to come.

Like many peoples around the world, local residents use dried bottle gourds as vessels for holding and transporting water. Such gourds are usually nurtured in house gardens, but in November 2005 I noted extensive mature bottle gourd vines on an isolated river terrace in the Cañon Huazacana, about 4.5 km north of the nearest residence (B, Figure 2). According to Mr. Puente Castillo, these had been planted by people from the community who would eventually collect the dried fruits while in the area on other business. In this instance no burning had taken place, nor was there any sign of further preparation of the planting area.

In November 2007, we stopped at an 8×8 m cleared and burned plot on an alluvial terrace adjacent to the dry bed of the Cañon Infiernillo, about 7.5 km by foot northeast of the *ejido* (C, Figure 2; Figure 3). An *ejido* resident had prepared the plot as a forage patch, but it also held more than a dozen large butternut squash fruits. Mr. Puente Castillo took one fruit back to his home in the *ejido* where it was steamed for dinner.

Local residents obviously are not dependent upon these behaviors for survival. They are beneficial because they result in supplementary food for extended trips into the mountains and in knowledge of the location of squash

FIGURE 3. Casually sown plot of butternut squash (*Cucurbita moschata*), 7.5 km by foot northeast of *ejido* San Lorenzo las Bayas (C, in Figure 2). Photo by José E. Zapata.

and gourd fruits ''whenever the craving strikes'' or when a new water container is desired. Though the practitioners are true farmers in the *ejido*, these observations demonstrate the casual, informal cultivation of domesticated plants *outside* the context of the primary means of subsistence, and illustrate the creativity and flexibility with which cultigens may be utilized on a small scale. They therefore have implications for prehistoric low-level food production in this region.

Implications for EIA Low-Level Food Production

Bottle gourd and Mexican pepo squash are among the earliest domesticated plants documented in North America (alongside a number of root crops and other squash varieties domesticated throughout the New World Neotropics at relatively early dates [Dickau et al. 2007; Dillehay et al. 2007; Piperno and Pearsall 1998; Piperno et al. 2000; Piperno et al. 2009; Piperno and Stothert 2003]). As presented in the EIA model and supported by current evidence, major crop plants were domesticated in widely scattered regions and at different times, then subsequently dispersed across the landscape at varying speeds (Smith 2001b). Numerous factors influenced the rate of this diffusion and the degree of a crop's acceptance by hunter-gatherers or low-level food producers. Such factors include cultural context (e.g., mobile versus sedentary settlement, food processing technology, ethnic differences between adjacent groups), human migration, productivity of existing dietary sources relative to the new food items, and

TABLE 2. Pepo squash, bottle gourd, and maize sequences for three major EIA cave locales in Mexico (dates in calibrated years B.P.).

Domesticated taxa	Oaxaca	Tehuacán Valley	Ocampo
Pepo squash	9975 B.P.[a]	7920 B.P.[e]	6030 B.P.[g]
Bottle gourd	9920 B.P.[b]	7200 B.P.[e]	6150 B.P.[g]
Maize	6250 B.P.[c]	5550 B.P.[f]	4405 B.P.[g]
Common Bean	2100 B.P.[d]	2285 B.P.[d]	1200 B.P.[d]

REFERENCES: [a] Smith 1997b; [b] Smith 2000; [c] Piperno and Flannery 2001; [d] Kaplan and Lynch 1999; [e] Smith 2005b; [f] Long et al. 1989; [g] Smith 1997a

suitability of local ecology to the needs of individual plant species. It is likely that in some contexts the early presence of domesticated squashes and gourds relative to some other crop plants was a function of cucurbits' hardiness in the absence of consistent tending, a quality that the modern cropping behaviors discussed in this article demonstrate clearly. This resilience rendered them profoundly compatible with human adaptations centered on mobile settlement systems; therefore early in the EIA, settlement patterns were not necessarily constrained by proximity to crop fields, even over the growing season.

As support for this argument, consider the three major archaeological regions that greatly influenced the formulation of the EIA framework: the Valley of Oaxaca, the Tehuacán Valley, and Ocampo. Early cultigen specimens from these areas have recently been directly dated using AMS, so solid (albeit tentative) chronologies exist for the arrival of various crop plants in each region (Kaplan and Lynch 1999; Long et al. 1989; Piperno and Flannery 2001; Smith 1997a, 1997b, 2000; 2005b). Directly dated macrobotanical remains from these sites indicate a span of millennia between the presence of cucurbits (pepo squash and bottle gourd) and maize, and the common bean arrives even later, following the end of the EIA (Table 2). On the other hand, recent research suggests that maize was an early domesticate alongside a cultivated species of squash in the Central Balsas River Valley (Piperno et al. 2007; Piperno et al. 2009; Ranere et al. 2009). It seems that local environmental and/or cultural conditions in the Balsas River Valley favored the early domestication and use of the potentially less tough maize concurrent with cucurbits.

