Archaeological Investigations at the Manifold Site (CA-KER-4220), Buena Vista Lake, Southern San Joaquin Valley, California

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Abstract

Between 1995 and 2001 field classes from California State University, Bakersfield, undertook test excavations at the Manifold site (CA-KER-4220), located along the northwestern shore of Buena Vista Lake in the southern San Joaquin Valley. Research questions addressed site function, seasonality, chronology, economic system, ethnic identity of the site inhabitants, and the role of KER-4220 within the larger regional settlement system. Also examined was the site's mound structure in an attempt to determine whether it was natural (i.e., formed by accumulation of soil and midden) or intentionally constructed. Evidence suggests that KER-4220 was sporadically occupied primarily between the Upper Archaic and Emergent period, with limited use before and after that time.

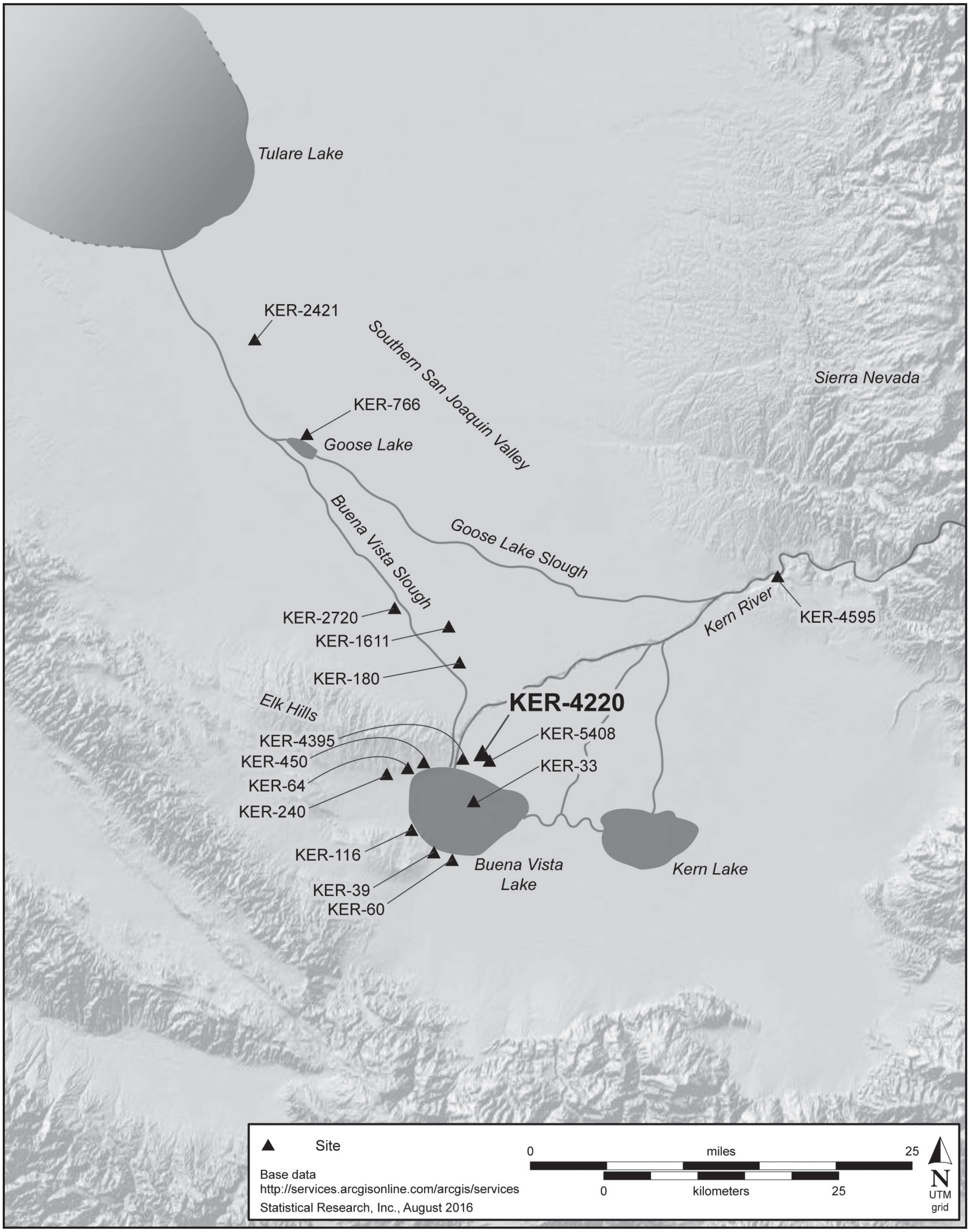
Numerous shell dumps documented at the site presented the opportunity to develop a freshwater shell correction factor for the Buena Vista Lake basin. The Feature 1 shell, mammal, and turtle remains together provided a correction factor of minus 300 years (see Sutton and Orfila 2003), a major contribution toward chronology building for a region where sites often contain quantities of *Anodonta* shell.

Introduction

In the southern San Joaquin Valley, Buena Vista and Kern lakes have witnessed human occupation for thousands of years. Large, complex, deep sites with abundant cultural materials have been documented along their shores (e.g., Wedel 1941; Dieckman 1977; Hartzell 1992). Easily accessible to looters, these sites were heavily vandalized for more than 100 years. The damage and destruction are so severe that their contribution to anthropological and archaeological research has been greatly compromised (see Sutton 2000).

As part of a roughly 20-year research program in the southern San Joaquin Valley commencing in the late 1980s, field classes from California State University, Bakersfield (CSUB), began excavations in 1995 at KER-4220—one of the better preserved sites in the region—under the direction of the lead author. The Manifold site is an apparently intact mound situated along the northwestern shore of Buena Vista Lake in the vicinity of its outlet channel, Buena Vista Slough (Figure 1), within ARCO Western Energy's South Coles Levee Ecological Preserve, which is fenced off and regularly patrolled.[1]

Fieldwork included mapping, surface collection, and excavation of four test units. When initially investigated, a number of discrete piles of *Anodonta* shell were discernible on the surface. They appeared to be purposeful "dumps" representing the remnants of individual cooking events. Additionally, *Anodonta* shell fragments and burned vertebrate remains were commingled in a subsurface shell feature, presenting an opportunity to generate a freshwater shell correction factor for the Buena Vista Lake basin. This report presents the results of the CSUB investigations and



Figire 1. Location of the Manifold site (CA-KER-4220) and other sites discussed in text in the southern San Joaquin Valley.

includes discussions of environmental and cultural backgrounds, research design, results and analyses of the excavations, and interpretations.

Environmental Background

The Buena Vista Lake basin is located at the southern end of California's San Joaquin Valley (Figure 1), which is drained by the Kern and San Joaquin rivers. These rivers emerge through the Carquinez Strait to drain into San Francisco Bay. The basin is bounded on the east by the central and southern Sierra Nevada, on the southeast by the Tehachapi Mountains, on the south by the San Emigdio Mountains, and on the west by the Temblor and Diablo ranges. At the south end of the Temblor Range, immediately west of Buena Vista Lake, are the Elk and Buena Vista hills.

Prior to the introduction of agriculture in historic times, the far southern San Joaquin Valley contained a vast network of interconnecting lakes, rivers, streams, and sloughs that were fed by the Kern River. Precipitation in the southern valley is low; thus, away from the river-fed mesic areas, a xeric desert-like environment prevailed. Beginning in the late nineteenth century and continuing into the twentieth century, the diversion and channelization of the Kern, Tule, Kings, Kaweah, and other rivers dramatically altered the physiography of the valley. As a result, the current path of the Kern River, flowing west of Bakersfield and into the northern portion of Buena Vista Lake, is likely recent. It is believed that prior to about 1860 the Kern River flowed south of Bakersfield and entered the northern portion of Kern Lake.

The plant communities that currently dominate the southern San Joaquin Valley, including the Buena Vista Lake basin, are the Lower Sonoran Grassland and Alkali Sink Association, with a very limited Freshwater Marsh Association (Twisselmann 1967:91). The most widespread perennial shrub in the Lower Sonoran Grassland is the common saltbush (*Atriplex* spp.), followed closely by the introduced Russian-thistle, or tumbleweed (*Salsola kali* var. *tenuifolia*). The Lower Sonoran Grassland is also host to a number of winter annuals, many of which are introduced species. Plants within the Alkali Sink Association include pickleweed (*Allenrolfea occidentalis*), glassworts (*Salicornia subterminalis*), and seep weeds (*Suaeda* spp.), among others. The Freshwater Marsh Association has virtually disappeared, but its remnants consist primarily of the common tule (*Scirpus acutis*), cattail (*Typha* spp.), spike rush (*Eleocharis* spp.), and sedges (*Carex* spp.). The plants that make up the Freshwater Marsh Association were extremely important to the aboriginal inhabitants (Twisselmann 1967; Preston 1981).

Numerous animal species are found in the area surrounding present-day Bakersfield, although many that were important to the prehistoric inhabitants of the region have been extirpated due to environmental pressures brought about by European contact beginning at approximately 1770. In addition, desiccation of the lakes, rivers, and sloughs has either eradicated or greatly reduced the numbers of mollusks, fishes, amphibians, and waterfowl that were formerly abundant in the area. Many of the animals discussed herein have been identified in archaeological contexts in the Buena Vista Lake basin (e.g., Demay 1942; Gayton 1948; Dillon and Porcasi 1990; Hartzell 1992; Jackson et al. 1998; Gobalet et al. 2004; Culleton et al. 2005; Sutton et al. 2012).

