

## PRIVATIZATION, SMALL-SEED INTENSIFICATION, AND THE ORIGINS OF POTTERY IN THE WESTERN GREAT BASIN

Jelmer W. Eerkens

---

*"Brownware" pottery technologies became widely used in the Great Basin around 600 years ago. A significant increase in the use of small seeds within the subsistence economy took place about the same time. I suggest that these two events are linked, that people consciously chose to focus on seeds because they could be privatized, that is, they could be individually owned and were not subject to unrestricted sharing. Pots were an integral component of this process because they could be individually made and owned and could be used within domiciles, placing food preparation and storage out of view from others in the community. Privatization of a staple food resource may have been a response to increased population size and, hence, the number of freeloaders, new village kinship organizations, and a desire to create surplus on the part of aggrandizers.*

*Hace aproximadamente 600 años la tecnología de cerámica "Brownware" llegó a ser ampliamente utilizada en la Gran Cuenca de los Estados Unidos, en la misma época tuvo lugar un aumento significativo en la utilización de semillas pequeñas en la economía de subsistencia. Se propone que estos dos eventos estuvieron relacionados, que la gente eligió conscientemente centrarse en la explotación de semillas porque era un recurso que podía privatizarse, esto es, ellos podían poseer éstas y no estar sujetos a las redes sociales de repartimiento general. Del mismo modo, la cerámica era un componente integral en este proceso porque era un recurso que podía ser elaborado y poseído por particulares, utilizado en las casas para la preparación y almacenamiento de alimentos, fuera de la vista de otras personas de la comunidad. La privatización de una fuente de alimento básico pudo haber sido la respuesta a un incremento de la población, correspondiente también a un aumento en el número de "gorriones", a nuevas formas de organización de parentesco en el pueblo, y al deseo de los "aggrandizers" de crear un excedente.*

---

The late prehistoric period, from 3,000 years ago until contact, was a time of rapid and momentous change in the Great Basin (Kelly 1997). There were dramatic reductions in residential mobility and major shifts in the subsistence economy, and several new technologies, such as the bow and arrow, pottery, and portable milling stones, became widely used. Though much is known about *what* happened, much less is known about *why* these changes took place. As Bettinger (1999b) has recently argued, many of our cherished explanatory models, including climatic change and population pressure, leave something to be desired. It is not that these models are wrong; it is just that they cannot account for everything that we see in the archaeological record. Moreover, they often dismiss internal or social factors as agents of culture change and fail to explain exactly how environmental shifts or population increases intersect with societal processes to bring about culture change.

Recently Hildebrandt and McGuire (2002) have suggested new directions for our understanding of the earlier part of this period, between approximately 3000 and 1000 B.P. Faunal assemblages dating to this period typically have high quantities of large mammals, whereas earlier and later assemblages contain more small mammals. They suggest that changes in the costs and benefits of prestige hunting by men account for this pattern, higher rates of prestige hunting contributing to the spike in large mammals between 3000 and 1000 B.P. Their innovative thinking on the matter shows how factors other than climate change and population pressure can lead to culture change and how these processes can manifest themselves in the archaeological record. Their analysis gives greater insight and understanding regarding prehistoric behavior in the Great Basin, in this case hunting, sharing, and the pursuit of prestige among men.

This article focuses on a slightly later time

---

Jelmer W. Eerkens ■ Department of Anthropology, University of California, Davis, California 95616

American Antiquity, 69(4), 2004, pp. 653–670  
Copyright© 2004 by the Society for American Archaeology

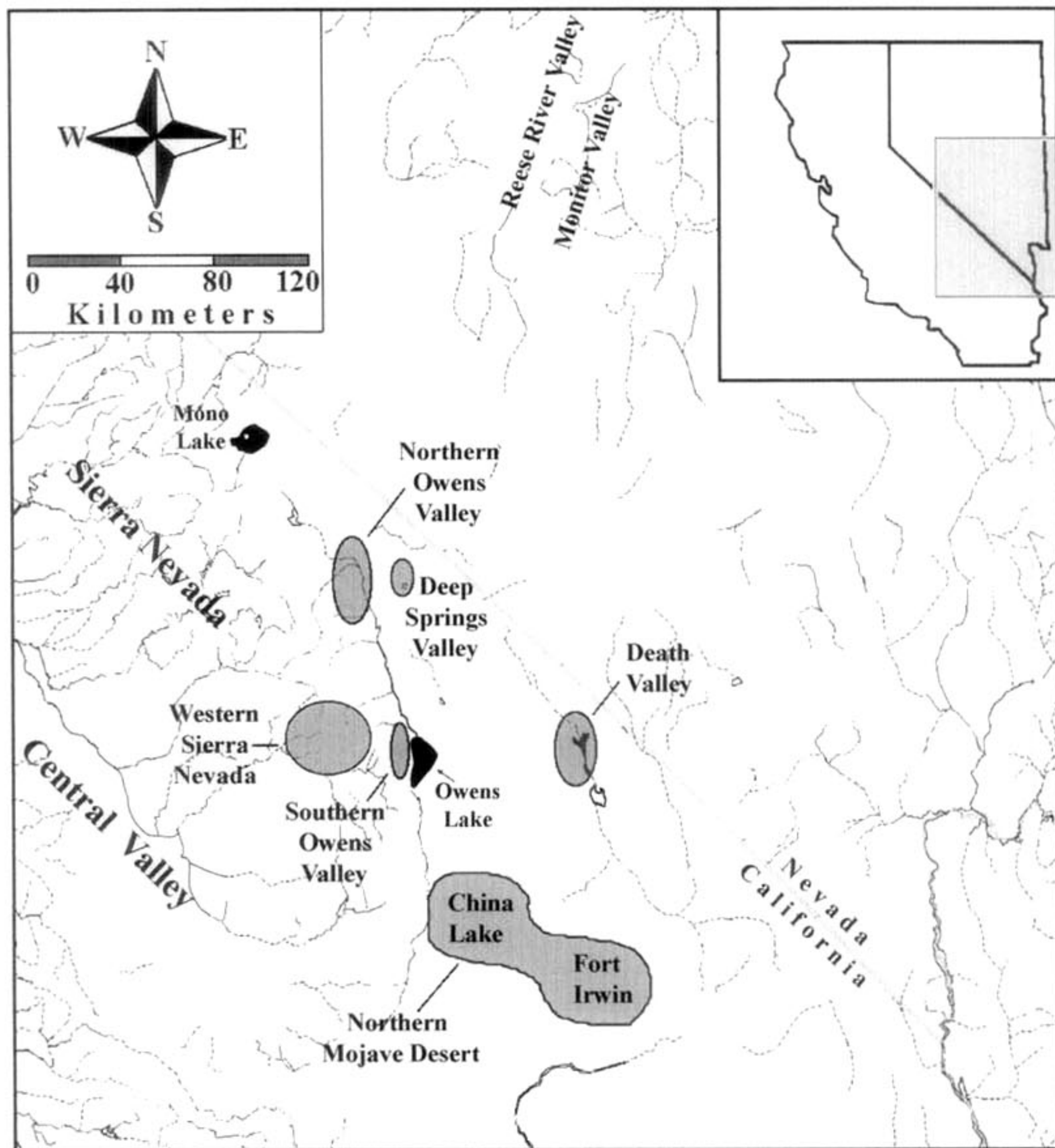


Figure 1. Map of study area and places mentioned in the text.

period and problem, the Marana period (ca. 600 B.P. to contact) and the introduction of fired clay technologies. It begins with a basic question regarding the origins of a new technology in the region and ends with an exploration of the social context of the craft and the factors that may have motivated people to adopt pottery. In particular, I focus on changes in the ownership of different food resources and how processing technologies and sharing strategies are related. Figure 1 shows the study area and regions discussed in the text.

### Seeds in the Western Great Basin

At the time of contact, the inhabitants of the western Great Basin were involved in a subsistence economy emphasizing gathering, particularly small seeds and piñon nuts. According to ethnographic accounts, the pursuit of these resources dictated much in the daily life of Paiute and Shoshone peoples, from settlement patterns, to material culture, to patterns in land ownership, to the timing of religious ceremonies (Fowler 1986; Kelly and Fowler



1986; Steward 1933, 1938; Stewart 1941, 1942). Indeed, Steward (1929, 1933; see also Lawton et al. 1976) suggested that the Owens Valley Paiute were involved in a proto-agricultural system. Seeds were sown across individually owned plots of land that were fed by a system of irrigation ditches. An elected man was honored with the position of "irrigator" and was in charge of overseeing water distribution through a system of small canals. Roots and seeds from these irrigated plots were harvested in the fall.

Despite apparent biases on the part of early ethnographers (Blackhawk 1997; Crum 1999; Thomas 1983; Walker 1999; Wobst 1978), archaeological evidence has generally supported ethnographic descriptions of native lifeways, especially in Owens Valley (Basgall and McGuire 1988; Bettinger 1975, 1977, 1989; Delacorte 1990, 1999; Delacorte et al. 1995). Although the irrigation ditches and plots in Owens Valley have not been the subject of much investigation, late prehistoric sites (post-1500 B.P. and particularly after 600 B.P.) contain impressive numbers of groundstone artifacts, widely assumed to have been used in seed processing. As well, flotation samples often contain large numbers of small seeds and piñon nutshells. Sites and assemblages dating prior to this period (i.e., pre-1500 B.P.) have much lower frequencies of groundstone and generally contain smaller numbers of charred seeds (Basgall and Giambastiani 1995; Basgall and McGuire 1988; Bettinger 1999a; Delacorte 1999; Delacorte et al. 1995).

Two independent analyses are offered as examples to demonstrate this change. First, flotation samples from radiocarbon-dated valley bottom house floor assemblages in southern Owens Valley demonstrate a shift to more intensive seed use around 600 B.P. Figure 2 plots the density of seeds per liter of sediment removed from house floors against uncalibrated radiocarbon dates. The marked increase in seed density in sites dating after 600 B.P. is clear from the graph. Although some houses dating after 600 B.P. have low densities of seeds, all those with greater than 25 seeds per liter are from after this date. A regression curve (solid) is plotted through the scatter of points to show this increase. Because this line suggests a gradual increase in the importance of seeds through time, a second "regression" line (dashed) is also offered showing what I

believe the shift really looked like, that is, a more abrupt increase in seed use around 600 B.P. Recent flotation analyses by Pierce (2002) and Reddy (2003), in central and extreme southern Owens Valley, respectively, support these conclusions. Both studies find significant increases in the representation of seeds, especially dryland species, in archaeological sites around 600 B.P. These results suggest that the shift to more intensive seed exploitation was a regional phenomenon in Owens Valley, not local to any one area.