Another quality to consider regarding the prehistoric domestication and adoption of cucurbits is utilitarian function. Pepo squash was initially brought under cultivation in the southern Mexican highlands as a food item, for its edible seeds (Flannery 1986; Smith 2000, 2006). The bottle gourd, on the other hand, is not consumed but rather fashioned into containers and other practical items. The earliest directly dated bottle gourd remains in North America were also recovered from Guilá Naquitz (Erickson et al. 2005; Smith 2000). Although its wild ancestor has been identified in Zimbabwe, domesticated forms were widespread throughout much of the ancient Old World (Decker-Walters et al. 2004; Erickson et al. 2005). North American varieties are genetically closer to Asian than African forms. This geographic affiliation and the very early presence of this species in the New World suggest that bottle gourds were first brought to the Americas over the Bering Land Bridge from Asia by mobile Paleoindian groups near the end of the Pleistocene (Erickson et al. 2005). The bottle gourd's initial domestication in the Old World was probably a direct result of both its usefulness as a container as well as its resilience with minimal tending; these qualities also facilitated its widespread adoption by hunter-gatherers in countless habitats around the world.

It is possible that initial cultivation for non-dietary purposes may have also been the case for some New World cucurbits, even those that ultimately ended up as food. Pepo squash was independently domesticated twice, once in Mexico and again in the southeastern United States (Decker-Walters et al. 1993). The processes may have differed greatly between these two regions. In Mexico it was initially a food item, but it has been suggested that fruits of the eastern United States variety (*C. pepo* subsp. *ovifera*) were first cultivated for use as net floats, as fishing became more important in Archaic subsistence systems (Fritz 1999). Recent experiments verify that the dried fruits could have served this purpose, but also that the bitter seeds of the wild ancestral plants can be easily processed to render them more palatable (Hart 2004; Hart et al. 2004). Therefore no single possible function entirely explains the early use of the plant. Whether utilitarian or culinary in purpose, the presence of such domesticated species by no means necessarily triggered a rapid transition to farming, and this is certainly the case in Ocampo.

Thickness and extent of occupation layers in the Ocampo caves indicate that prehistoric visits were sporadic and of varying intensities or durations. MacNeish originally interpreted these differences as reflecting either short-term stays by microbands or occasional, longer-term aggregations of macrobands. More recently, Binford (1980) proposed a distinction between *foragers*, hunter-gatherers that tend to live in small groups and ''map onto'' resources through frequent residential moves, and *collectors*, groups that establish a relatively long-term, continuously occupied base camp from which smaller, logistically-organized task groups venture out to acquire more distant yet valued resources. In other words, *foraging* brings people to resources, while *collecting* brings resources to people. The distribution of available resources largely conditions which strategy is used in a given habitat, although foragers and collectors are idealized categories, and in reality most groups fall somewhere along the continuum between the extremes (Binford 1980:12). MacNeish's and Binford's frameworks are not mutually exclusive because small microband camps, multi-family macroband base camps, and various logistically-organized special purpose camps can be integrated into one larger yet flexible settlement pattern, as illustrated by Flannery (2003:32, Figure 2.6) for the Oaxaca and Tehuacán pre-ceramic periods.

In light of site characteristics observed during survey, I hypothesize that low-level food producers in the study area were oriented towards ''logistically organized collecting.'' Caves may have occasionally served as primary camp sites, as seen in the Ocampo excavations as thicker, more extensive occupation layers. Thinner layers or discrete occupations associated with artifacts and features representing special purpose activities may be interpreted as logistically organized camps related to primary camps located elsewhere. For instance, six large retouched tabular stone knives were found on the surface in a single shallow rock shelter during my archaeological survey of the study area. Because

TABLE 3. Important non-domesticated foods of the Era of Incipient Agriculture from the Ocampo Caves.