Large mammals such as tule elk (*Cervus elaphus nannoides*), pronghorn (*Antilocapra americana*), black bears (*Ursus americanus*), and grizzly bears (*U. arctos*) were once common residents. Bears are now absent from the valley, and only a small herd of reintroduced elk resides there. A small population of pronghorn can be found on the Carrizo Plain, just west of the San Joaquin Valley. A number of medium to small mammals also reside in the region, including coyotes (*Canis latrans*), foxes (*Vulpes macrotus*, *Urocyon cinereoargenteus*), skunks (*Spilogale putoris*, *Mephitus mephitus*), badgers (*Taxidea taxus*), black-tailed hares (*Lepus californicus*), cottontail rabbits (*Sylvilagus audubonii*), squirrels (e.g., *Spermophilus* spp.), pocket gophers (*Thomomys bottae*), voles (*Microtus californicus*), kangaroo rats (*Dipodomys* spp.), and mice (e.g., *Perognathus* spp., *Peromyscus* spp., *Onychomys torridus*) (Jameson and Peeters 1988). Various species of birds in the region, such as geese (e.g., *Branta canadensis*), ducks (e.g., *Anas* spp.), coots (e.g., *Fulica americana*), and grebes (e.g., *Podilymbus podiceps*), were also important human resources.

Many fish species present in the rivers, sloughs, and lakes were abundant prehistorically. Species that were major food sources include Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Lavinia exilicauda*), thicktail chub (*Gila crassicauda*), Sacramento sucker (*Catostomus occidentalis*), Sacramento perch (*Archoplites interruptus*), and tule perch (*Hysterocarpus traskii*). Various reptiles and amphibians are also found in the valley. Gayton (1948:14) reported the use of turtles (*Actinemys marmorata*) by the Yokuts of the Tulare Lake area.

In addition to vertebrates, several invertebrates reside in the valley and were also important food sources. These include a variety of insects (see summary by Gardner [1997]), several species of freshwater bivalves (primarily *Anodonta* spp. and *Margaritifera* spp.), and freshwater snails (*Physa* spp.). Land snails (*Helminthaglyptha* spp.) have been recovered from many site deposits, although they do not appear to have been culturally significant.

Brief Ethnographic Background

Native Americans that inhabited the San Joaquin Valley during ethnographic times are known collectively as Yokuts, who have been the focus of several ethnographic studies (e.g., Kroeber 1925; Gayton 1948; Latta 1977; Wallace 1978a, 1978b). The following discussion of the Yokuts was synthesized from these sources (also see Osborne 1992; Sutton 1997). A brief ethnographic summary distilled largely from Osborne (1992) is provided below.

There were more than 40 Yokuts tribes, each with a distinct name, dialect, and territory. They can be separated into three geographical divisions, Northern Valley, Southern Valley, and Foothill. The Tulamni, a Southern Valley Yokuts tribe, occupied the region around Buena Vista Lake. Their principal village, known as Tulamniu, was reportedly located somewhere along the western or northwestern shore of the lake "where the hills come close to the water" (Kroeber 1925:478).

Much like other Southern Valley Yokuts groups, the Tulamni were organized into single large village settlements or several closely associated smaller settlements. Availability of resources such as fish, waterfowl, shellfish, roots, and seeds allowed the Tulamni to occupy villages and/or seasonal encampments. The Tulamni built two types of dwellings, oval-shaped single family huts and larger communal structures. Tule grass was used to manufacture baskets, mats, and canoes. Tule roots were processed into a starchy flour for mush, and seeds were ground into meal. Baskets of many varieties were woven with great technological skill. Knives, scraping tools, and projectile points were made from stone that was often imported. Coastal marine shells obtained in their natural state were crafted into a variety of disks, beads, pendants, and other items for use as money and personal adornment.

Fish represented a significant food resource for the Tulamni and were generally captured by netting, either in large nets dragged in the water using a tule raft or by diving with small hand nets. Waterfowl were also preferred resources and were shot with arrows or snared. Large quantities of mussels (*Anodonta* spp.) were gathered for consumption. The dietary regime included seeds and roots of tule, grass, clover, fiddleneck, and other flowering herbs. Rabbits were hunted in communal drives, and elk and pronghorn were shot from blinds near the lakes or sloughs. While acorns, a staple of many Native California groups, were not readily available to the Tulamni, some tribes traded fish for acorns with their eastern neighbors.

Archaeological Background

To characterize the prehistory of the Central Valley, which includes the Sacramento and San Joaquin valleys, the chronology of Rosenthal et al. (2007) is summarized below. For the sake of clarity throughout this article, the time ranges reported by Rosenthal et al. (2007) as BC have been converted to BP.

Paleoindian (≈13,550 to 10,550 BP)

There is evidence of human habitation in the lake country of the southern San Joaquin Valley dating back to at least 12,000 years ago, although few sites of this age have been identified. This lack of identification is partly due to geoarchaeological episodes of erosion and deposition that have destroyed or buried many ancient Holocene deposits under more recent alluvial deposits. Most evidence of such early occupation comes from isolated finds of Clovis projectile points. One of the most notable early sites is the Witt site along the shore of Tulare Lake (north of the Buena Vista Lake basin), which contained fluted (Clovis-like) projectile points, scrapers, crescents, and Lake Mojave points (Moratto 1984:81–82; Wallace and Riddell 1988; Wallace 1991, 1993:6; also see Hopkins 1991; Hopkins and Garfinkel 2008).

Lower Archaic (≈10,550 to 7550 BP)

Similar to the Paleoindian era, occupations during the Lower Archaic are largely represented by isolated finds, including stemmed points, crescents, and early concave base projectile points. Many such isolates occur along the shores of Tulare Lake. The best known Lower Archaic site in the southern San Joaquin Valley is CA-KER-116 (Fredrickson and Grossman 1977; also see Hartzell 1992) on the southwestern shoreline of Buena Vista Lake. It had a deeply buried component that contained crescents, a stemmed projectile point, and radiocarbon dates ranging between 9,175 and 8,450 years ago.

In the adjacent Elk Hills, several sites have produced obsidian hydration rim micron values that indicate a Lower Archaic occupation (Jackson et al. 1998). Lower Archaic sites that have contained Lake Mojave, Silver Lake, and Pinto projectile points as well as crescents and humpies (an oblong-shaped flaked stone tool with pointed ends; e.g., Sampson 1991) have also been identified in the Tulare Lake basin. The projectile points and the few identified faunal remains suggest that artiodactyl hunting was a subsistence focus. Milling implements are rare to absent, so the extent of plant usage is not clear. Evidence of regional interaction spheres during the Lower Archaic is derived from marine shell beads (primarily *Olivella*) and obsidian from the eastern Sierra Nevada.

Middle Archaic (≈7550 to 2550 BP)

The Middle Archaic witnessed substantial climate change in the Central Valley as conditions became warmer and drier and lakes began to desiccate. Landscapes eventually became more stable after a period of deposition at about 7,550 years ago, and buried sites in alluvial landforms are well represented. High residential mobility is characteristic of the foothills adaptation, and increasing residential stability is more typical of the valley floor adaptation.

Artifacts of the Middle Archaic include *Haliotis* shell ornaments in various geometric shapes, *Olivella* and *Haliotis* beads, slate ornaments, spindle-shaped charmstones, mortars, pestles, and atlatl dart points. There was extensive use of bone for awls, fish spear tips, fish hooks, and saws. Remains of tule elk, mule deer, pronghorn, fish, rabbits, hares, water birds, raptors, and rodents are frequent constituents in Middle Archaic deposits. Baked clay objects, largely unidentified as to function, are also common.

Upper Archaic (≈2550 to 1000 BP)

The Upper Archaic heralded a shift to cooler, wetter, and more stable environmental conditions, with lakes becoming significantly replenished. There was more cultural diversity, as evidenced partly by different artifact styles (e.g., Rose Spring projectile points, saddle and saucer *Olivella* beads, *Haliotis* ornaments, stone beads and cylinders, and ceremonial blades). Exotic marine shell and obsidian artifacts attest to exchange and trade practices between the valley inhabitants and outside groups.

In the southern valley, residential features dating to the Upper Archaic have been identified in the later KER-116 component and at CA-KER-39 (Hartzell 1992), along with both aquatic and terrestrial resources (e.g., fish, shellfish, elk, pronghorn, deer, and rabbit). Milling implements were ubiquitous, indicating the grinding of particular resources such as nuts and seeds.

Emergent Period (≈1000 BP to Historic Contact)

In various parts of the Central Valley, the Emergent period witnessed the disappearance of many Archaic traditions and technologies as Euroamerican contact forced changes on the Native populations. The Emergent period marks the introduction of the bow and arrow between about 1,000 and 700 years ago, replacing the dart and atlatl as the hunting weapon of choice. Throughout the valley, fishing and plant collecting increased in importance. Residential sites have included large quantities of fish remains as well as a variety of mammals and birds. Mortars and pestles continued to be used to process seeds, nuts, and perhaps small animals (see Yohe et al. 1991).

A History of Archaeological Research in the Southern San Joaquin Valley

Formal archaeological investigations have been conducted in the southern San Joaquin Valley, including the Buena Vista Lake region, for more than 110 years (see Table 1), beginning in 1899 with a research group from the University of California, Berkeley (Gifford and Schenck 1926:5). Led by Phillip Mills Jones, the group worked for three weeks near Buttonwillow, where they investigated approximately 150 mounds and identified cultural material, including human skeletal remains (Wallace 1971:13–14). In the early 1900s Nelson recovered skeletal remains and artifacts from the western end of the Elk Hills (Gifford and Schenck 1926:41), Strong recovered two burials from the same vicinity (Gifford and Schenck 1926:40–41), and Kroeber excavated cremations adjacent to Buena Vista Lake (Hartzell 1992:121). Gifford and Schenck (1926) were especially prolific with their comprehensive research project in the valley, recording sites and conducting numerous test excavations in and around the lake region.