The second analysis is again from flotation remains, this time from cooking features in the China Lake region in the northwest corner of the Mojave Desert (for greater discussion of the data set, see Eerkens and Rosenthal 2004). Features were classified as being associated with either seed or geophyte processing based on the types of paleobotanical remains recovered and the structure and layout of associated materials. Figure 3 plots radiocarbon dates (again uncalibrated) for these features and shows a marked shift around 300 B.P. from geophyte (i.e., roots, bulbs, and tubers) to seed processing. Features older than 300 B.P. contain few seeds and are primarily formal circular pit hearths with large numbers of fire-cracked rock, which Rosenthal and I interpret as heating stones. On the other hand, most features younger than 300 B.P. are ephemeral charcoal scatters with high densities of charred seeds that often contain burned small-mammal bones (especially lagomorphs) and more rarely contain fire-cracked rock. These findings have been interpreted as representing a fundamental shift in subsistence activities from geophyte processing to seed harvesting around 300 B.P. Why the transition to intensive seed use in the China Lake region seems to have taken place some 250 radiocarbon years later than it did in southern Owens Valley is beyond the scope of this article. However, what is clear from the two analyses is that a shift to intensive seed use took place quite late in prehistory, sometime after 600 B.P.

### **The Relationship between Pots and Seeds**

This section attempts to link the introduction of pottery technologies in the Great Basin to the increased use of seed resources discussed above. This is done through several means. Before reviewing the evidence, it is important to show at the outset that

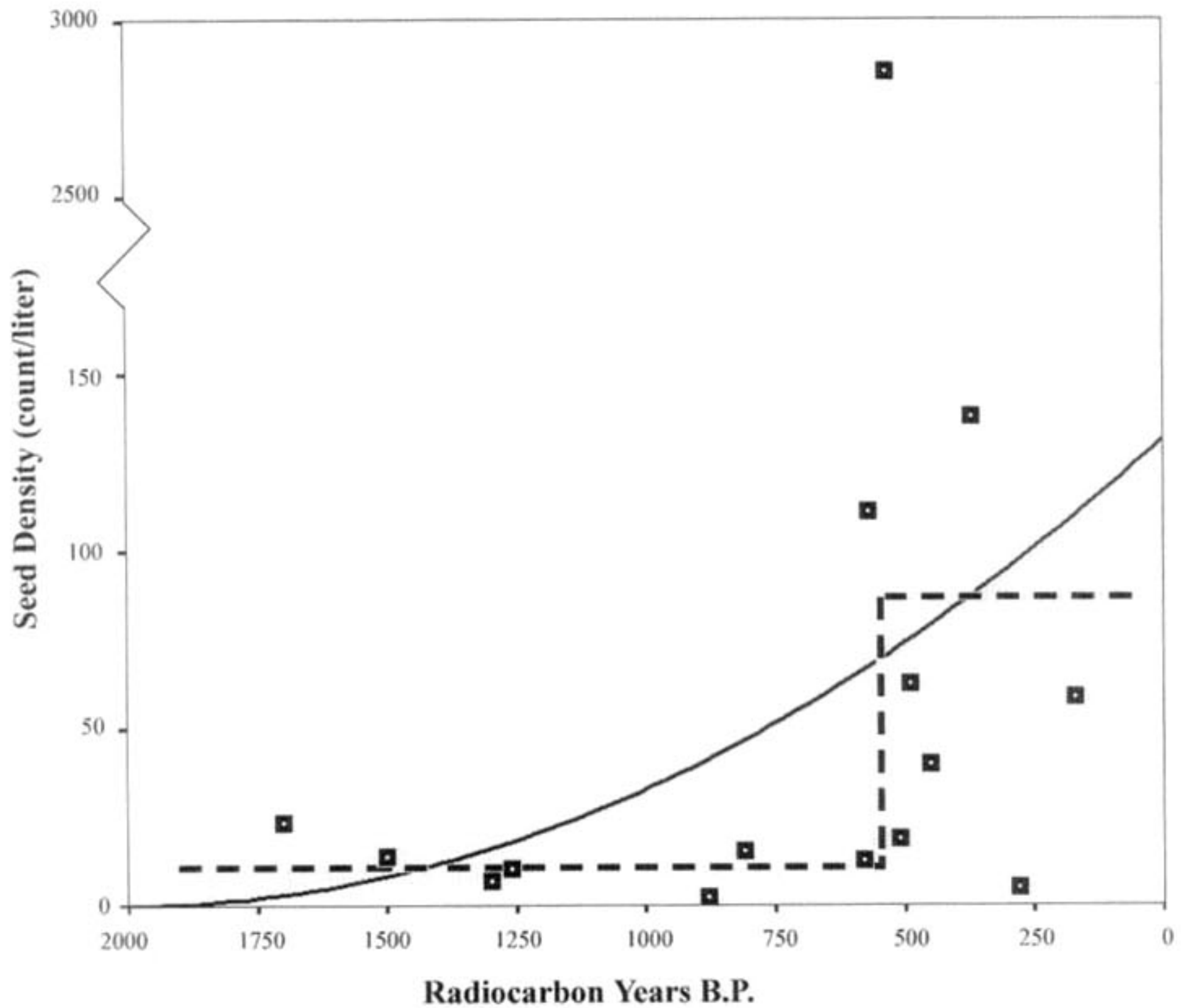


Figure 2. Flotation samples from southern Owens Valley house floors through time. Source: Data from Basgall and McGuire 1988; Delacorte 1999; Delacorte and McGuire 1993; Delacorte et al. 1995; Eerkens 1997; Gilreath 1995.

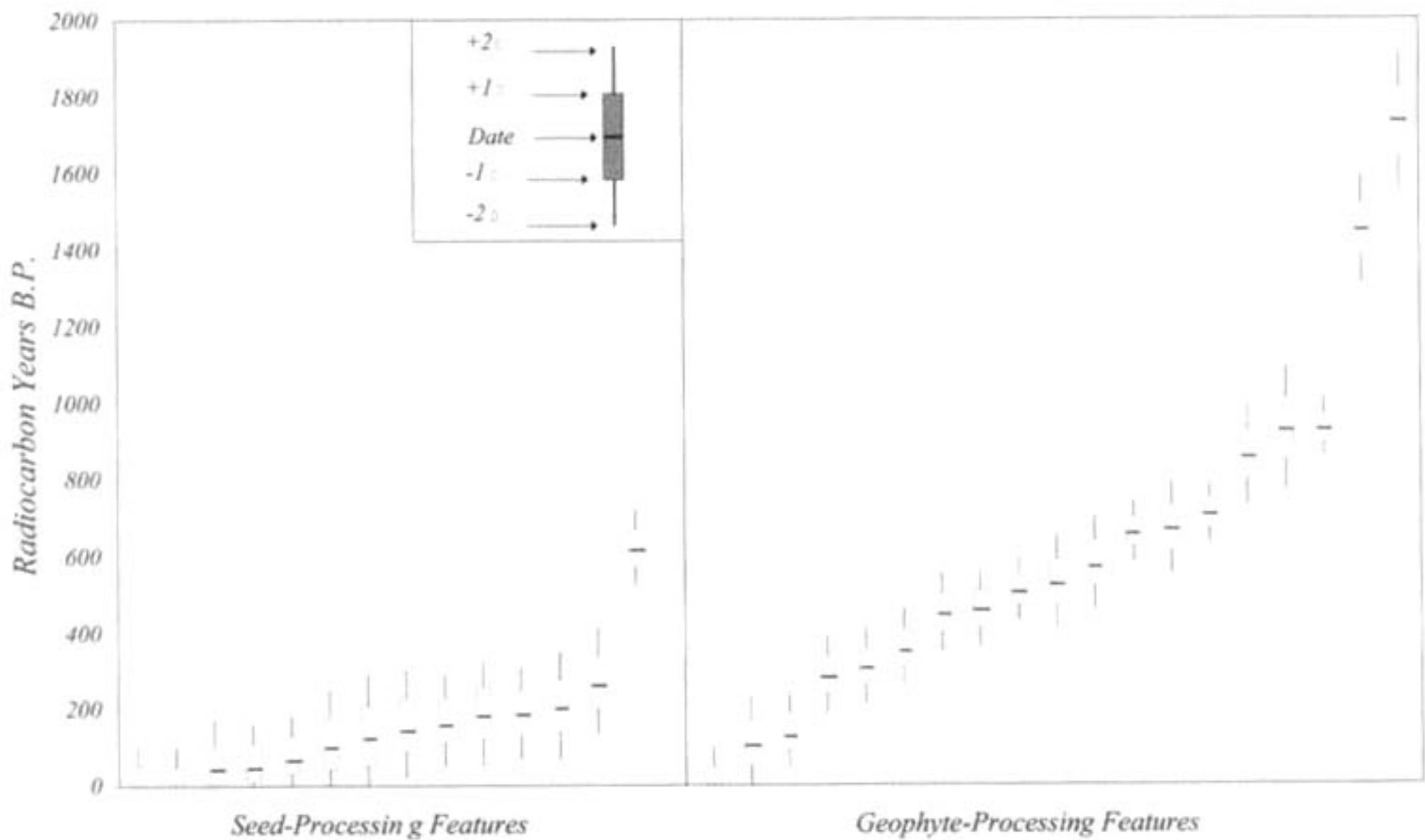


Figure 3. Radiocarbon dates (uncalibrated) from China Lake thermal features showing one- and two-sigma confidence intervals.



there is a correlation in the timing of the introduction of pottery and seed intensification. Although dating ceramics has not been a focus of much archaeological research in the Great Basin, a few studies have broached this topic. Rhode's (1994) thermoluminescence study of brownware pottery across the entire Great Basin suggests a late date for the inception of pottery. The majority of his brownware samples date after 500 B.P. (11 of 13), and all postdate 1130 B.P. Similarly, Pippin (1986) reviews radiocarbon data from the central Great Basin and, after discounting a number of tenuous older dates, finds that the only securely dated contexts with pottery postdate 500 B.P. The earliest of these accepted dates occurs at Hogup Cave at  $480 \pm 80$  B.P. Delacorte (1999) reaches a similar conclusion in Owens Valley, where brownware pottery is not associated with any feature dating earlier than 780 radiocarbon years before the present, and all except one postdate 500 B.P. Farther afield, Wright (1978) comes to a similar conclusion in Wyoming, where the oldest secure pottery-bearing contexts are dated to  $450 \pm 80$  B.P., and many assemblages postdate this figure. Although there is a handful of sherds from earlier contexts (e.g., Eerkens et al. 1999) indicating some experimentation with the craft from 1400 B.P. onward, these results demonstrate that the lion's share of pottery in the Great Basin postdates 600 B.P. In a temporal sense, then, pottery production and an increase in seed use are coeval.