Plants	Animals
Acorns (*Quercus* spp.)	Bison (*Bison bison*)
Agave (*Agave* spp.)	Deer (*Odocoileus* spp.)
Amaranth (*Amaranthus* spp.)	Coatimundi (*Nasua* sp.)
Guapilla (*Bromelia penguin*, *Hechtia glomerata*)	Jaguar (*Panthera onca*)
Runner beans (*Phaseolus coccineus*)	Skunk (*Mephitis* sp.)
Foxtail millet (*Setaria parviflora*)	
Yucca (*Yucca* spp.)	

very few artifacts were observed otherwise, this small site is tentatively interpreted as the camp of a task group intent on harvesting the fibrous leaves of agave, yucca, or bromeliad species.

The natural habitats of the study area maintain a variety of edible wild plant and animal species, many of which were sought after by EIA populations (Table 3). Meat from deer (*Odocoileus* Rafinesque), skunk (Mephitidae Bonaparte), coatimundi (*Nasua narica* L.), bison (*Bison bison* L.), and jaguar (*Panthera onca* L.) contributed to the diet during the EIA (MacNeish 1992:103–105). Up to and after the advent of agricultural villages, local peoples also continuously utilized non-domesticated plants such as agave (*Agave* L.), bromeliads (*Bromelia pinguin* L., *Hechtia glomeratata* Zucc.), foxtail millet (*Setaria parviflora* [Poiert] Kerguélen),[2] amaranth (*Amaranthus* L.), yucca (*Yucca* L.), mesquite (*Prosopis* L.), runner beans (*Phaseolus coccineus* L.), and acorns (*Quercus* L.), alongside the introduced domesticated maize, bottle gourd, and squash (Callen 1963; Kaplan and MacNeish 1960; MacNeish 1964, 1992; Mangelsdorf et al. 1964; Mangelsdorf et al. 1967; Smith 1997a; Whitaker et al. 1957). Excavators in the Ocampo caves exposed storage pits containing copious reserves of such wild plants dating throughout the EIA (MacNeish 1992). These lines of evidence indicate both a persistent mixed foraging-farming economy and the employment of wide ranging, logistically organized resource extraction activities until entrenched agriculture was well established.

Based upon these archaeological implications and the present-day behavioral observations discussed in this article, I suggest that early food production in southern Tamaulipas was a fluid adaptation in which formal/planned and informal/opportunistic strategies played integral roles. These were further integrated into sophisticated foraging strategies. Once added to the repertoire, crops may have been formally cultivated in plots positioned near primary campsites, for instance on the mesa top 50 m above the excavated Ocampo caves. However, the informal sowing practices observed in the study area demonstrate that cultivators need not have been consistently present to tend to casually sown cucurbit plants, but instead might only return after a few months to reap the rewards. This presents the possibility that some species could have been incidentally cultivated by individuals on logistical forays some distance from the home base. In order to be viable, this scenario implies that Ocampo groups followed settlement and mobility strategies that allowed them to predict their likely route and return to a particular location months into the future. Squash plants are dependent upon moisture for germination and are therefore only productive in the study area in the fall following the summer monsoons, so their successful planting and procurement would depend on annual rounds that accommodate this schedule. Seed stock may have been carried with them in anticipation of casual cultivation; however present-day observations show that occasional encounters with lost or abandoned fruits can lead to unforeseen opportunities as well. These notions suggest a degree of forethought on the part of EIA populations in Tamaulipas, yet with a willingness to engage in opportunistic planting activities. Under this scenario local low-level food producers could have maintained their routine annual hunting and gathering rounds while successfully integrating domesticated plants, particularly if these species held only a peripheral status in the local diet and served to supplement other major prey items, were simply an occasional indulgence, or were primarily utilitarian in function.

As stated before, it is doubtful that people of the EIA made a strong distinction between domesticated and wild plant foods, but instead recognized that various resources required differing degrees of investment. Thus it is important to note that technically non-domesticated plants could have been subject to opportunistic sowing on fertile ground as well, as has been documented among historic Native American groups in the western United States (Castetter and Bell 1951). The availability and predictability of important wild resources in the Ocampo region (e.g., amaranth, foxtail millet) could have been improved in this manner. Local residents do not practice intentional, casual cultivation of wild plant species for their own consumption, but this does not exclude the possibility that such activities occurred in the distant past. In fact, in all likelihood they did.

Although they were not of central importance in the economies of early Ocampo low-level food producers, the casual use of food cultigens would have been potentially advantageous in a number of ways. The increased predictability such plots afforded may have rendered the procurement of productive wild resources more successful, allowing for more extensive or prolonged searches for and harvests of non-domesticates (see Wills and Huckell 1994:51). The resulting plants also would have served as a buffer when wild crops were less profitable. In addition, casual cultivation of a variety of taxa in widely scattered plots in diverse microenvironments is an effective risk minimization tactic, as it increases the odds of some crops succeeding even if others fail (Minnis 1992:132).