In the 1930s a number of projects where burials were discovered were undertaken, including excavations by Gifford and Schenck (1926:41–42; also see Estep 1993) at Pelican Island (CA-KER-33) off the north shore of Buena Vista Lake, by Walker (1935, 1947) along the northwestern shore of Buena Vista Lake, and by Wedel (1941) along the southern shore of the lake. In 1959 von Werlhof (1960:1; also see Siefkin et al. 1996) excavated burials at the Buena Vista Golf Club on the northwest shore of the lake.

In the 1970s Fredrickson and Grossman (1977; also see Hartzell 1992) tested a deeply buried, very early component (≈8,000 years ago) at KER-116 on the southwest shoreline of Buena Vista Lake. At about the same time, Dieckman (1969, 1977; also see Bass and Andrews 1977) conducted excavations at the Bead Hill site (CA-KER-450) on the northwest shore and concluded that it was the village of Tulamniu. Peak

Table 1. Summary of Excavation Projects in the Buena Vista Lake Region.

Site No. (CA-KER-)	Site Name/Area	Site Type	General Age	Conducted by	References
multiple	Southern San Joaquin Valley	various	"relative antiquity" to "relative recency" (Gifford and Schenck 1926:118)	UC Berkeley	Gifford and Schenck 1926; Wallace 1971
various	Elk Grove	habitation, burials	not provided	UC Berkeley	Gifford and Schenck 1926
33	Pelican Island	habitation, burials	Middle Archaic–Emergent	Bakersfield College	Gifford and Schenck 1926; Estep 1993
–	Elk Hills, Sites 14, 15	burials	Emergent	UC Berkeley	Gifford and Schenck 1926; Kroeber 1951
64	Elk Hills Cemetery	cemetery	Emergent	Smithsonian	Walker 1935, 1947
39, 60	Buena Vista Lake Sites 1 and 2	habitation, burials	Emergent	Smithsonian, Taft College	Wedel 1941; Hartzell 1992; Williams 2002
116	Buena Vista Lake	habitation	Middle Archaic–Emergent	State Parks	Fredrickson and Grossman 1977; Hartzell 1992
450	Bead Hill	habitation	Emergent (and possibly as early as Middle Archaic)	various, CSUB	Dieckman 1969, 1977; Bass and Andrews 1977; Jones et al. 1996; Sutton 2000; Minor 2002; Barton et al. 2010
240	Buena Vista Golf Course	burials	Upper Archaic–Emergent	College of the Sequoias, CSUB	von Werlhof 1960; Siefkin et al. 1996
180	Tule Elk Reserve (Buena Vista Slough)	habitation	Emergent to Postcontact	UC Davis	Hartzell 1992
1611	Tule Elk Reserve (Buena Vista Slough)	habitation	Upper Archaic–Emergent	UC Davis	Hartzell 1992
766	Goose Lake	habitation	Lower Archaic–Emergent	CSUB	Sutton 1992
2421	Lost Hills	burials	Emergent–Protohistoric	CSUB	Novickas 1992
various	Elk Hills	various	Lower Archaic–Emergent	Pacific Legacy	Jackson et al. 1998; Culleton et al. 2005
2720	Buttonwillow	habitation	Upper Archaic–Emergent	CSUB	Sutton 1996
4595	Kern Canyon	habitation	Middle Archaic–Emergent?	CSUB	Parr 1998
4395	Big Cut	temporary camp	Middle Archaic–Emergent	CSUB	Sutton et al. 2012
4220	Manifold	habitation	Upper Archaic–Emergent	CSUB	this report

Note: Refer to Figure 1 for site locations.

(1991) later worked at several sites within the Elk Hills Naval Petroleum Reserve, and Hartzell (1992) completed limited excavations at several sites within the Buena Vista Lake basin in her study of lacustrine adaptations.

Beginning in 1992, studies at several sites were initiated at CSUB by the lead author with various field archaeology classes. These include Goose Lake north of Buena Vista Lake (Sutton 1992), Lost Hills (Novickas 1992), Buttonwillow (Sutton 1996), and additional work at Bead Hill (see Jones et al. 1996; Sutton 2000; Minor 2002; Barton et al. 2010). Other work in the area from the late 1990s to the early 2000s included 1980s excavations at Buena Vista Lake by Taft College investigators (see Williams 2002), at

Poso Creek (Shapiro and Jackson 1998), in the Elk Hills (Jackson et al. 1998; also see Culleton et al. 2005), and in Kern River Canyon (Parr 1998).

Research Issues for the Manifold Site

In addition to general questions of function, chronology, and seasonality, several issues were raised concerning the site. First, the east–west linear structure of the mound on which the site rests is roughly parallel to the northern shoreline of Buena Vista Lake, suggesting that the site was occupied while the lake level was slightly below an elevation of about 300 feet and that it was situated on the lakeshore itself. Second, the method by which the mound was formed, whether by natural accumulation of soil and midden or by intentional construction, was of interest. There is some indication of depressed areas on both the southern and northern margins of the site that may represent aboriginal borrow pits. The idea that the mound may have been purposefully constructed is based on the description of such mounds:

> The building of mounds was common practice throughout the delta area [to the north]. Literally, there were dozens of those artificial mounds between the west branch of the San Joaquin River, the mouth of the Mokelumne River and the Stockton Channel. This building of artificial mounds was not confined to the San Joaquin River delta area. On the channels between Buena Vista and Tulare Lakes and along the shores of Goose Lake, Jerry, Bull, Buena Vista and Goose Lake Sloughs at least 300 acres were covered by mounds built by digging out the low areas with digging sticks, carrying the dirt in baskets and piling it on high ground to make dry foundations for their houses [Latta 1977:71].

To test the hypothesis of a lakeshore occupation at Manifold, geomorphic data were required. A distinct shoreline should exhibit beachline and beach sand. A less distinct shoreline—perhaps due to the shallow topographic relief of the site area—may have fluctuated often, even seasonally, leaving little evidence of a distinct shoreline. We wondered whether stratigraphic profiles of the excavation units would show evidence of beach features and soils as well as soil mounding. If the mound was constructed, one might expect to see that the initial (basal) portion of the mound was of a noncultural soil, the same soil type as the area of the nearby low-lying areas (perhaps borrow pits). If clays and silts were mounded under the midden soils, it could indicate an artificial mound.

In addition, a number of areas of very dark soil are present on the site. The soil is so dark that it was originally thought that the midden may have been contaminated by petroleum and/or petroleum products (given its proximity to ARCO oil activities), altering not only the color of the soil but also its chemistry. To test this possibility, soil samples from several of the darkest midden areas were analyzed via gas chromatography/mass spectrometry (GC/MS) to determine the presence or absence of petroleum products.

Site Function and Chronology

Site function can be assessed in a number of ways, including documentation of: the presence of activity loci (e.g., lithic reduction areas, milling features); evidence of permanent, seasonal, or special purpose occupations, such as structures, middens, and/or large quantities of cultural materials; and the presence or absence of faunal and/or botanical remains to characterize resource exploitation and to determine what resources were available to the inhabitants. Site function may also be established by the presence/absence of burials or cremations and by the evaluation of potential trade items that could indicate interactions with other groups. When appropriate data are available, chronology can be established through multiple lines of evidence, including artifact typologies (e.g., projectile points, shell beads), radiocarbon assays, and obsidian hydration data.

Season of Site Occupation

To determine the season of occupation for the Manifold site, analysis of the faunal and botanical remains was conducted. Seasonality data from Manifold will be compared to such data from nearby contemporaneous sites so that existing or new settlement models may be tested.

Subsistence System

Subsistence systems include food, water, and the technology for obtaining and processing resources. Identification of resources is critical for the development of a subsistence model. Many resources in the Buena Vista Lake area appear to have been locally acquired, although some (e.g., obsidian, marine shell) were obtained from some distance. To explore this research issue, three general topics will be investigated: ecozone utilization, catchment zones, and food procurement and processing.

Ecozone Utilization

The Manifold site is located at the southern terminus of Buena Vista Slough. Assuming its ecological setting is similar to other sites in the region, any differences in adaptation could be due to a variety of factors, including temporal period(s) of occupation, seasonality of occupation, lake level during occupation, and/or cultural variation. Four major ecozones are found within the general area of the northwestern shore of Buena Vista Lake: (1) aquatic habitats (lake and slough); (2) Lower Sonoran Grassland; (3) Alkali Sink Association; and (4) Freshwater Marsh Association, which while currently almost nonexistent was much more widespread prehistorically. Each of these zones and their associated ecotones are within a short distance of the Manifold site. Determining which resources from each zone were utilized at the site by season and over time is one of the goals of this study.

Catchment Zones

Site catchment analysis attempts to predict where resources found at a site were obtained (Flannery 1976:103–104; Roper 1979; also see Sutton 1997). For hunter-gatherer groups, the primary catchment range is considered to encompass about a 5 km radius. The site catchment approach generally employs modern environmental data, a serious problem for the study of early sites due to the risks inherent in extrapolating modern data to ancient landscapes. Moreover, tule boats and/or rafts were known to have been used by the Tulamni to make waterways efficient highways of travel and transport.