Several lines of evidence, however, suggest a more direct association between pottery and seeds. First, an analysis of the technological attributes of both whole vessels and rim sherds suggests that the majority of pots in the western Great Basin were not built for storage or to transport goods (Eerkens 2001, 2003). Thin walls, mineral temper, minimal organic temper, and roughened exteriors are all design features that facilitate the efficient and even transfer of heat from an external source to the vessel contents and allow pots to withstand repeated episodes of heating and cooling (Braun 1983; Juhl 1995; Pierce 1999:129–137; Schiffer 1990; Schiffer et al. 1994; Skibo et al. 1989). Attributes for western Great Basin sherds, shown in Table 1, are in line with these expectations and support the notion that cooking was one of the primary functions of pots in this area. Supporting evidence comes from the frequent presence of sooting or blackening on the

Table 1. Technological Data Supporting the Use of Pots as Cooking Vessels: Average and Modal Attributes of Great Basin Rim Sherds by Region.

Region	Number of Rim Sherds Measured	Thickness			Diameter			Rim Shape		
		Average (mm)	Coefficient of Variation (%)	Average (mm)	Coefficient of Variation (%)	Average (mm)	% Decorated	% Incurred	% Direct	% Recurved
Western Sierra	34	5.15	23	237	36	39	3	9	91	0
Fort Irwin	7	5.45	20	214	15	0	14	0	86	14
China Lake	14	6.03	18	218	28	14	7	21	71	7
Death Valley	73	5.57	18	251	25	10	20	3	79	18
Southern Owens	117	5.97	22	248	31	19	10	8	90	2
Deep Springs	15	5.55	11	237	28	22	22	27	53	20
Northern Owens	30	6.64	17	274	35	7	6	4	86	10
Nevada Test Site	19	5.42	11	332	31	18	5	29	59	12

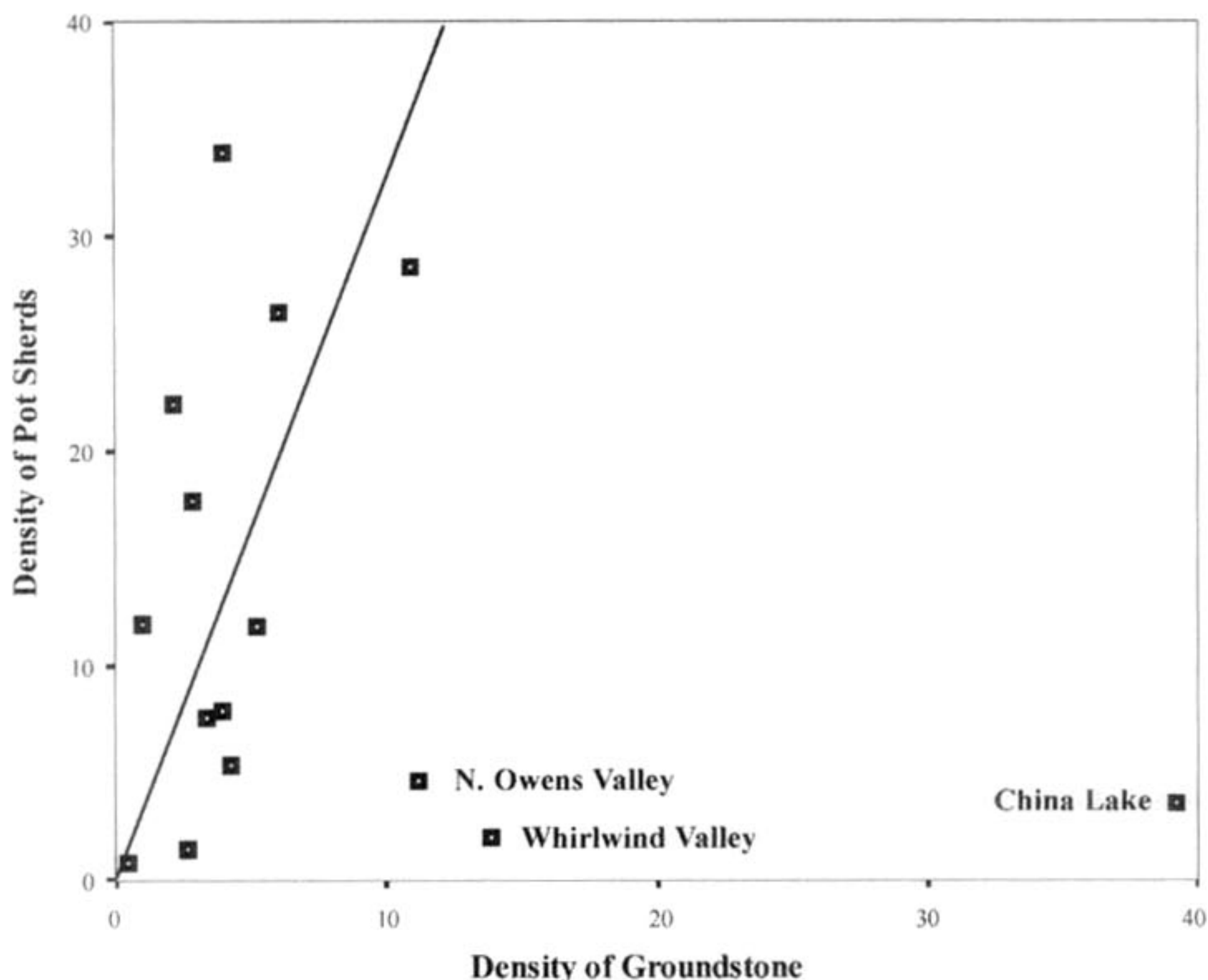


Figure 4. Groundstone and pot sherd densities by region.

exterior of pots and the occasional presence of carbonized materials on the inside of pots near the rim. As discussed by Henrickson and McDonald (1983), pots designed for storage are typically larger and thicker and display more constricted mouth openings than the values in Table 1. As well, serving pots are typically smaller and thinner and are usually decorated. More specifically, the open and nonconstricting mouths of western Great Basin pots suggest use in boiling and simmering activities. Such cooking is particularly conducive to the preparation of gruels of oily and carbohydrate-rich foods, such as ground seeds (e.g., Braun 1980, 1983; Crown and Wills 1995b; Juhl 1995; Linton 1944; Skibo 1992; Smith 1985; Wandsnider 1997). Thus, the way in which these pots were constructed is consistent with high-temperature boiling activities, the optimal method for preparing seeds.

Second, there is a strong association on a regional scale between the density of pot sherds and the density of groundstone (Eerkens 2001).

Figure 4 plots the density of pot sherds and groundstone in several large Great Basin surveys. Pot sherd and groundstone densities have been standardized to the density of a third, independent artifact category, late period projectile points, specifically Desert Side-Notched and Cottonwood Triangular points (for a discussion of the temporal placement of these points in the Great Basin, see Bettinger and Taylor 1974; Thomas 1981). With the exception of three notable outliers that are not included in the calculation of the regression line, the number of sherds increases linearly with the number of groundstone artifacts. As previously mentioned, groundstone is usually associated with the processing (i.e., grinding) of plant resources, especially hard seeds and nuts. The correlation between groundstone and pot sherds suggests that as more seeds were ground, more sherds were deposited, implying a link between pottery making and seed processing. The three outliers contain more groundstone than expected given the



Table 2. Ethnographic Accounts of Food Preparation and the Use of Pottery.

Group	Region	Foods Cooked in Pots	Foods Not Cooked in Pots	Reference
Western Mono	Western Sierra Nevada	greens, deer meat, acorn mush (rarely)	small rodents, fish, manzanita, grasshopper	Gayton 1948
Owens Valley Paiute	Owens Valley	seeds, piñon, berries, acorn, rabbit, water fowl, sheep, Pandora moth, brine fly	fish, deer, rodents	Steward 1933
Western Shoshoni	Western Nevada	seeds, roots, animal internal organs	meat flesh, piñon, acorn	Steward 1941
Tubatulabal	Southern Sierra Nevada	seeds, piñon, elderberry, yucca, buckeye, acorn, meat flesh	small game, fish, freshwater mussel, roots	Voegelin 1938
Western Shoshoni	Inyo County	seeds, rabbit	piñon, blue dick, Joshua tree seeds	Irwin 1980

density of pottery. Three explanations come to mind to account for these anomalies: groundstone could have been used to process other resources in these areas, seeds could have been prepared in nonceramic cooking containers, or the manner in which “groundstone” was defined by the archaeologists is inconsistent among the different areas. This issue is revisited below.

Third, gas chromatography–mass spectrometry (GC-MS) analysis of organic residues preserved within the walls (i.e., not on the surface) of western Great Basin pot sherds is consistent with the conclusion that the majority were used to boil seeds (Eerkens 2001, 2004). Although the identification of specific species or genera is not possible using GC-MS, this technique can be used to identify general food classes represented in the residues of pots, such as meats, fish, roots, greens, berries, and nuts and seeds (Evershed et al. 1997; Malainey et al. 1999a, 1999b; Mottram et al. 1999; Patrick et al. 1985). Seventy-five pot sherds from the western Great Basin were analyzed for fatty acids using GC-MS. Based on the ratios of various fatty acids, over half the sherds appear to have been used to cook seeds: 27 percent for seeds alone and 27 percent for seeds mixed with other plants or meat. An additional 13 percent of the sherds could only be assigned to a generic “plant” category and may also represent seed processing. The remaining 32 percent seem to have been used primarily to process roots, greens, and berries. Thus, although pots were used to process a variety of foods, seeds seem to have been the primary component.