Although this article is primarily concerned with the adoption of squash and gourd plants domesticated elsewhere into the prehistoric low-level food producing economy of the Ocampo region, its argument can be extended to address cases of the initial domestication of cucurbits in Mesoamerica. Documented earliest at Guilá Naquitz rock shelter, Oaxaca, Mexican pepo squash was seemingly domesticated in the southern highlands by decidedly non-sedentary groups. Squash's hardiness in the absence of tending would indeed be an advantage to a group that frequently left the vicinity of the growing crops for extended periods. In all probability, early cultivated but not yet fully domesticated squashes were even more resilient than domesticated forms, as phytolith and lignin production in the fruits combine to render the exterior rind hard and resistant to insect and mammal herbivores, a quality that diminished during the later stages of domestication as humans selected for fruits with softer rinds (Piperno et al. 2002; Piperno et al. 2009:5022). However, for the effects of selection and ''the adaptive syndrome of domestication'' to accumulate until desirable phenotypic and genotypic changes were traceable, the casual cultivation of squashes must have been sustained yearly and the resulting crops successful enough to provide sufficient seed stock for planting the next season (Smith 2006:25). Of course, because different factors besides hardiness may come into play in different regions, this attribute may not be as important for other squash species domesticated under different cultural circumstances.

Different Domesticates, Different Strategies

Other types of domesticated plants respond differently to the kinds of casual cultivation practices described here for squashes and gourds. To complicate matters further, the same species will react differently depending on local growing conditions or cultural practices. While cucurbits are known to do well with minimal tending, other Mesoamerican seed and grain crops may be more sensitive to predation and competition with weeds, and are thus less likely to survive without increased human investment. Thus far maize is the only non-cucurbit domesticate recognized in Ocampo during the EIA (Tables 1 and 2), and the viability of casually sown maize has important implications for cultural processes during this period. Current evidence indicates that a period exceeding 1,500 years passed between the earliest known domesticated gourd and squash and the earliest known maize in the Ocampo region. If maize requires more consistent care and protection from predation by mammals, birds, and insects than do squashes and gourds, it may have required a higher level of residential stability in order to be successfully incorporated into the local economy. Pre-existing residential stability may have facilitated its acceptance, or the presence of the plant itself may have enhanced sedentism.

Relatively informal maize use may still fit within a scenario characterized by moderately mobile low-level food producers. Particularly vulnerable stages in the maize plant's life cycle are early on, when the tender vegetative parts are most appetizing to animals, and late, when emerging and maturing ears might catch the attention of browsers. During the intervening months maize appears as just another green plant on the landscape and thus may be less likely to be noticed and eaten by pests, particularly in an environment as lush as the study area (Karen R. Adams, personal communication, 2008). Contemporary Ocampo cultivators plant traditional maize varieties in early to mid-summer, with the onset of the summer rains, and harvest late in the fall. As traditional, non-industrial methods are still used and rely on local rainfall and climate patterns with no irrigation, it is likely that local EIA low-level food producers would have followed similar planting and harvesting schedules. Thus casually planted maize may have been compatible with varying degrees of mobility, provided that base camps were occupied near the plots during late summer and late fall.

I have already stated that environmental context greatly conditions how a species will respond to casual cultivation, so the degree of success in informal cropping strategies in other regions is not necessarily indicative of results in southern Tamaulipas. However, some recent investigations into how maize reliance may have constrained residential mobility on the Colorado Plateau of the southwestern United States are worth consideration here. Archaeological data indicates that Basketmaker II (2,950–1,450 B.P.) populations in this region were highly dependent upon maize agriculture (Matson 1999; Reed 2002:6). In May 1999, to test the viability of unattended crops in this context, Barr (2001) sowed ten test plots of maize and squash near archaeological sites in Comb Ridge, southeastern Utah. He selected the sites for these plots based on available groundwater and ''which areas appeared suitable for planting'' (Barr 2001:80). Each 3 × 1.5 m plot was cultivated using a digging stick fashioned after Basketmaker II sticks recovered from dry cave sites, and some plots were fenced in to control animal predation. Upon harvest in September (the time of the Hopi harvest), he found that although many plants showed signs of reproductive maturity (i.e., tassel development, immature ears) only three plots had plants with mature maize ears.