Three general catchment zones (Figure 2) are delineated for this study. Catchment Zone 1 is defined as those areas within a 5 km radius of the Buena Vista-Kern Lake system. Within Catchment Zone 1, materials collected from at least three ecozones (aquatic, alkali sink, and grassland) and multiple ecotones would be expected. Access to Zone 1 would not require overnight stays. Catchment Zone 2 is the surrounding area within which an individual would likely have to camp overnight in order to procure resources. This zone would be limited almost entirely to grassland areas away from the Buena Vista Lake basin (e.g., upland areas). Catchment Zone 3 is defined as other regions at some distance from the site where the most logical way in which resources were obtained was by trade (e.g., lake fish traded for Pacific coast shell).

Obsidian is one of the primary trade items identified in the area. Most of the obsidian has been sourced to the at the northern extent of the Mojave Desert. This pattern has been observed at a number of sites dating to the Middle Archaic, Upper Archaic, and Emergent period. Other obsidian sources represented

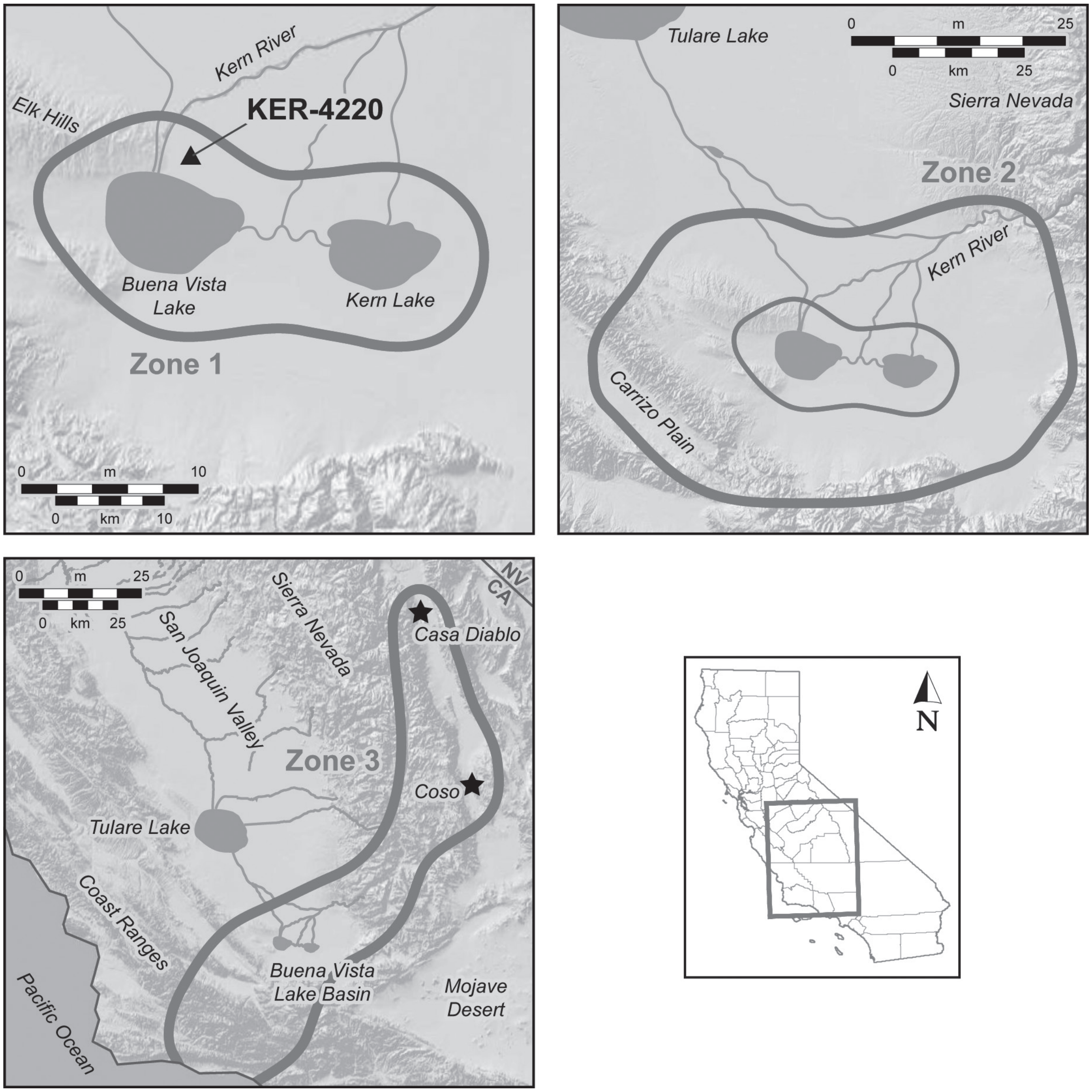


Figure 2. Catchment zones of the Manifold site (CA-KER-4220; from Sutton 1997:Figure 2).

in the archaeological record of the lake basin are Casa Diablo, Queen, Fish Springs, Obsidian Butte, and Truman Meadows (see Sutton and Des Lauriers 2002). Obsidian hydration and/or source data have been obtained at several sites in the Buena Vista Lake region and the Elk Hills (e.g., Hartzell 1992; Jackson et al. 1998; Culleton et al. 2005; also see Sutton and Des Lauriers 2002).

Food Procurement and Processing

The identification and quantification of faunal and botanical materials from the Manifold site are necessary to ascertain the patterns of processing (e.g., butchering techniques), preparation (e.g., cooking techniques), and consumption (e.g., disposal practices) of food sources. Large mammals may have been killed and butchered elsewhere with few faunal elements carried back to the site (the schlepp effect) (Daly 1969). Highly fragmented remains, which are a common occurrence at sites in the region, may hinder identification but may also reflect extreme processing methods and/or taphonomic processes. Patterns of animal processing techniques (such as butchering) can be quite informative regarding resource use, levels of resource stress, and cultural preference. An analysis of the types and diversity of the faunal and botanical remains recovered from the Manifold site can help determine resource availability and abundance.

Whether from lakes or sloughs, the species and quantity of fish remains and their season of capture—winter/spring, when the river is usually flowing with cooler water, or summer/fall, when river flow is reduced and the lake water is warmer—could indicate exploitation of specific habitats. The recovery of fish otoliths and vertebrae is particularly important because they are frequently recovered as complete specimens and may be analyzed to assess the species, age, size, and season of death of individual fish; they may also assist in determining water temperature (see Casteel 1976:31; Wheeler and Jones 1989:145, 158; Colley 1990:214).

Ethnic Identity of the Manifold Site Inhabitants

Ethnographic data (briefly outlined above) demonstrate that the Buena Vista Lake basin was inhabited by the Southern Valley Yokuts (specifically the Tulamni along the northwestern shore of the lake), but it remains unclear how long they occupied the area (Moratto 1984:571–573). It is possible that older sites were occupied by other groups. Powers (1877:369–370) suggested that the "Paiuti" attacked the Yokuts and occupied much of the southern San Joaquin Valley in fairly recent times. These attacks were so severe that the Yokuts "as a geographically solid body of allied tribes, were cut in two in one place and nearly in another" (Powers 1877:369). The Paiute seized territory along the Kern and White rivers, Poso Creek, and Kern Lake, "thus completely severing the Yokuts nation" (Powers 1877:369). As such, it is not necessarily a given that the inhabitants of the site were Yokuts.

Role of the Manifold Site Within the Regional Settlement System

Every site within a specific region represents a segment of a settlement pattern for a particular period of time. Determining the role of a site in such a system is difficult at best since the function, chronology, seasonality, ethnicity, and other aspects of a site must be assessed to place it within a system model. It is also necessary to identify other sites and place them in their proper position within the system. Once that is accomplished, a model of regional settlement may be proposed.

Site Location and Description

The Manifold site was recorded by Doug Manifold, a former CSUB student and ARCO employee at the time. The site is a long, low mound on the northwest margin of Buena Vista Lake (Figure 3). The mound is approximately 300 by 120 m in area (about 36,000 m^2) and perhaps less than 1 m in height. It is generally east–west trending and contains extremely dark-colored soil and a considerable number of surface artifacts, including flaked and ground stone tools, shell and stone beads, and faunal remains (almost exclusively fish bones and *Anodonta* shell). The crest of the site is at an elevation of 300 ft.

At the time of the initial fieldwork in 1995, the site appeared to be largely intact with only minor damage. No previous archaeological work had been undertaken, and only two small vandal pits were evident. Construction of a dirt road along the southern edge of the site had impacted its far eastern tip, and a narrow north–south path had been bladed through its western portion to lay a small-diameter pipe.

Field Methods

In 1995 two concrete datums (labeled A and B) were set, and the site was mapped using a transit and stadia rod. Diagnostic or other "interesting" items observed on the surface (including surface shell features; see below) were mapped and collected. Finally, four 1 x 2 m test units (TUs) were excavated. In addition, photographs were taken of the TUs, level notes were completed, wall profiles were drawn for all four units, and one column sample (20 x 20 x 10 cm; volume = 6,400 ml) from the northwest corner of TU-1 was collected.

The TUs were all oriented north/south, were excavated in arbitrary 10 cm levels using the highest corner as the unit datum, and were backfilled upon completion of the excavations. The ease of excavation ranged from good to very difficult depending on the consistency of the soil, much of which was hard-packed clay. Where possible, unit soils were screened through 1/8-inch mesh on site. If the soil was too heavily compacted, it was bagged and brought to the CSUB laboratory for wet screening through 1/8-inch mesh.