Finally, ethnographic data suggest that boiling seeds was one of the main uses of earthenware pots. Table 2 summarizes data on food preparation techniques and pottery use for several western Great Basin groups. Although we should be skeptical of ethnographic data about pottery because production had ceased some 50 years before ethnographic fieldwork commenced, ethnographers did try to reconstruct prehistoric lifeways as best as they could. As shown in the table, ethnographic data often support an association between pots and seeds. Seeds are nearly ubiquitously mentioned as having been boiled in clay pots.

These results are in line with other studies in the eastern part of the Great Basin. For example, in the Little Boulder Basin of north-central Nevada, Bright, Ugan, and Hunsaker (2002) found that late prehistoric (i.e., post-600 B.P.) brownware sherds are rare in the sediments surrounding hearths containing high counts of mammal bone. Instead, over 90 percent of brownware pottery is associated with smaller hearths containing large numbers of charred seeds. Presumably these hearths were used to boil seeds cooked within these pots, suggesting a link between the two.

In sum, evidence from several independent lines is consistent in linking pottery with seed processing and consumption. This is not to say that Paiute and Shoshone people did not use pots for other purposes. Like most technologies and artifact classes, pots were probably used for a variety of purposes. When the need for a temporary storage or transport container arose, pots were surely put



Table 3. Distribution of Pot Sherds and Groundstone by Environmental Zone (Adjusted by Area Surveyed).

Region	Pot Sherds			Groundstone			Reference(s)
	% on Valley Bottom	% in Piñon/Juniper	% above Piñon Zone	% on Valley Bottom	% in Piñon/Juniper	% above Piñon Zone	
Owens Valley	86	12	4	48	52	0	Bettinger 1975
Deep Springs	64	36	0	62	31	7	Delacorte 1990
Monitor Valley	76	15	9	51	28	21	Thomas 1988
Reese River	100	0	0	57	38	4	Thomas 1971
China Lake	63	37	0	48	52	0	Gilreath and Hildebrandt 1997; Hildebrandt and Ruby 2004

to use. However, given the substantial supporting evidence presented above, I submit that the origins of pottery production and intensive seed harvesting were intricately linked in the western Great Basin, that is, one was not possible without the other.

### The Origins of Pottery in the Western Great Basin

Why did western Great Basin groups begin making and using pots? As discussed above, it clearly has something to do with the processing of seeds. But it is not simply the consumption of some seed resources that brought about this new technology. Small numbers of seeds were being eaten long before pots were adopted. Instead, it is the significant increase of seed processing with which the origins of pottery is associated. What is it about seed intensification that encouraged the production of pots (or perhaps vice versa)?

A number of studies in other parts of the world have focused on the origins of pottery (e.g., Barnett and Hoopes 1995; Rice 1999). These studies have produced a range of models to explain the origins of pottery, whether by innovation or by diffusion from another area. For example, some suggest that pots provided access to a wider range of foods by facilitating detoxification and increasing palatability (Arnold 1985; Braun 1983; Ikawa-Smith 1976). Others emphasize the value of a mobile system of storage (e.g., Damp and Vargas 1995; Matson 1972; Moore 1995), the conservation of fuel/firewood when cooking with pots (e.g., Bettinger 1999b; Bettinger et al. 1994), the economy of scale afforded by pottery production (e.g., Brown 1989), the ease with which pots can be decorated to express ethnic or individual identity (Armit and Finlayson 1995),

or the ability of pots to render oils and ferment beverages for use in competitive feasts (e.g., Hayden 1990, 1995; Hoopes 1995). Although some of these factors may have played a role in the Great Basin, none explains the process with great satisfaction (Eerkens 2001; Eerkens et al. 2002). In short, there is no evidence for new foods being incorporated into the diet at this time, pots do not seem to have been designed for storage, pots are not more plentiful in areas where firewood is scarce, pots seem to have been produced on a local scale in small numbers, most pots (ca. 80–90 percent) are undecorated (and only minimally in a standardized fashion when they are), and pots were not used in a manner consistent with competitive feasting.

Instead, following the work of Crown and Wills (1995b) and Sassaman (1993), I have argued that pots in the Great Basin served to minimize time and labor demands on women (Eerkens 2001). In terms of nutrition, seeds are optimally processed by grinding to increase surface area and the amount of food that can be absorbed by the human digestive tract. Grinding is followed by extended boiling to help break down complex organic compounds that are otherwise difficult to digest in the gut (Crown and Wills 1995a; Wandsnider 1997). Seeds can certainly be processed in this manner without the use of earthenware pots. This is typically accomplished by “stone-boiling” in baskets. However, stone-boiling is a labor-intensive activity, requiring constant stirring of stones to avoid burning the basket and frequent replacement of cooled rocks with hot ones. As many have pointed out (e.g., Arnold 1985:128; Crown and Wills 1995b; Ikawa-Smith 1976:514; Van Kamp 1979:74), one of the advantages of pots is that they can sit over an open fire or heated coals with minimal attention, allowing foods to simmer.

Prior to 600 B.P., small-seed processing was not



a major activity in the western Great Basin, and women likely had the time to occasionally stone-boil seed resources in baskets. Although they knew about pots from intermittent trade with pottery-using populations in the Southwest and rarely even made their own pots (Eerkens et al. 1999), the limited importance of seeds did not outweigh the costs (time, labor, and fuel to fire) associated with large-scale pottery production. However, with the shift to more intensive seed use around 600 B.P., the situation changed. Seed-processing tasks likely became too time consuming to continue using baskets and stone-boiling, and the production of earthenware pots was added to the range of chores required of women. Ethnographic data are consistent in mentioning women as the producers of pots (e.g., Driver 1937:80; Gayton 1929; Steward 1933:266; Voegelin 1938:35). In this respect, the use of pots facilitated the intensive extraction and processing of seed resources (e.g., Oyuela-Caycedo 1995).

As found by Bettinger (1975), Delacorte (1990), and Thomas (1971, 1988), the distribution of pot sherds across the landscape is skewed toward valley bottom and lowland locations, especially near riverine and lacustrine settings (Table 3; for greater discussion, see Eerkens 2003). That is, although sites and artifacts are found across the landscape, pot sherds are found predominantly in lowlands. In accordance with the arguments made above, these environments are known for their seed productivity, especially compared with upland locations that are known more for their piñon nut and geophyte resources. Not surprisingly, Table 3 shows that groundstone is frequently found at higher densities on the lowlands of the landscape as well. Interestingly, two instances where groundstone is actually more common in the piñon zone occur in northern Owens Valley and China Lake. As discussed earlier, these regions were found to be anomalous in that they contained far more groundstone relative to pottery (Figure 4). This suggests that a significant fraction of the groundstone in these areas was used for processing nonseed resources in the piñon zone that did not require the use of pots, such as geophytes and piñon nuts.

That pots are primarily undecorated (see Table 1) supports the notion that they were not used to express identity or group affiliation. In fact, they were not even made in a consistent and symmetric

manner, often displaying variable wall thickness and undulating rims. Such traits are seldom associated with a status or identity-expressing artifact class. In short, pots were functional objects used to meet a certain end, namely, cooking seed resources.

### Seed Use, Sharing, and Privatization

Although the cost-benefit explanation of pottery as a time- and labor-saving technology for women is more satisfying than other models for the adoption of pottery and fits well with existing data from the region, I think that this is only part of the story. There are several other characteristics of seeds and pots that bind them together, particularly when examined from the viewpoint of resource ownership strategies and artifact production and use.

In many hunting and gathering societies subsistence resources are often shared. However, as Waguespack (2003) has recently discussed, sharing is context dependent and varies based on factors such as kinship distance, social obligations, and whether the resource is acquired through individual or communal efforts. Ethnographically, meat is among the most widely shared products in such societies. Plant foods, on the other hand, are often regarded as private properties, especially those that are gathered and cooked individually. The reasons for this seem to stem, in part, from the spatial and temporal predictability of plants relative to animals. Because hunting is typically less predictable on a day-to-day basis, sharing is an effective strategy to even out variability and ensure a more constant and steady supply of meat (Gould 1982; Gurven et al. 2000; Kaplan and Hill 1985; O'Shea 1981; Winterhalder 1986, 1996). Seeds are much more predictable spatially, and sharing would do little to ensure a more reliable supply. As well, the hunting of some game, particularly herding animals that can be driven toward an ambush or cliff, often involves the cooperation of large numbers of individuals where the end product is shared. Seeds typically do not require such cooperation during harvest and preparation. Were seeds regarded as private resources in the Great Basin? If so, is it possible that they were targeted as a staple after 600 B.P. because they could be owned and stored and did not have to be shared? Several lines of evidence suggest that this might be the case.



First, unlike the technologies used to harvest other resources, the items needed to harvest and process seeds can be individually made and used. This is true of seed beaters, burden baskets, grinding stones, winnowing trays, and the cooking utensil, whether a basket or pot. On the other hand, the tools used to harvest many other resources do not exhibit this property. For example, though a rabbit net can be made individually, it requires large numbers of people to drive rabbits into the net. As a consequence, returns of the hunt are typically shared by all involved, though the owner of the net may take a bigger share. Similarly, roots and tubers, which are optimally prepared by steaming (Wandsnider 1997), are usually cooked in pit hearths. Although a small pit hearth could be excavated and used by an individual, in fuel-scarce areas large pits will be preferred in order to conserve firewood, favoring communal construction and cooking. Moreover, the large size of such pits will support construction in the open where everyone in the community can see them. Both of these factors make hoarding foods cooked in pit hearths difficult. Indeed, as discussed by Wandsnider (1997), pit hearth roasting in North America was typically a communal affair where the results were shared by all, and the use of communal pit hearths is known from ethnographic work in many Great Basin cases (e.g., Drucker 1937:10; Kelly 1932; Lowie 1909, 1939; Steward 1941:333). Thus, the harvesting and processing technologies used to process roots and tubers subject these resources to sharing. As discussed earlier, there is evidence in the China Lake region for a shift from the use of pit hearths used for roasting roots and tubers to the use of more ephemeral cooking features associated with seeds. This shift may have been a conscious effort on the part of families to target resources that were more amenable to individual harvesting and processing and did not have to be shared.