Regardless, Barr (2001:92) concluded, ''If I could get plants to grow without additional cultivation after planting, a Basketmaker with vast amounts [of] knowledge about local growing conditions would doubtlessly have astronomically greater success,'' and that unattended maize could potentially provide a viable dietary supplement to mobile groups in the Comb Ridge region. These results confirm the need to test maize hardiness specifically in the Ocampo region under casual cultivation circumstances. This experiment will contribute to the formulation of models of local subsistence and settlement patterns over the course of the EIA.

The common bean, the third element to the traditional Mesoamerican subsistence triad, was seemingly not adopted in Ocampo until relatively recently, a pattern that is consistent with other parts of Mexico (Tables 1, 2; Kaplan and Lynch 1999). Wild common beans have a wide geographic distribution, ranging from northern Mexico to northern Argentina (Gepts 1996). Molecular studies have revealed that the common bean was domesticated independently both in the Andes and Mesoamerica (Chacón et al. 2005), and recent research has further specified that the latter variety likely originated in the Río Lerma-Río Grande de Santiago Basin in west-central Mexico (Kwak et al. 2009). While various factors probably contributed to the late appearance of common beans relative to other crop plants, hardiness was likely of importance: beans do not have the same defense mechanisms as more resilient plants and therefore may have required a higher degree of sedentism and investment for their successful cultivation. Beans readily germinate even when casually broadcast in fertile soil, but the very nutritious, tender, digestible seedlings and young plants are attractive to herbivores, particularly when sown in dense stands. Serious bean cultivation, therefore, would have likely required more of a consistent human presence to ward off pests. Another factor that may have made a substantial impact on the late intensification of bean use is the development near the end of the EIA of ceramic vessels, which facilitated bean preparation for consumption by boiling. In contrast to their apparently late appearance relative to other crops, common beans spread rapidly among major archaeological sites in Mesoamerica and the American Southwest once domestication took place. Kaplan and Lynch (1999:270) note, ''This rapid adoption and dissemination of the domesticated common bean, and the absence of any domesticated beans from the rich archaeobotanical record prior to 2,500 years ago, poses a question, if domesticated common beans had been available previously in Mesoamerica, why did they not appear earlier among the apparently 'bean hungry' agriculturalists in Tamaulipas, Tehuacán, and Valley of

Oaxaca?''. Perhaps their initial intensification and subsequent rapid spread were strongly dependent on sustained human care (increased sedentism) and the availability of technology appropriate to their processing (ceramic cookery).

In recent years a body of data has accumulated regarding the cultivation and domestication of various root crops in the New World Neotropics (Dickau et al. 2007; Piperno and Pearsall 1998; Piperno et al. 2000; Piperno and Stothert 2003). Evidence for the use of such crops at Ocampo is limited, but Callen (1963:239) noted the remains of cassava (*Manihot dulcis* [J.F. Gmel.] Pax.) among Palmillas phase (1,900–1,100 B.P.) floor refuse in the caves, and that it was one of the dominant food plants during the succeeding San Lorenzo phase (1,100–500 B.P.). The Ocampo archaeological remains probably do not represent a domesticated plant such as *M. esculenta* Crantz, which likely originated in the Amazon basin (Olsen and Schaal 1999). However, it is possible that prehistoric groups could have actively manipulated the production and distribution of the wild plant, as tubers and other root crops are known to respond well to transplanting even with minimal tending (see Hildebrand 2003). Several species of wild cassava (e.g., *M. pringlei* S. Wats., *M. subspicata* Rogers & Appan) are present in the mountain forests of southern Tamaulipas where they are known for their edible roots (Hernández Sandoval et al. 1991). Piperno and Pearsall (1998:124) describe the domesticated form as ''very productive and undemanding;'' cassava is resilient under various moisture regimes, and many varieties have potent chemicals in the tubers that deter pests. Its undemanding nature as well as its nutritional value possibly influenced more intensive cassava use in the lowland Neotropics as human populations grew and land availability decreased (Piperno and Pearsall 1998:125). However, its hardy qualities would also render it amenable to less intense forms of manipulation and cultivation under different circumstances.

Conclusion

The modern behaviors observed at San Lorenzo las Bayas illuminate how some plants that were fully domesticated by the time they arrived in the Ocampo region could have been successfully incorporated into an otherwise hunter-gatherer lifestyle without major economic disruptions. If storage and the natural environment provided sufficient food resources throughout the year, complex strategies integrating logistical mobility, hunting and gathering, storage, and the casual use of domesticated plants could have supported small populations for an extended period without a necessary escalation in food production. I believe that these notions complement discoveries elsewhere in refining earlier authors' understanding of a ''complex mosaic of regional development'' in early Mesoamerican cultivation (Smith 1998:169).