TU-1 was placed directly south of Datum B at the western end of the site. It was excavated to a depth of 70 cm. Vertebrate and invertebrate faunal remains were found throughout the unit, and cultural materials were recovered to a depth of 30 cm. Due to the contour of the terrain within TU-1, the first 10 cm only extended to about three-quarters of the unit. An auger hole was excavated in the center of the unit from 70 to 100 cm in 10 cm increments.

TU-2 was placed about 30 m northeast of Datum B and was excavated to a depth of 30 cm. A charcoal lens covered the south end of the basal level. Vertebrate and invertebrate faunal remains were found in the first two levels in small quantities, but only one artifact (an *Olivella* bead) was recovered (at 0 to 10 cm). Very compacted soil emerged at about 20 cm that made excavation very difficult, so coupled with the fact of a dearth of cultural materials, the decision was

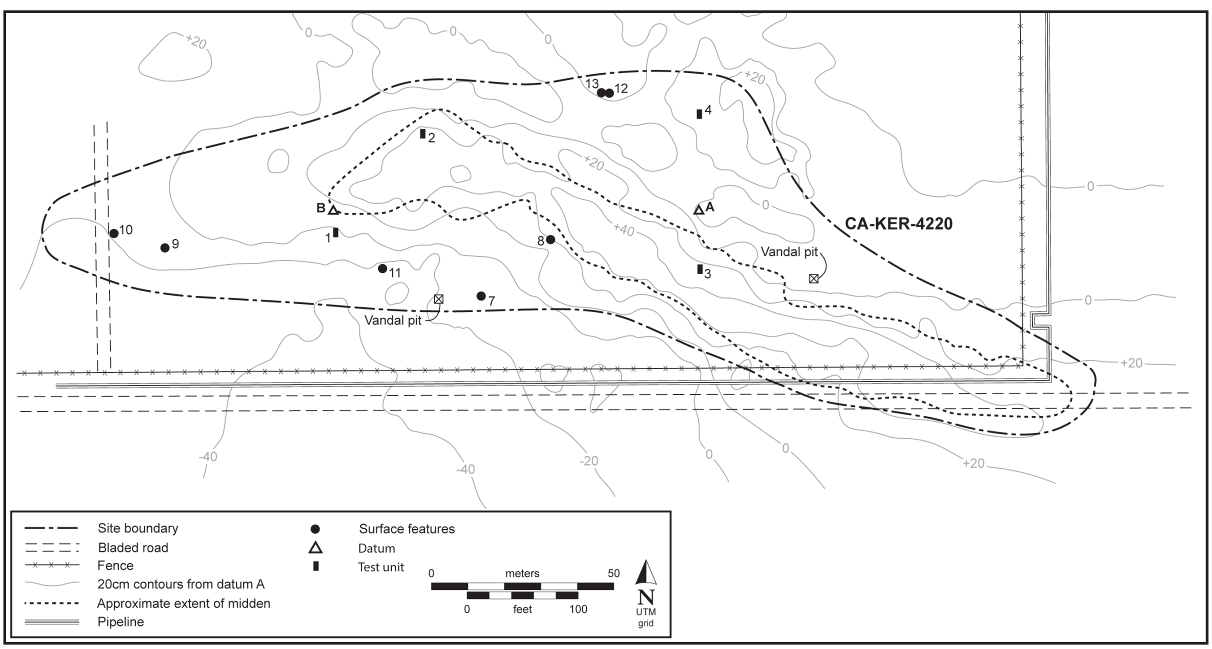


Figure 3. Map of the Manifold site (CA-KER-4220).

made to terminate the unit at 30 cm. Two soil samples were taken from the top 10 cm.

TU-3 was placed about 15 m south of Datum A and was excavated to a depth of 90 cm. Some bioturbation (rodents, insects, roots) was evident in the unit. Five dense, oval-shaped shell concentrations were documented in TU-3 (see below), and a possible posthole was discovered at 30 to 40 cm in the southwest quarter of the unit. This putative posthole measured 8.0 x 8.5 cm in diameter and contained charcoal-colored soil along its perimeter and light brown soil in its center. It is possible that it merely represents a rodent burrow. Vertebrate and invertebrate faunal remains were recovered throughout the unit, and cultural materials were found to a depth of 60 cm.

TU-4 was placed about 20 m north of Datum A and was excavated to a depth of 60 cm. Insect burrows were scattered throughout the unit. Vertebrate and invertebrate faunal remains, as well as cultural materials, were found in most levels. A heavy concentration of *Anodonta* shell (Feature 6) emerged at 30 cm and extended into the west wall. At 40 cm, excavation continued only in the north half of TU-4 due to the virtual absence of cultural materials, and the unit was terminated at 60 cm. An auger hole was excavated to 100 cm to test for additional subsurface materials, but none were found. Bulk soil samples were taken from each stratum in the unit for laboratory processing.

Laboratory Methods

In the CSUB archaeology laboratory the materials collected from the screens were washed (when necessary), sorted into specific categories, and catalogued. All materials were catalogued by provenience (i.e., surface, unit, level) and given consecutive numbers. Formed artifacts were individually catalogued, while lithic debitage was catalogued by material. Faunal remains were separated by material and/or species and weighed.

In order to ascertain the types of materials that may have been missed in the 1/8-inch mesh screens and to provide information on the microcomposition of the site soils, the column sample taken from TU-1 was catalogued (weight and volume), and 50 percent of the sample was processed. These samples were processed through No. 40 mesh screen. In addition, two small soil samples were taken from the first 10 cm of TU-2 for processing. Additional small soil samples were retrieved and processed from Strata A, B, C, D, and E of TU-4, but nothing was found in these samples.

The soils from both the surface and subsurface shell features (see below) were removed almost in their entirety and transported to the laboratory for processing. The smaller samples from Features 8, 11, 12, and 13 were analyzed at the laboratory in 2004 and were screened through 1/8-inch mesh. The larger bulk soils from Features 1, 2, 4, 5, 6, 7, 9, and 10 were processed off-site in 2014, at which time they were washed in a 5-gallon bucket through 100 percent cotton natural cheesecloth (high-quality, dense weave). All the materials that were processed in 2004 and 2014 were examined under magnification, and the recovered items were identified and placed in vials. Finally, the auger soil samples from TU-1 were also examined in 2014. Nothing was found in any of the auger samples from this unit.

Results of the Excavations

The following sections discuss the excavation results at Manifold. The discussion includes details regarding stratigraphy and soils, features, and material culture. Also included are the results of the faunal, botanical, and debitage analyses, gas chromatography/mass spectrometry testing, and dating.

Stratigraphy and Soils

The stratigraphy at Manifold was variable across the site, due partly to disturbances such as road construction and pipeline installation. The deposit had been bioturbated by insects and other small animals (see Figures 4 through 7). Seven soil strata were identified, and each is described below. All Munsell values were taken from dry soil.

Stratum A is the uppermost stratum and consists of slightly compacted sandy silt in TUs 1, 2, and 3 and hard compacted silt in TU-4. In TUs 1, 2, and 4, the Munsell value was 10YR 6/2 (light brownish gray), while in TU-3 the Munsell value was 10YR 7/1 (light gray). The thickness of this stratum in TU-1 ranges between about 10 cm at the south end of the unit to about 55 cm at the north end. In TU-2, Stratum A has a consistent thickness of about 12 to 13 cm. The thickness of this stratum in TU-3 ranges widely across the unit, from about 10 to 30 cm. In TU-4, the thickness of Stratum A ranged between about 5 and 10 cm. Faunal remains and cultural materials were recovered consistently, although mostly in small quantities, throughout the TUs in this stratum.

Stratum B contains slightly to moderately compacted soils, although the soil types vary by unit. In TU-1 it is fine, sandy clay with a Munsell value of 10YR 4/2 (dark grayish brown). This stratum only appears at the south end of TU-1 and ranges in thickness between about 5 and 15 cm. In TU-2 the soil is a sandy, dark, greasy midden with a Munsell value of 10YR 4/2 (dark grayish brown). The thickness of Stratum B in TU-2 ranges between about 3 and 10 cm. The soil in TU-3 within Stratum B is quite distinct from the other three units as it contains black midden soil with abundant *Anodonta* shell and has a Munsell value of 10YR 4/1 (dark gray) to 10YR 2/1 (black). In TU-3 the thickness of this stratum ranges between about 10 and 30 cm with several small pockets intruding into Stratum A. The Stratum B soil in TU-4 is slightly