Not only *can* seed-processing tools be made and used individually, but there is chemical evidence that western Great Basin pots *were* (Eerkens et al. 2002). Of 380 unique sherds sourced by Instrumental Neutron Activation Analysis, few seem to have been traded or moved, even over relatively short distances of 30–40 km. Overall, the organization of pot production seems to have been on a small scale. There was no attempt to economize the production of pots by having a few specialists make

pots for everyone. Moreover, the size of most pots, typically between 20 and 40 cm in height and width (Eerkens 2001:56, 63; Lockett and Pippin 1990), suggests that they could easily have been used by a single person to prepare a modest-sized meal to feed a small group of people (i.e., a family). In this respect, the technology used to process seeds (i.e., pots) seems to have been an individual endeavor for family-level use.

A second line of evidence linking pots and privatization comes from the spatial distribution of sherds within archaeological sites. Unlike pit hearth roasting and certain other cooking technologies, pots can be operated entirely within a house. The significance here is that such use potentially puts food preparation outside of the view of other people in the community. I say *potentially* because in order for this to be true we must assume that the interior of a house represents family-level and “private” space and was demarcated from community-level and “public” space across the rest of the site (see Sørensen 2000:156–165). As discussed by Dowling (1968:503), there is ethnographic evidence among hunter-gatherers that individuals consciously exploit indoor cooking to avoid sharing with other members of the group. That is, if others cannot see what is being prepared and stored, it is harder for them to demand a share.

Data presented in Table 4 suggest that western Great Basin pots were used primarily inside houses. The density of pot sherds on, to 20 cm above, the floors of ten excavated houses in southern Owens Valley is much higher than that just outside these houses or in general midden contexts. As it is unlikely that broken sherds were carried from outside houses and placed within them before abandonment, this distribution implies that pots were used and deposited primarily within houses. Though it is difficult to establish contemporaneity between house floors and general midden contexts, such a distribution is less pronounced for other artifact categories, such as debitage, where interior and exterior densities are more equal. This suggests that whereas some activities, such as pot use, took place within the house, others, such as flint knapping, took place in public out in the open. Because pots could just as easily have been used outside the house, a concerted effort to restrict the space where seeds were boiled and stored is implied. A desire to keep seed mush out of view and limit the access



Table 4. Density of Pot Sherds within Houses, Exterior to Houses, and in General Midden Contexts in Southern Owens Valley.

Site	Context	<sup>14</sup> C Date B.P.	Sherds			Debitage		
			Floor	Exterior	Midden	Floor	Exterior	Midden
Iny-30	Structure 9	180	21.4	6.1	0.1	79	17	227
Iny-5207	Structure 1	205	18.0	—	1.0	891	—	1688
Iny-3769	Structure 1	293	4.0*	0.6	1.1	16.5*	13	20
Iny-30	Structure 10	360	16.0	0	1.4	389	820	330
Iny-30	Structure 1	390	23.1	0	0.1	223	40	262
Iny-30	Structure 5	410	16.6	0	0.1	139	16	262
Iny-30	Structure 8	470	148.0	0	0.1	93	75	257
Iny-30	Structure 7	480	0.0	2.7	0.1	186	158	257
Iny-30	Structure 13	710	6.5	—	1.3	577	—	1775
Iny-30	Structure 6		3.8*	0	0.1	471*	16	262

\* Data from house fill substituted because of lack of data from floor.

Note: Density given in counts per cubic meter; <sup>14</sup>C date reflects weighted average of several dates if more than one exists.

Source: Data from Basgall and McGuire 1988; Delacorte 1999; Delacorte et al. 1995; Eerkens 1997; and original museum catalogs of those studies.

of nonfamily members is consistent with a determined effort to privatize these resources.

Finally, there is support for seeds being privately owned from the ethnographic record itself. As discussed by Steward (1933, 1938:74, 119), many plant foods, especially seeds, were regarded as private goods once they had been collected, that is, once work or energy had been invested. This notion does not unilaterally extend to all resources, however. Hunters were obligated to freely and publicly distribute game such as deer, antelope, and mountain sheep (e.g., Steward 1938:115, 120, 184, 253). Intermediate to these extremes, caches of piñon nuts were owned by families, but permission to open them was sometimes extended to other relatives. Theft often resulted in fights (i.e., was not tolerated), but no killing was reported (Steward 1938:73).

Because pots can be individually made and can be used inside houses, they are well suited to privatization. Indeed, everything about pots in the western Great Basin suggests small-time production and privatized use. Though other artifacts, including shell beads and obsidian, were widely exchanged, pots were made and used locally. As well, pots were differentially used within domiciles, out of view from the rest of the community. This probably also explains why pots were largely undecorated (only ca. 10 percent), that is, because they were not on display. Finally, the ethnographic record demonstrates that seeds, which were prepared in pots, were largely considered private goods. Whether pots were instrumental in the pri-

vatization of seeds or were adopted to process an already privatized resource is unclear. However, all these findings are highly consistent with what we would expect of a private technology used to process privatized goods.

### Why Privatize?

What factors could have promoted a shift to the use of tools that could be operated by individuals (i.e., pots) and resources that could be owned by individuals or families (i.e., seeds)? Answering questions addressing the motivations of individuals in the past is always harder than identifying what they did and how they did it. Admittedly, answers often form only speculative hypotheses. However, I would like to briefly consider this question and offer some potential explanations that, I hope, can be tested in future research.

When considering this question, several possibilities come to mind. First, as Bettinger (1999b) has recently argued, a focus on privately owned resources solves the "freeloader problem." Freeloading occurs when certain individuals reap the benefits of additional work by others without investing any labor themselves. When resources are held as common pool or public goods, there is little incentive to invest additional time and energy in gathering them because they are easily lost to others in the sharing process (Hawkes 1992, 1993; Kohler 2004; Smith 1988; Winterhalder 1986). Such public access systems strongly discourage storage, even when storage would be advantageous



in the face of seasonal fluctuations in the availability of foods (Bettinger 1999b:71). Weissner (1982) has previously proposed a division of hunter-gatherer societies into two types, those that pool risk at the group level and those that pool risk at the family level. The shift from a public goods system to a privatized one would correlate well with such a division.

If the population in the Great Basin was increasing and overtaxing local food resources, freeloading may have been favored as a way to make up resource shortfall or simply to work less. As the number of these freeloaders increased and traditional social leveling mechanisms failed, the burden may have been too great on other community members, and they may have turned to privatization as a strategy to keep food within the family. Storage of privately owned seeds may also have been a strategy to bank food resources for possible future subsistence (Bettinger and King 1971; Delacorte 1999:389). A shift to the use of pots and small seeds in the Great Basin, then, may reflect the conscious actions of individuals to move away from harvesting and cooking technologies that required cooperative behavior (to either make or use) or had to be used out in the open, such as communal hunting and pit hearth roasting. In other words, once the loss of energetic returns related to freeloading was factored in, the return rates on seeds, including harvesting and production of all associated artifacts, may have been higher than those for other foods. In addition, seeds could have been stored, solving potential seasonal resource shortfall problems (Delacorte 1999). Pots are convenient storage containers and could have doubled in this capacity.

The positive correlation between pot use and the production of easily digestible gruels that can substitute for mother's milk is also worth mentioning. In the Southwest, the production of such gruels has been argued to facilitate earlier weaning of children and to increase infant survivability, both of which act to increase population levels (Crown and Wills 1995a, 1995b). Such a positive feedback cycle may have heightened the need to privatize resources.

Second, the shift to privately owned resources may have been an outgrowth of the desires of certain individuals to increase production of foods to create surplus (Bettinger 1978; Bettinger and King 1971; Delacorte 1999). Within most egalitarian societies surplus would normally be shared; how-

ever, privatization would allow ownership and hoarding of surplus, which could have been used toward a number of ends, principally the acquisition of social status (Arnold et al. 1997; Bender 1985; Earle 1991; Saitta and Keene 1990). For example, surplus foods could be used to maintain and expand long-distance exchange networks to acquire exotic items to mark one's higher status. As well, surplus could be redistributed locally to create debt, which can later be recalled to mobilize the labor of others. Thus, spending time and labor on processing foods that were not subject to sharing may have been in the interest of prestige-seeking individuals. Seeds may have been one such option in the western Great Basin.

Third, it is possible that privatization of seed resources was a reaction to the privatization of hunted foods. Bettinger (1999b) has argued that use of the bow and arrow, which became widespread around 1500 B.P., encouraged individual hunting of smaller game, such as rabbits. Because they were individually tracked and shot, animals of this sort may not have been subject to sharing. Once established, the notion of privatized foods may have spread to other resources such as seeds. Extending myself even further, it is possible that certain segments of the community, especially unmarried or widowed women who no longer had access to publicly shared meat resources (assuming men were doing the hunting), may have sought to intensify other oil-rich foods (i.e., seeds) that did not have to be shared. This reasoning might also explain why an increase in seed use followed the introduction of bow and arrow technology.

Finally, changes in the social structure (i.e., kinship) of Great Basin communities may have fostered seed intensification and pottery use. Ethnographic data indicate that individuals are more likely to share with kin and people they have shared with in the past than with genetically unrelated individuals (Gould 1980; Gurven et al. 2000; Yellen 1977). If so, changes in postmarital residence patterns and rates of endogamous marriages may have resulted in the formation of communities where most individuals were unrelated to the majority of other members. Such a change could have prompted intensification of foods that did not have to be shared, such as seeds.

Unfortunately, it is not possible to evaluate which of these hypotheses (or some other hypoth-



esis) best explains the transition to privatization or if they all play a role. Additional archaeological data will need to be collected from the region. In particular, we will need to gather information on community structure just before and after 600 B.P., including population size, genetic relatedness of different households, the establishment of long-distance exchange networks, and other data on sharing (i.e., following the model set forth in Waguespack 2003). I hope that this research will help spark an interest in the topic and prompt the collection of this information.