The casual cultivation scenario outlined in this article compares favorably with some suggested for parts of the southwestern United States, another region characterized by ''primary crop acquisition,'' or the initial adoption of domesticated crops developed elsewhere into areas without pre-existing cultigens. Minnis (1992) argued that the historic Western Apache served as ideal analogs for late pre-ceramic populations in the desert borderlands of the Southwest. The Apache practiced a non-intensive form of cultivation that easily conformed to their mobile lifestyle; domesticates were left in their fields and only harvested after naturally available plant crops were exhausted. Hogan (1994) offered that in the San Juan Basin of northwestern New Mexico, planting domesticates in strategic locations minimized scheduling conflicts between cultivation and wild-resource foraging. These locations could be visited during periodic moves between winter and summer camps. Also, the adoption of domesticated plants may have served simply to enhance hunting and gathering efficiency and productivity by supporting extended searches and harvests, as has been suggested for the Mogollon highlands (Wills 1995). Of course, casual cultivation in the desert Southwest would have differed greatly from practices in the mountain forests of southern Tamaulipas. The desert environment, with its unique ecological conditions and suite of pests, would require different practical considerations and degrees of investment depending on the species in question.

It was suggested earlier in this article that the late intensification of bean use in Mexico may have been contingent upon the existence of ceramic pots to facilitate boiling. This brings up the important role of ingenuity and technology in the adoption of crops that require some degree of care during their life cycle. For instance, even relatively mobile groups can invest time and labor into facilities that protect cultivated plots in their absence, such as rudimentary fences. A few feathers tied to a long string deter rodents and other small pests; while flapping in the wind, the object fools pests into suspecting the presence of a bird of prey (Benjamin Bellorado, personal communication, 2008). Wind chimes also may startle would-be raiders. Domesticated dogs, present in the New World likely since the earliest human occupations, can be trained to remain at a location to guard crops. These examples illustrate that a wide range of creative tactics were available to mobile low-level food producers to circumvent species vulnerability and improve the chances of crop success.

The Ocampo region has experienced very little field research focusing on the EIA in recent decades. Open-air sites remain largely uninvestigated, and there are only three thoroughly excavated cave sites, each with evidence of mere snapshots of human occupation sometimes separated by several thousand years (Smith 1997a). While findings in these caves continue to enlighten us, the small number of excavated sites and the temporal gaps between their occupations underscore just how *little* we know. Building from this study we can evaluate alternative models of cultivation practices as we collect more archaeological and environmental data.

Final Thoughts

Upon being overwhelmed with questions about their common, present-day activities, my guides were at first confused at why an archaeologist would be so interested. Then one dark, cold night in November 2007, following dinner around a campfire in the mountains far from the *ejido*, we discussed the concepts of low-level food production, the EIA, and the likelihood that casual cultivation practices in the region today can shed light on subsistence economies of the distant past.

These revelations produced a noticeable burst of enthusiasm in the two men, as if they immediately perceived a stronger bond with their native soil and its past residents. While the contexts are obviously not identical, local indigenous peoples met the day-to-day food quest under natural environmental conditions comparable to those they themselves face today, and they may have dealt with such concerns in similarly creative ways. I was quite pleased, and not only about the profitable returns of our day's work. One of the most rewarding aspects of my field experience in Tamaulipas was fostering my friends' appreciation of, and sense of personal connection with, the rich past of their beautiful home.

Notes

[1] All dates in this article include the error range as presented by the original authors: Kaplan and Lynch (1999) present calibrated dates using a one-sigma error range; MacNeish (2001) uses an unspecified (but likely one-sigma) error range; and Smith (1997a) uses a two-sigma error range.

[2] Callen (1963) interpreted abnormally large foxtail millet (*Setaria* sp.) caryopses recovered from Ocampo paleofeces to reflect intentional selection and possibly domestication of this grass over time, and seemingly excessive abundance of the caryopses in the Tehuacán caves led Callen (1967:287) and Smith (1967:249) to speculate that it had been under cultivation there as well. However, there are alternative explanations for these phenomena and challenges to the status of foxtail millet as a domesticated plant in Mesoamerica (Austin 2006), so here I consider it to be a wild food resource.

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