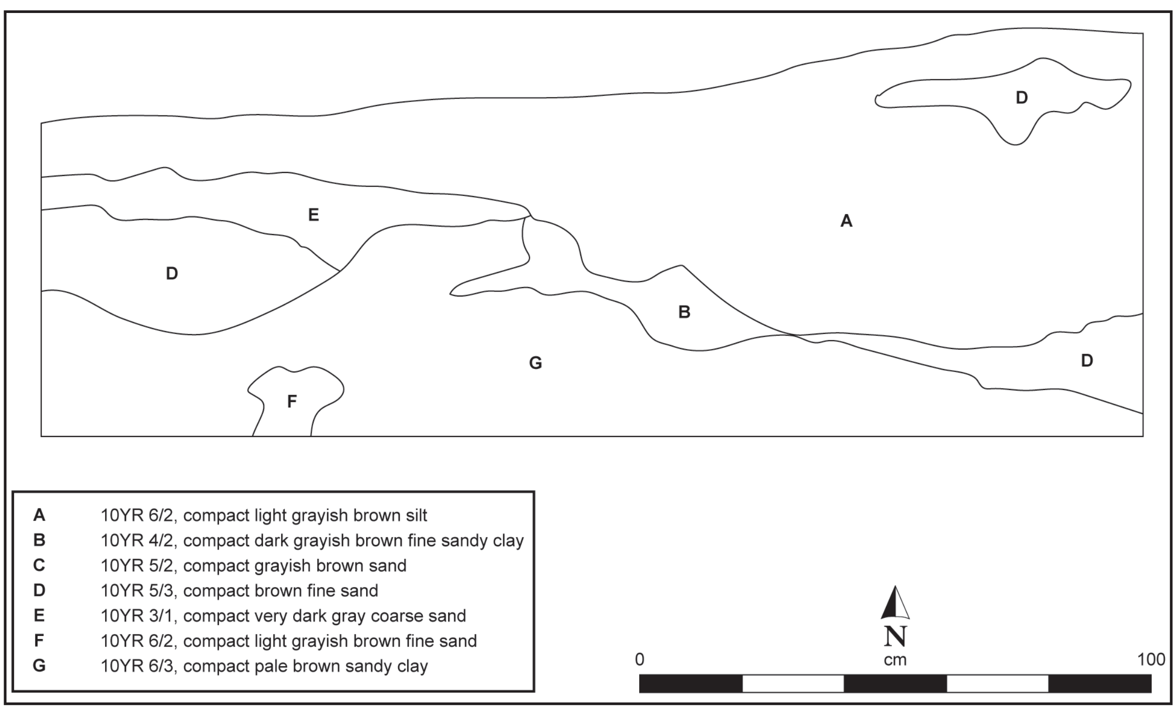


Figure 4. Soil profile of the west wall of TU-1 at the Manifold site (CA-KER-4220).

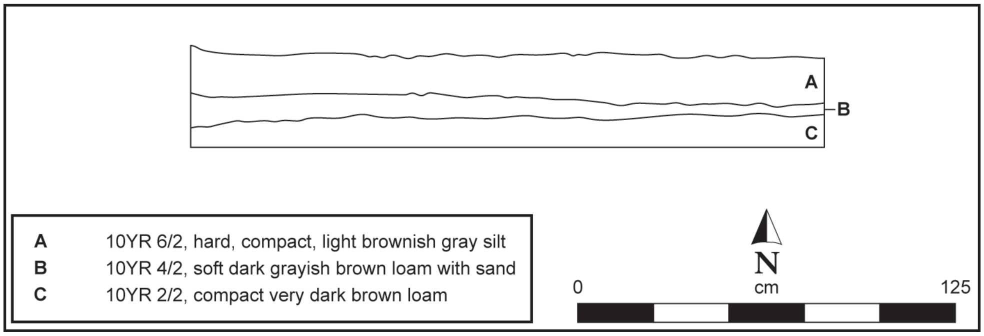


Figure 5. Soil profile of the west wall of TU-2 at the Manifold site (CA-KER-4220).

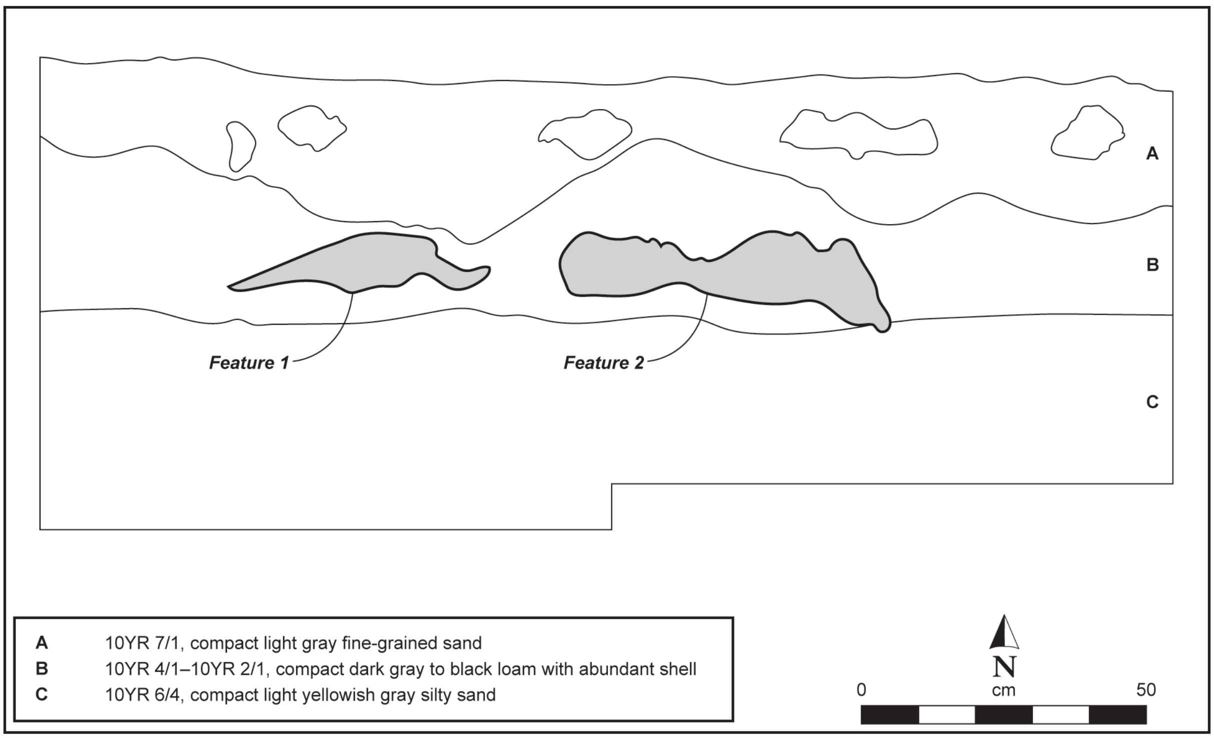


Figure 6. Soil profile of the west wall of TU-3 at the Manifold site (CA-KER-4220).

different from the others in that it is a friable soft loam with a Munsell value of 10YR 5/2 (grayish brown). The thickness of this stratum in TU-4 ranges between about 5 and 10 cm. As with Stratum A, faunal remains were recovered fairly consistently in small quantities throughout the TUs in this stratum, although most of the cultural materials came from TU-3. Within Stratum B and continuing into Stratum C were the subsurface *Anodonta* shell features from TU-3 (discussed below), which likely accounts for the variable Stratum B thickness.

In Stratum C the soil types and consistency also vary by unit. In TU-1 the soil in this stratum is very fine sand with a Munsell value of 10YR 5/2 (grayish brown). This stratum is limited to two small pockets at the north end of the unit and ranges in thickness between about 3 and 20 cm. The soils in TU-2 within

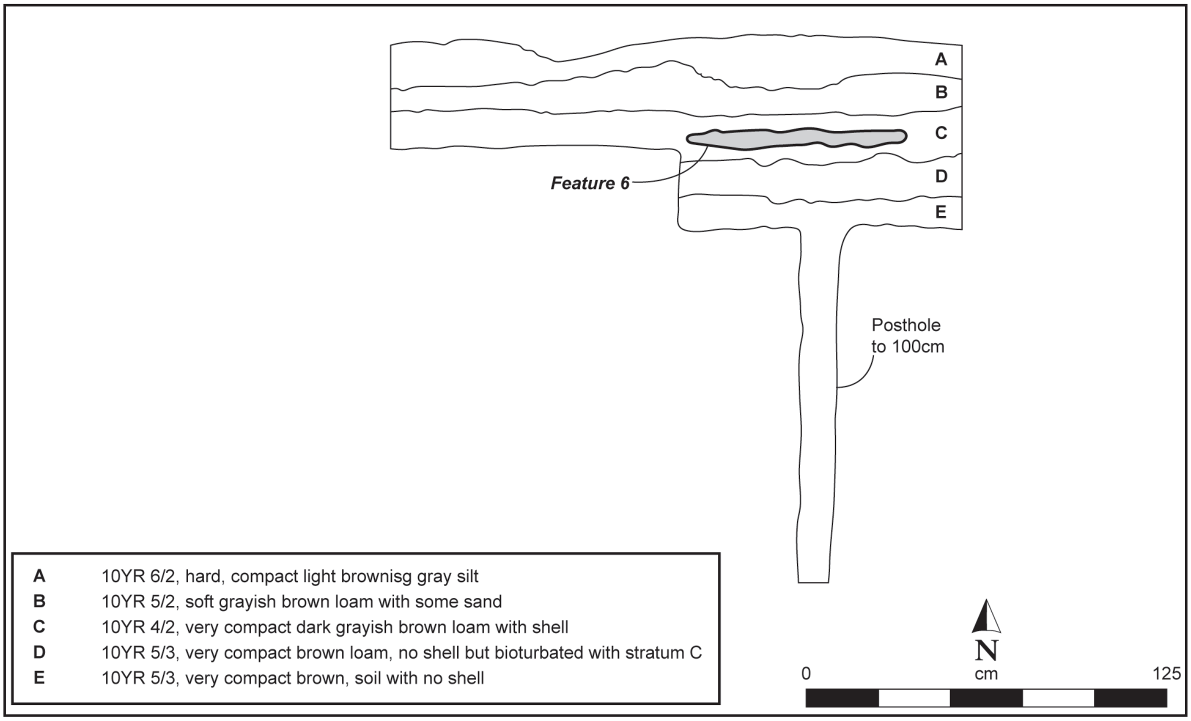


Figure 7. Soil profile of the west wall of TU-4 at the Manifold site (CA-KER-4220).

this stratum are silty loam with a Munsell value of 10YR 2/2 (dark grayish brown), and the thickness ranges between about 6 and 12 cm. In TU-3 the soils in this stratum are extremely fine, silty sand with a Munsell value of 10YR 6/4 (light yellowish brown). Stratum C in this unit ranges in thickness between about 30 and 40 cm. TU-4 soils are very compact and dark with a Munsell value of 10YR 4/2 (dark grayish brown). The thickness of this stratum in TU-4 ranges between about 10 and 15 cm. Faunal remains were found throughout all the TUs in Stratum C, but there were very few cultural materials.