### Summary and Conclusions

A shift to the use of pots and the intensification of small seeds are clearly evident in the archaeological record of the western Great Basin. Flotation studies and radiocarbon and thermoluminescence dates from Owens Valley indicate that these changes took place in concert around 600 B.P. A comparison of radiocarbon-dated thermal features from China Lake (see Figure 3) suggests that this shift took place some 300 years later in that area. Thus, climate change, at least in isolation, is not accountable for these broad patterns, for climate is assumed to have been similar in these two nearby regions. Instead, I argue that other factors, including population pressure, an increase in the number of freeloaders, changes in community kinship structure, and possibly social striving, were responsible. Although the reasons for these changes were probably complex, one outcome of this process was the privatization of a staple food resource, namely, seeds.

Two factors imply that privatization was an intentional outcome and not simply a by-product of the process of intensification. First, people could just as easily have cooked and stored seeds in pots outside their homes where they would have been available for sharing to all in the community. Instead they chose to process and store seeds within their domiciles where they were out of view. Second, Owens Valley inhabitants could have chosen to intensify the extraction of other food resources, such as roots and tubers, large game, or perhaps even grasshoppers, brine fly, or other insects. They could have moved their residential bases to other parts of the landscape to better and more intensively exploit such resources. Instead, sometime between

1500 and 600 B.P., they chose to locate their villages and activities in areas that were highly productive in their output of seed resources (Basgall and Giambastiani 1995; Basgall and McGuire 1988; Bettinger 1975, 1978; Delacorte 1990, 1997, 1999). I believe that these decisions were a response to, in part, the technologies available for processing these different resources. Everything about seeds, from the way they are harvested and processed (individually), to how the tools used in these activities are manufactured (individually), to where they are cooked (inside houses), suits them to small-scale and family-level ownership. As I have argued, this is not the case with the technologies needed to harvest other resources, such as pit hearths and game drives. It is for these reasons that I propose seeds were specifically targeted in the western Great Basin. In short, intensified harvesting of small seeds seems to have been a by-product of the desire to privatize the subsistence economy and not vice versa.

Extending these ideas even further geographically, it is perhaps no accident worldwide that the introduction of pots, seed intensification, and the development of social stratification often appear together temporally (or nearly so). If pots allowed for individual ownership of seed resources, eliminated the "freeloader problem," and fostered storage and the production of surplus, certain enterprising individuals may have seized on these factors, time and again, to build wealth and social debt. This could have been accomplished by giving away or trading surplus foods for labor or future gifts. A focus on seeds and pottery technology may have allowed certain individuals to cook food within their houses and circumvent traditional leveling mechanisms (e.g., sharing) that promoted egalitarianism. These hardworking individuals and their families may then have inspired others to pursue similar strategies, thereby spreading seed intensification and pottery technologies over large areas. As more and more individuals withdrew from traditional sharing networks, others may have been forced to follow suit because they no longer had access to reliable sources of food. For those without the ability to even out the variable return rates of higher-risk foods such as game by pooling returns across a larger set of people (Cashdan 1985; Gurven et al. 2000; Kaplan and Hill 1985; Winterhalder 1986, 1996, 1997), low-risk (but low-



return) resources such as seeds may have been particularly attractive. In this respect, seed intensification probably created a positive feedback cycle where more and more individuals were forced to participate in a system that devalued sharing and emphasized private ownership.

The changes proposed above for Owens Valley are remarkably similar to those that Flannery (2002) has recently discussed for early villages in Mesoamerica and the Near East. As he discussed (see also Weissner 1982), both regions witnessed changes in house configuration (from round to rectangular), a shift in the location of storage facilities (from out in the open to within domiciles), an intensification of food production, a privatization of food resources, and a decrease in sharing between family units. Although houses remained circular in Owens Valley, as discussed above we do have direct and tangential evidence for many of these other processes. Flannery (2002:421) relates these changes in Mesoamerica and the Near East, in large part, to rapidly increasing population levels. Within growing villages individuals had to mitigate against unrestricted sharing with neighbors they were no longer closely related to and resolved to privatize food resources. If we use these cases as a model for the western Great Basin (i.e., these processes are applicable cross-culturally), they lend much support to Bettinger's (1999b) notions about an increase in the number of freeloaders in late prehistoric Great Basin societies.

In conclusion, I am arguing that the way in which available seed-harvesting technologies were produced and used in the western Great Basin, namely, baskets and especially pots, promoted privatization of seed resources. I suggest that privatization was at least in part a conscious and preconceived goal that ultimately resulted in seed intensification. Most likely, population increase and a greater presence of freeloaders and aggrandizers played a role in the process as well (Bettinger 1999b; see also Delacorte 1999; Kohler 2004; Rosenberg 1998). In order to bring a better understanding to the introduction of new technologies and economies archaeologically, such as pottery and seed intensification, we need to consider how different processes, including environment and population pressure, as well as social factors, interact. Ownership strategies, which have not received much attention in the past, are integral to these

issues. It is really at the intersection of all these processes that we are likely to find more satisfying explanations for past behaviors. Although I have applied these ideas in the western Great Basin, I certainly think that they can be relevant in other archaeological contexts.

Finally, what might we expect a "privatized" technology, or at least one that promoted individual ownership of the goods it was associated with, to look like in the archaeological record? The arguments provided here for pots and seeds in the Great Basin give some general direction. These ideas are particularly applicable in societies where the notions of privatized goods are not yet widespread and well established. First, the majority of the material components of the technology should have the potential to be manufactured by individuals or small numbers of related individuals. Second, individuals should be able to operate the tools, when assembled, without assistance from others. In general, this should limit the technology to relatively small and lightweight items. Third, individuals should be able to use the technology out of view from the rest of the community, likely within a domicile or other walled structure or compound, again limiting the size of material components. If used within the house, it also precludes the use of hazardous materials that would threaten either the structural stability of the house (e.g., large bonfires or extremely high temperatures, if houses are made of combustible materials) or the immediate health of individuals (e.g., the release of poisonous fumes). Fourth, because they are generally out of view, such technologies should have only a minimal role in village-level social functions (i.e., they should not be put on display or used to signal wealth or status). As a result they may often be undecorated or only minimally decorated according to individual preferences.

*Acknowledgments.* I kindly thank Michael Delacorte, William Barnett, and an anonymous reviewer for their thoughtful comments on an earlier draft. Much of this research comes from my dissertation, which was supported by a National Science Foundation dissertation improvement grant (#9902836) and a Wenner-Gren predoctoral grant (#6529). I also thank Michael Jochim, Robert Bettinger, Michael Glassow, and Mark Aldenderfer for reading and commenting on the dissertation and Elizabeth Klarich for help with the Spanish abstract. Any mistakes are mine, of course.



## References Cited

- Armit, Ian, and William L. Finlayson  
1995 Social Strategies and Economic Change: Pottery in Context. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 267–276. Smithsonian Institution, Washington, D.C.
- Arnold, Dean E.  
1985 *Ceramic Theory and Cultural Process*. Cambridge University Press, Cambridge.
- Arnold, Jeanne E., Roger H. Colten, and Scott Pletka  
1997 Contexts of Cultural Change in Insular California. *American Antiquity* 62:300–318.
- Barnett, William K., and John W. Hoopes (editors)  
1995 *The Emergence of Pottery: Technology and Innovation in Ancient Societies*. Smithsonian Institution, Washington, D.C.
- Basgall, Mark E., and Mark A. Giambastiani  
1995 *Prehistoric Use of a Marginal Environment: Continuity and Change in Occupation of the Volcanic Tablelands, Mono and Inyo Counties, California*. Center for Archaeological Research at Davis, Publication No. 12. Davis, California.
- Basgall, Mark E., and Kelly R. McGuire  
1988 *The Archaeology of CA-Inyo-30: Prehistoric Culture Change in the Southern Owens Valley, California*. Report submitted to the California Department of Transportation, Sacramento. Far Western Anthropological Research Group, Davis, California.
- Bender, Barbara  
1985 Emergent Tribal Formations in the American Midcontinent. *American Antiquity* 50:52–62.
- Bettinger, Robert L.  
1975 The Surface Archaeology of Owens Valley, Eastern California: Prehistoric Man–Land Relationships in the Great Basin. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Riverside.  
1977 Aboriginal Human Ecology in Owens Valley: Prehistoric Change in the Great Basin. *American Antiquity* 42:3–17.  
1978 Alternative Adaptive Strategies in the Prehistoric Great Basin. *Journal of Anthropological Research* 34:27–46.  
1989 *The Archaeology of Pinyon House, Two Eagles, and Crater Midden: Three Residential Sites in Owens Valley, Inyo County, California*. Anthropological Papers of the American Museum of Natural History, No. 67. New York.  
1999a From Traveler to Processor: Regional Trajectories of Hunter-Gatherer Sedentism in the Inyo-Mono Region, California. In *Settlement Pattern Studies in the Americas, Fifty Years since Viru*, edited by B. R. Billman and G. M. Feinman, pp. 39–55. Smithsonian Institution Press, Washington, D.C.  
1999b What Happened in the Medithermal. In *Models for the Millennium*, edited by Charlotte Beck, pp. 62–74. University of Utah Press, Salt Lake City.
- Bettinger, Robert L., and Thomas F. King  
1971 Interaction and Political Organization: A Theoretical Framework for Archaeology in Owens Valley, California. *University of California Archaeological Survey Annual Report* 13:187–195.
- Bettinger, Robert L., David B. Madsen, and Robert G. Elston  
1994 Prehistoric Settlement Categories and Settlement Systems in the Alashan Desert of Inner Mongolia, PRC. *Journal of Anthropological Archaeology* 13:74–101.
- Bettinger, Robert L., and R. E. Taylor  
1974 Suggested Revisions in Archaeological Sequences of the Great Basin and Interior Southern California. *Nevada Archaeological Survey Research Papers* 5:1–26.
- Blackhawk, Ned  
1997 Julian Steward and the Politics of Representation: A Critique of Anthropologist Julian Steward's Ethnographic Portrayals of American Indians of the Great Basin. *American Indian Culture and Research Journal* 21:61–81.
- Braun, David  
1980 Experimental Interpretation of Ceramic Vessel Use on the Basis of Rim and Neck Formal Attributes. In *The Navajo Project: Archaeological Investigations, Page to Phoenix 500 KV Southern Transmission Line*, edited by Donald C. Fiero, R. W. Munson, M. T. McClain, S. M. Wilson, and A. H. Zier, pp. 170–231. Museum of Northern Arizona, Flagstaff.  
1983 Pots as Tools. In *Archaeological Hammers and Theories*, edited by James A. Moore and Arthur S. Keene, pp. 107–134. Academic Press, New York.
- Bright, Jason, Andrew Ugan, and Lorie Hunsaker  
2002 The Effect of Handling Time on Subsistence Technology. *World Archaeology* 34:164–181.
- Brown, James A.  
1989 The Beginnings of Pottery as an Economic Process. In *What's New? A Closer Look at the Process of Innovation*, edited by Sander E. van der Leeuw and Robin Torrence, pp. 203–224. Unwin Hyman, London.
- Cashdan, Elizabeth  
1985 Coping with Risk: Reciprocity among the Basarwa of Northern Botswana. *Man* 20:454–474.
- Crown, Patricia L., and Wirt H. Wills  
1995a Economic Intensification and the Origins of Ceramic Containers in the American Southwest. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 241–254. Smithsonian Institution, Washington, D.C.  
1995b The Origins of Southwestern Ceramic Containers: Women's Time Allocation and Economic Intensification. *Journal of Anthropological Research* 51:173–186.
- Crum, Steven J.  
1999 Julian Steward's Vision of the Great Basin: A Critique and Response. In *Julian Steward and the Great Basin: The Making of an Anthropologist*, edited by Richard O. Cletcher, L. Daniel Myers, and Mary Elizabeth Rudden, pp. 117–127. University of Utah Press, Salt Lake City.
- Damp, Jonathon E., and L. Patricia Vargas  
1995 The Many Contexts of Early Valdivia Ceramics. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 157–168. Smithsonian Institution, Washington, D.C.
- Delacorte, Michael G.  
1990 The Prehistory of Deep Springs Valley, Eastern California: Adaptive Variation in the Western Great Basin. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Davis.  
1997 *Culture Change along the Eastern Sierra Nevada/Cascade Front, vol. 7: Pah Rah Uplands*. Report submitted to Tuscarora Gas Transmission Co., Reno. Far Western Anthropological Research Group, Davis, California.  
1999 *The Changing Role of Riverine Environments in the Prehistory of the Central-Western Great Basin: Data Recovery Excavations at Six Prehistoric Sites in Owens Valley, California*. Report submitted to Caltrans District 9, Bishop, California. Far Western Anthropological Research Group, Davis, California.
- Delacorte, Michael G., Matthew C. Hall, and Mark E. Basgall



- 1995 *Final Report on the Evaluation of Twelve Archaeological Sites in the Southern Owens Valley, Inyo County, California*. Report submitted to the California Department of Transportation, Sacramento.
- Delacorte, Michael G., and Kelly R. McGuire  
1993 *Report of Archaeological Test Evaluations at Twenty-Three Sites in Owens Valley, California*. Report submitted to Contel Corporation. Far Western Anthropological Research Group, Davis, California.
- Dowling, John H.  
1968 Individual Ownership and the Sharing of Game in Hunting Societies. *American Anthropologist* 70:502–507.
- Driver, Harold E.  
1937 Culture Element Distributions, VI: Southern Sierra Nevada. *University of California Anthropological Records* 1(2):53–154.
- Drucker, Philip  
1937 Culture Element Distributions, V: Southern California. *University of California Anthropological Records* 1(1):1–51.
- Earle, Timothy K.  
1991 The Evolution of Chiefdoms. In *Chiefdoms: Power, Economy, and Ideology*, edited by Timothy K. Earle, pp. 1–15. Cambridge University Press, Cambridge.
- Eerkens, Jelmer W.  
1997 *Preliminary Report on Survey and Test Excavations on the Western and Southern Fringes of Owens Lake*. Report on file with Bureau of Land Management, Bishop, California.  
2001 The Origins of Pottery among Late Prehistoric Hunter-Gatherers in California and the Western Great Basin. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Santa Barbara.  
2003 Residential Mobility and Pottery Use in the Western Great Basin. *Current Anthropology* 44:728–738.
- Eerkens, Jelmer W., Hector Neff, and Michael Glascock  
1999 Early Pottery from Sunga'va and Implications for the Development of Ceramic Technology in Owens Valley, California. *Journal of California and Great Basin Anthropology* 20:275–285.  
2002 Ceramic Production among Small-Scale and Mobile Hunters and Gatherers: A Case Study from the Southwestern Great Basin. *Journal of Anthropological Archaeology* 21:200–229.  
2004 GC-MS Analysis and Fatty Acid Ratios of Archaeological Potsherds from the Western Great Basin of North America. *Archaeometry*, in press.
- Eerkens, Jelmer W., and Jeffrey S. Rosenthal  
2004 The Transition from Geophyte to Seed Processing in the Northern Mojave Desert: Evidence from Thermal Features Near China Lake. *Pacific Coast Archaeological Society Quarterly*, in press.
- Evershed, Richard P., Hazel R. Mottram, Stephanie N. Dudd, Stephanie Charters, Andrew W. Stott, G. J. Lawrence, A. M. Gibson, A. Conner, Paul W. Blinkhorn, and V. Reeves  
1997 New Criteria for the Identification of Animal Fats Preserved in Archaeological Pottery. *Naturwissenschaften* 84:402–406.
- Flannery, Kent V.  
2002 The Origins of the Village Revisited: From Nuclear to Extended Households. *American Antiquity* 67:417–433.
- Fowler, Catherine S.  
1986 Subsistence. In *Handbook of North American Indians, vol. 11: Great Basin*, edited by Warren L. d'Azevedo, pp. 64–97. Smithsonian Institution, Washington, D.C.
- Gayton, Anna H.  
1929 Yokuts and Western Mono Pottery-Making. *University of California Publications in American Archaeology and Ethnography* 24(3):239–251.
- 1948 Yokuts and Western Mono Ethnography. *University of California Anthropological Records* 10:1–302.
- Gilreath, Amy J.  
1995 *Archaeological Evaluations of Thirteen Sites for the Ash Creek Project, Inyo County, California*. Report submitted to the California Department of Transportation, Sacramento.
- Gilreath, Amy J., and William R. Hildebrandt  
1997 *Prehistoric Use of the Coso Volcanic Field*. Contributions of the University of California Archaeological Research Facility, No. 56. Berkeley.
- Gould, Richard  
1980 *Living Archaeology*. Cambridge University Press, Cambridge.  
1982 To Have and Have Not: The Ecology of Sharing among Hunter-Gatherers. In *Resource Managers: North American and Australian Hunter-Gatherers*, edited by Nancy M. Williams and Eugene S. Hunn, pp. 69–92. Westview Press, Boulder.
- Gurven, Michael, Kim Hill, Hillard Kaplan, Ana Hurtado, and Richard Lyles  
2000 Food Transfers among Hiwi Foragers of Venezuela: Tests of Reciprocity. *Human Ecology* 28:171–214.
- Hawkes, Kristen  
1992 Sharing and Collective Action. In *Evolutionary Ecology and Human Behavior*, edited by Eric A. Smith and Bruce Winterhalder, pp. 269–300. Aldine de Gruyter, New York.  
1993 Why Hunter-Gatherers Work: An Ancient Version of the Problem with Public Goods. *Current Anthropology* 34:341–362.
- Hayden, Brian  
1990 Nimrods, Piscators, Pluckers, and Planters: The Emergence of Food Production. *Journal of Anthropological Archaeology* 9:31–69.  
1995 The Emergence of Prestige Technologies and Pottery. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 257–265. Smithsonian Institution, Washington, D.C.
- Henrickson, Elizabeth F., and Mary A. McDonald  
1983 Ceramic Form and Function: An Ethnographic Search and an Archaeological Application. *American Anthropologist* 85:630–643.
- Hildebrandt, William R., and Kelly R. McGuire  
2002 The Ascendance of Hunting during the California Middle Archaic: An Evolutionary Perspective. *American Antiquity* 67:231–256.
- Hildebrandt, William R., and Allika Ruby  
2004 Prehistoric Pinyon Exploitation in the Southwestern Great Basin: A View from the Coso Range. In *Avocados to Millingstones: Papers in Honor of D. L. True*, edited by Georgie Waugh and Mark E. Basgall. Monographs in California and Great Basin Prehistory 3. California State University–Sacramento Press, Sacramento.
- Hoopes, John W.  
1995 Interaction in Hunting and Gathering Societies as a Context for the Emergence of Pottery in the Central American Isthmus. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 185–198. Smithsonian Institution, Washington, D.C.
- Ikawa-Smith, Fumiko  
1976 On Ceramic Technology in East Asia. *Current Anthropology* 17:513–515.