Stratum D was identified only in TUs 1 and 4. Both contain Munsell values of 10YR 5/3 (brown). Toward the bottom of this stratum in TU-4, the soil becomes very compact and sterile, with a Munsell value of 10YR 5/4 (yellowish brown). In TU-1 Stratum D is restricted to a single pocket at the south end of the unit and ranges in thickness between about 3 and 20 cm. In TU-4 the thickness of this stratum is about 10 cm. Very small quantities of faunal remains and cultural materials were found in this stratum.

Stratum E was also identified only in TUs 1 and 4. In TU-1 the soil is coarse, sandy clay with a Munsell value of 10YR 3/1 (very dark gray), and it is limited to a single pocket ranging in thickness from about 3 to 15 cm. In TU-4 the soils are hard, compacted, and sterile with a Munsell value of 10YR 5/4 (yellowish brown). Stratum E forms the base of TU-4 and extends from about 30 cm to the bottom of the auger hole at 100 cm. Few faunal remains and no cultural materials were recovered from this stratum.

Strata F and G were identified only in TU-1. The soils in Strata F are fine sand with a Munsell value of 10YR 6/2 (light brownish gray), while the soils in Strata G are very fine, sandy clay with a Munsell value of 10YR 6/3 (pale brown). Stratum F is limited to one small pocket at the base of the unit near the south end that is roughly 15 x 10 cm in size. Stratum G forms the base of TU-1 and ranges widely in thickness between about 5 and 40 cm. Few faunal remains and no artifacts were found in this stratum.

Features

Twelve features were documented, four from TU-3 (between 30 and 50 cm), one from TU-4 (at 30 to 40 cm), and seven on the surface. Feature 3 was originally thought to be a single feature within TU-3 (see Figure 8), but upon further excavation it was determined to be two separate features, which were then designated Features 4 and 5. As such, Feature 3 does not exist, and there are no data specifically related to it. All these features appear to be intentional shell dumps, and each is described below.

Subsurface Shell Features

Feature 1

This feature was partially within the west wall of TU-3 (see Figures 8 through 11) and contained very dark midden soil. Other than one fire-affected rock and a small amount of unidentified botanical material, the constituents of this feature consisted entirely of *Anodonta* shell and faunal bone. The bones were mostly fish vertebrae along with elements from western pond turtle (*Actinemys marmorata*) and small, medium, and large mammals. Many of these bones were burned.

Feature 1 contained the burned bones of at least two different vertebrates (mammal and turtle) that were recovered from the shell matrix. Since the shell features in TU-3 undoubtedly represent a single event, the assumption was made that the bones and shell would be of the same age. With that in mind, the specimens were collected with great care in anticipation of submitting them for radiocarbon assay to provide a

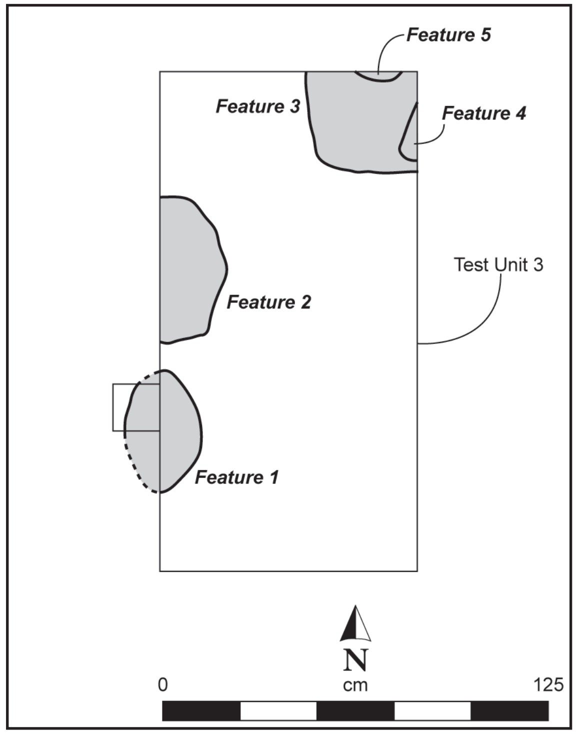


Figure 8. Plan view map of Features 1 through 5 in TU-3 at the Manifold site (CA-KER-4220). As noted in the text, Feature 3 was determined to be two separate features that were designated Features 4 and 5, and Feature 3 was eliminated.

much-needed correction factor for dating freshwater shell in the lower Kern River/northern Buena Vista Lake region. To that end, three samples consisting of a turtle carapace, a large mammal long bone fragment, and *Anodonta* shell from the feature were submitted for radiocarbon analysis.

The turtle carapace returned a date of 2010 ± 40 RCYBP, calibrated between 2000 and 1900 cal BP; the large mammal bone fragment returned a date of 2030 ± 40 RCYBP, calibrated between 2010 and 1930 cal BP; and the *Anodonta* shell returned a date of 2320 ± 50 RCYBP, calibrated between 2350 and 2330 cal BP. Assuming that all three animals died at the same time, the *Anodonta* dates about 300 years older, indicating a freshwater shell correction factor of minus 300 years (Sutton and Orfila 2003; also see Culleton 2006).

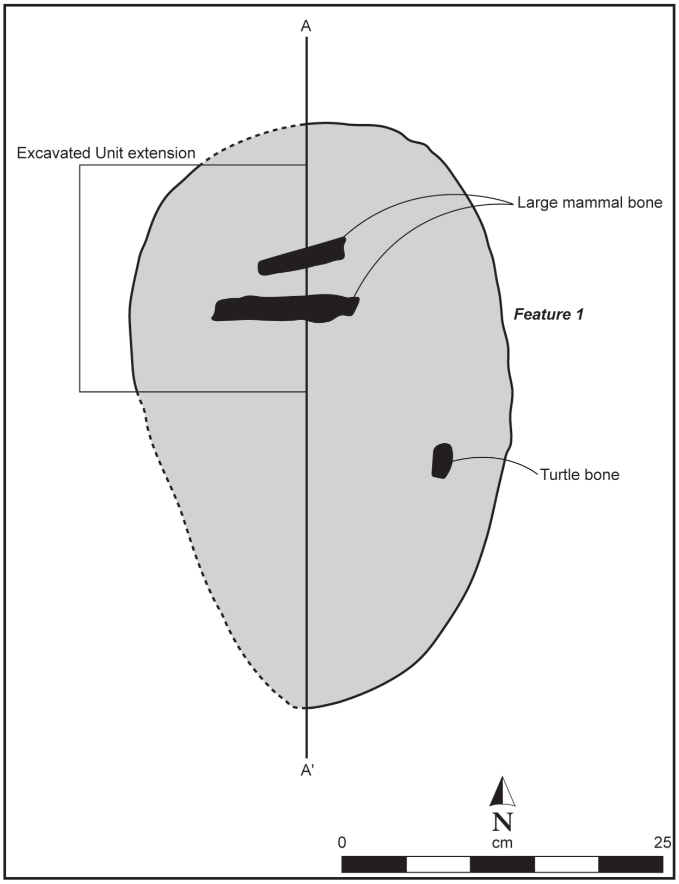


Figure 9. Plan view map of Feature 1 at the Manifold site (CA-KER-4220).

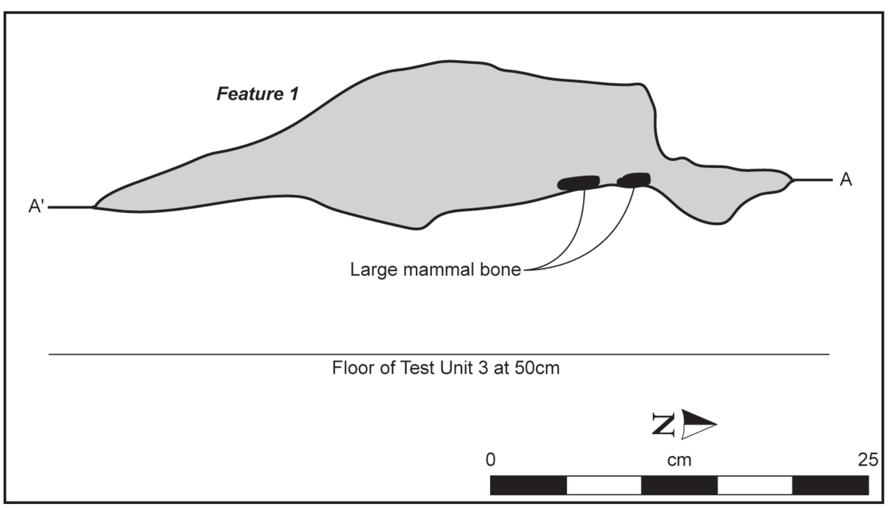


Figure 10. Profile view map of Feature 1 at the Manifold site (CA-KER-4220).

Figure 11. Photograph of Feature 1 at the Manifold site (CA-KER-4220).

Feature 2

Feature 2 (Figure 12) was also partially within the west wall of TU-3. It contained dark soil and consisted of *Anodonta* and fish bones (many burned). No artifacts were identified within it.