- Irwin, Charles N.  
1980 *The Shoshoni Indians of Inyo County, California: The Kerr Manuscript*. Ballena Press, Independence, California.
- Juhl, Kirsten  
1995 *The Relation between Vessel Form and Vessel Function: A Methodological Study*. Arkeologisk museum i Stavanger, Stavanger, Norway.
- Kaplan, Hilliard, and Kim Hill  
1985 Food Sharing among the Ache Foragers: Tests of Explanatory Hypotheses. *Current Anthropology* 26:223–245.
- Kelly, Isabel T.  
1932 Ethnography of the Surprise Valley Paiute. *University of California Publications in American Archaeology and Ethnology* 31(3):67–210.
- Kelly, Isabel T., and Catherine S. Fowler  
1986 Southern Paiute. In *Handbook of North American Indians, vol. 11: Great Basin*, edited by Warren L. d'Azevedo, pp. 368–397. Smithsonian Institution, Washington, D.C.
- Kelly, Robert L.  
1997 The Late Holocene Prehistory of the Great Basin. *Journal of World Prehistory* 11:1–49.
- Kohler, Timothy A.  
2004 Population and Resources in Prehistory. In *The Archaeology of Global Change*, edited by Charles L. Redman, Steven R. James, Paul R. Fish, and J. Daniel Rogers, pp. 257–270. Smithsonian Institution Press, Washington, D.C.
- Lawton, Harry W., Philip J. Wilke, Mary DeDecker, and William M. Mason  
1976 Agriculture among the Paiute of Owens Valley. *Journal of California Anthropology* 3:13–50.
- Linton, Ralph  
1944 North American Cooking Pots. *American Antiquity* 9:369–380.
- Lockett, Cari, and Lonnie Pippin  
1990 Re-Examining Brownware Ceramics in the Central and Southern Great Basin. In *Hunter-Gatherer Pottery from the Far West*, edited by J. M. Mack, pp. 67–82. Nevada State Museum Anthropological Papers No. 23. Carson City, Nevada.
- Lowie, Robert H.  
1909 *The Northern Shoshone*. Anthropological Papers of the American Museum of Natural History, Vol. 2, pt. 2.  
1939 Ethnographic Notes on the Washo. *University of California Publications in American Archaeology and Ethnology* 36(5):301–352.
- Malainey, Mary E., Roman Przybylski, and Barbara L. Sherriff  
1999a The Fatty Acid Composition of Native Food Plants and Animals of Western Canada. *Journal of Archaeological Science* 26:83–94.  
1999b Identifying the Former Contents of Late Precontact Period Pottery Vessels from Western Canada Using Gas Chromatography. *Journal of Archaeological Science* 26:425–438.
- Matson, Frederick R.  
1972 Ceramic Studies. In *The Minnesota Messenia Expedition*, edited by William A. McDonald and George R. Rapp Jr., pp. 220–224. University of Minnesota Press, Minneapolis.
- Moore, A. M. T.  
1995 The Inception of Potting in Western Asia and Its Impact on Economy and Society. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 39–54. Smithsonian Institution, Washington, D.C.
- Mottram, Hazel R., Stephanie N. Dudd, G. J. Lawrence, Andrew W. Stott, and Richard P. Evershed  
1999 New Chromatographic, Mass Spectrometric and Stable Isotope Approaches to the Classification of Degraded Animal Fats Preserved in Archaeological Pottery. *Journal of Chromatography A* 833:209–221.
- O'Shea, John  
1981 Coping with Scarcity: Exchange and Social Storage. In *Economic Archaeology: Towards and Integration of Ecological and Social Approaches*, edited by Alison Sheridan and Geoff Bailey, pp. 167–186. BAR International Series 96, Oxford.
- Oyuela-Caycedo, Augusto  
1995 Rocks versus Clay: The Evolution of Pottery Technology in the Case of San Jacinto 1, Colombia. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp. 133–144. Smithsonian Institution, Washington, D.C.
- Patrick, M., Adrianus J. deKoning, and Andrew B. Smith  
1985 Gas Liquid Chromatographic Analysis of Fatty Acids in Food Residues from Ceramics in the Southwestern Cape, South Africa. *Archaeometry* 27:231–236.
- Pierce, Christopher D.  
1999 Explaining Corrugated Pottery in the American Southwest: An Evolutionary Approach. Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington.
- Pierce, Wendy  
2002 Paleoethnobotanical Remains. In *Final Report on Phase II Investigations at 26 Archaeological Sites for the Aberdeen-Blackrock Four-Lane Project on Highway 395, Inyo County, California*, vol. 1, edited by David Zeahah and Anastasia Leigh, pp. 623–634. Report submitted to Caltrans District 9, Bishop, California. Pacific Legacy and Archaeological Research Center, Sacramento.
- Pippin, Lonnie C.  
1986 Intermountain Brown Wares: An Assessment. In *Pottery of the Great Basin and Adjacent Areas*, edited by Suzanne Griset, pp. 9–21. Anthropological Papers, No. 111. University of Utah, Salt Lake City.
- Reddy, Seetha  
2003 Harvests in the Past: Paleoethnobotanical Remains from INY-1317, INY-1991, INY-5967, INY-5987, INY-6021, and INY-6263. In *Lacustrine Lifestyles along Owens Lake: NRHP Evaluation of 15 Prehistoric Sites for the Olancho/Cartago Four-Lane Project, U.S. Route 395, Inyo County, California*, edited by Brian F. Byrd and Micah Hale, pp. 713–763. Report submitted to Caltrans District 9, Bishop, California. ASM Affiliates, San Diego.
- Rhode, David  
1994 Direct Dating of Brown Ware Ceramics Using Thermoluminescence and Its Relation to the Numic Spread. In *Across the West: Human Population Movement and the Expansion of the Numic*, edited by David B. Madsen and David Rhode, pp. 124–130. University of Utah Press, Salt Lake City.
- Rice, Prudence M.  
1999 On the Origins of Pottery. *Journal of Archaeological Method and Theory* 6:1–54.
- Rosenberg, Michael  
1998 Cheating at Musical Chairs: Territoriality and Sedentism in an Evolutionary Context. *Current Anthropology* 39:653–681.
- Saitta, Dean J., and Arthur S. Keene  
1990 Politics and Surplus Flow in Prehistoric Communal Societies. In *Evolution of Political Systems: Sociopolitics*



- in *Small-Scale Sedentary Societies*, edited by Steadman Upham, pp. 203–224. Cambridge University Press, Cambridge.
- Sassaman, Kenneth  
1993 *Early Pottery in the Southeast: Tradition and Innovation in Cooking Technology*. University of Alabama Press, Tuscaloosa.
- Schiffer, Michael B.  
1990 The Influence of Surface Treatment on Heating Effectiveness of Ceramic Vessels. *Journal of Archaeological Science* 17:373–381.
- Schiffer, Michael B., James M. Skibo, Tamara C. Boelke, Mark A. Neupert, and Meredith Aronson  
1994 New Perspectives on Experimental Archaeology: Surface Treatments and Thermal Responses of the Clay Cooking Pot. *American Antiquity* 59:197–217.
- Skibo, James M.  
1992 *Pottery Function: A Use-Alteration Perspective*. Plenum Press, New York.
- Skibo, James M., Michael B. Schiffer, and Kenneth C. Reid  
1989 Organic-Tempered Pottery: An Experimental Study. *American Antiquity* 54:122–146.
- Smith, Eric A.  
1988 Risk and Uncertainty in the “Original Affluent Society”: Evolutionary Ecology of Resource Sharing and Land Tenure. In *Hunters and Gatherers, vol. 1: History, Evolution, and Social Change*, edited by Tim Ingold, David Riches, and James Woodburn, pp. 222–251. Berg, Oxford.
- Smith, Marion F., Jr.  
1985 Towards an Economic Interpretation of Ceramics: Relating Vessel Size and Shape to Use. In *Decoding Prehistoric Ceramics*, edited by Ben A. Nelson, pp. 254–309. Southern Illinois University Press, Carbondale.
- Sørensen, Marie L. S.  
2000 *Gender Archaeology*. Polity Press, Cambridge.
- Steward, Julian H.  
1929 Irrigation without Agriculture. *Papers of the Michigan Academy of Science, Arts, and Letters* 12:149–156.  
1933 Ethnography of the Owens Valley Paiute. *University of California Publications in American Archaeology and Ethnography* 33:233–350.  
1938 *Basin-Plateau Aboriginal Sociopolitical Groups*. Smithsonian Institution, Washington, D.C.  
1941 Culture Element Distributions, XIII: Nevada Shoshoni. *University of California Anthropological Records* 4(2):209–360.
- Stewart, Omer C.  
1941 Culture Element Distributions, XIV: Northern Paiute. *University of California Anthropological Records* 4:361–446.  
1942 Culture Element Distributions, XVII: Ute–Southern Paiute. *University of California Anthropological Records* 6:231–356.
- Thomas, David H.  
1971 Prehistoric Subsistence–Settlement Patterns of the Reese River Valley, Central Nevada. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Davis.  
1981 How to Classify the Projectile Points from Monitor Valley, Nevada. *Journal of California and Great Basin Anthropology* 3:7–43.
- 1983 On Steward’s Model of Shoshonean Sociopolitical Organization: A Great Bias in the Basin? In *The Development of Political Organization in Native North America*, edited by Elisabeth Tooker and Morton H. Fried, pp. 59–67. American Ethnological Society, Washington, D.C.
- 1988 *The Archaeology of Monitor Valley, 3: Survey and Additional Excavations*. Anthropological Papers, Vol. 66, Pt. 2. American Museum of Natural History, New York.
- Van Camp, Gena R.  
1979 *Kumeyaay Pottery: Paddle-and-Anvil Techniques of Southern California*. Ballena Press, New Mexico.
- Voegelin, Erminie  
1938 Tubatulabal Ethnography. *University of California Anthropological Records* 2(1):1–84.
- Waguespack, Nicole M.  
2003 Caribou Sharing and Storage: Refitting the Palangana Site. *Journal of Anthropological Archaeology* 21:396–417.
- Walker, Deward E., Jr.  
1999 A Revisionist View of Julian Steward and the Great Basin Paradigm from the North. In *Julian Steward and the Great Basin: The Making of an Anthropologist*, edited by Richard O. Clemmer, L. Daniel Myers, and Mary Elizabeth Rudden, pp. 60–84. University of Utah Press, Salt Lake City.
- Wandsnider, Luann  
1997 The Roasted and the Boiled: Food Composition and Heat Treatment with Special Emphasis on Pit-Hearth Cooking. *Journal of Anthropological Archaeology* 16:1–48.
- Weissner, Polly  
1982 Beyond Willow Smoke and Dogs’ Tails: A Comment on Binford’s Analysis of Hunter-Gatherer Settlement Systems. *American Antiquity* 47:171–178.
- Winterhalder, Bruce  
1986 Diet Choice, Risk, and Food Sharing in a Stochastic Environment. *Journal of Anthropological Archaeology* 5:369–392.  
1996 A Marginal Model of Tolerated Theft. *Ethology and Sociobiology* 17:37–53.  
1997 Gifts Given, Gifts Taken: The Behavioral Ecology of Non-Market, Intragroup Exchange. *Journal of Archaeological Research* 5:121–168.
- Wobst, Martin H.  
1978 The Archaeo-Ethnology of Hunter-Gatherers or the Tyranny of the Ethnographic Record in Archaeology. *American Antiquity* 43:303–309.
- Wright, Gary A.  
1978 The Shoshonean Migration Problem. *Plains Anthropologist* 23:113–137.
- Yellen, John E.  
1977 *Archaeological Approaches to the Present: Models for Reconstructing the Past*. Academic Press, New York.

---

Received July 1, 2003; Revised February 4, 2004; Accepted February 4, 2004.