Feature 4

Feature 4 (Figure 13) was discovered in the northeast quadrant of TU-3 and was partially within the east wall. It consisted of very dark midden soil containing *Anodonta*. No artifacts were identified within it.

Feature 5

This feature (see Figure 13) was identified in the far northeast portion of TU-3, partly within the north wall. It contained very dark midden soil and *Anodonta* shell, but no cultural materials. A bulk sample of the midden soil (69.4 g) was retrieved and retained without processing for potential future study.

Feature 6

This feature (Figure 14) was a shell concentration in the northwest portion of TU-4 at 30 to 40 cm. A burned mano fragment (Cat. No. 435) was discovered either within or possibly on top of the feature, but no other cultural materials were identified.

Surface Shell Features

Numerous discrete piles of highly fragmented, densely compacted, and burned *Anodonta* shell discernible on the surface were not directly associated with any test units (see Figure 3). These shell piles were all relatively small and appeared to have been dumped from a container. We interpret these features as representing the disposed remnants of cooked meals.

Seven of these surface shell dumps (Features 7–13) (Table 2; Figures 15–18) were judgmentally selected for further investigation based on size, location, visual integrity, and/or the presence of associated dark soil. Each of the seven features was mapped, sketched, and photographed, and samples were recovered for processing.

Feature 7

This feature was southeast of Datum A, near the western edge of the visible midden (Figure 15). Its dimensions were approximately 24 x 14 cm. Two soil samples with a combined volume of 200 ml were collected. The constituents of Feature 7 consisted of *Anodonta* shell and fish bone, almost all of which was burned. One small obsidian flake (Cat. No. 007B-007) was found in the feature. One radiocarbon specimen containing *Anodonta* shell returned a date of 1090 ± 40 RCYBP, corrected to 790 ± 40 RCYBP and calibrated to between 1050 and 950 cal BP.

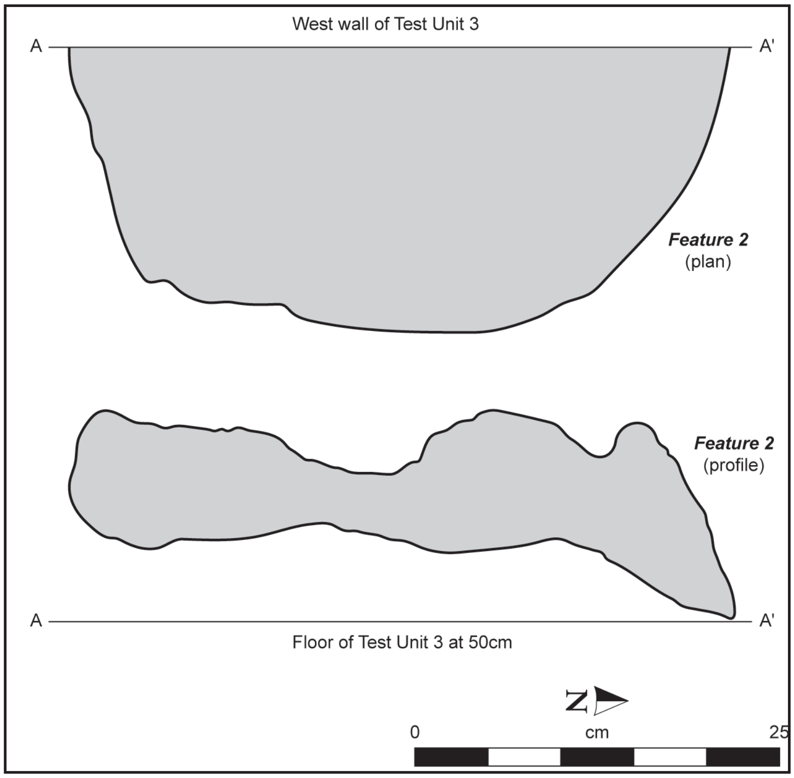


Figure 12. Plan and profile maps of Feature 2 at the Manifold site (CA-KER-4220).

Feature 8

Feature 8 was located southeast of Datum A, just east of Feature 7 (see Figure 16). The size of this feature was about 22 x 18 cm and had no associated blackened soil. As with Feature 7, two soil samples (combined volume of ca. 200 ml) were collected from each end. Feature 8 contained *Anodonta* shell and one unburned snake vertebra; no cultural materials were identified. One sample of *Anodonta* was submitted for radiocarbon assay. The sample returned a date of 1110 ± 40 RCYBP, corrected to 810 ± 40 RCYBP and calibrated to between 1060 and 960 cal BP.

Feature 9

This feature was west of Datum A on the edge of a small gully near one of the pipelines (see Figure 17). The dimensions of Feature 9 were approximately 34 x 22 cm. Its eastern end became less discernible due to erosion, so it is unclear whether it had originally extended beyond and was partially washed down the gully. There was no heavily darkened soil associated with this feature. Two soil samples with a combined volume of 250 ml were retrieved. Feature 9 contained a relatively small quantity of *Anodonta* shell and nothing more. The shell sample was submitted for radiocarbon assay, which returned a date of 1170 ± 40 RCYBP, corrected to 870 ± 40 RCYBP and calibrated to between 1160 and 1050 cal BP.

Feature 10

This feature was also west of Datum A, just north of Feature 9. It was discovered on the surface of the blade cut associated with the road construction but was originally about 10 to 15 cm below the surface. Feature 10 measured about 10 x 12 cm but was likely larger prior to the road blading. The soil in direct association with the feature was very dark. One soil

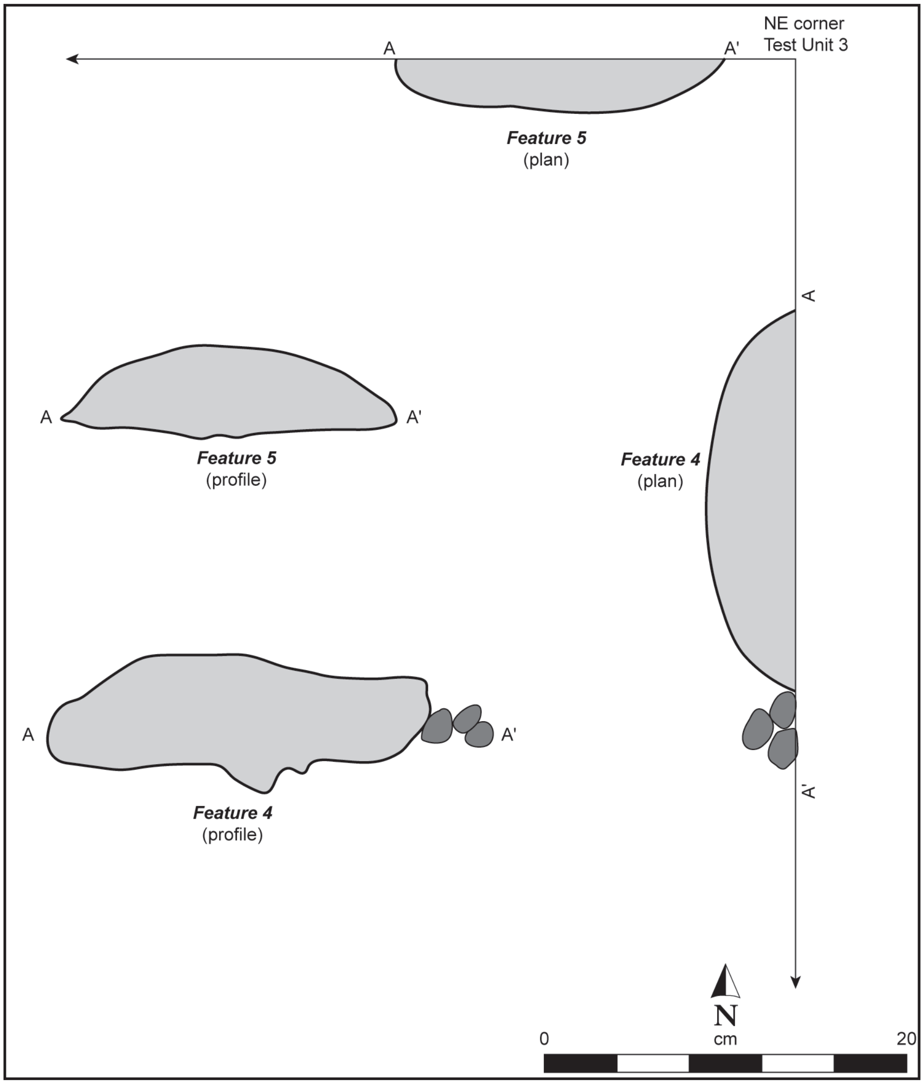


Figure 13. Plan and profile maps of Features 4 and 5 at the Manifold site (CA-KER-4220).

sample with a volume of 100 ml was collected from this feature. The feature consisted solely of *Anodonta* shell, a sample of which was submitted for radiocarbon assay. The sample assay returned a date of 1610 ± 40 RCYBP, corrected to 1310 ± 40 RCYBP and calibrated to between 1470 and 1430 cal BP.

Feature 11

Feature 11 was southeast of Datum A, immediately adjacent to the westernmost edge of the midden. It measured about 18 x 20 cm and contained a small quantity of *Anodonta* shell but no other faunal remains or cultural materials. Two soil samples with a combined volume of almost 100 ml were taken from the north and south halves of the feature. No specimens were submitted for radiocarbon assay.

Feature 12

Feature 12 was northwest of Datum B and north of the visible midden. Its dimensions were approximately 26 x 22 cm, and there was no obviously darkened soil associated with it. Two samples were taken from

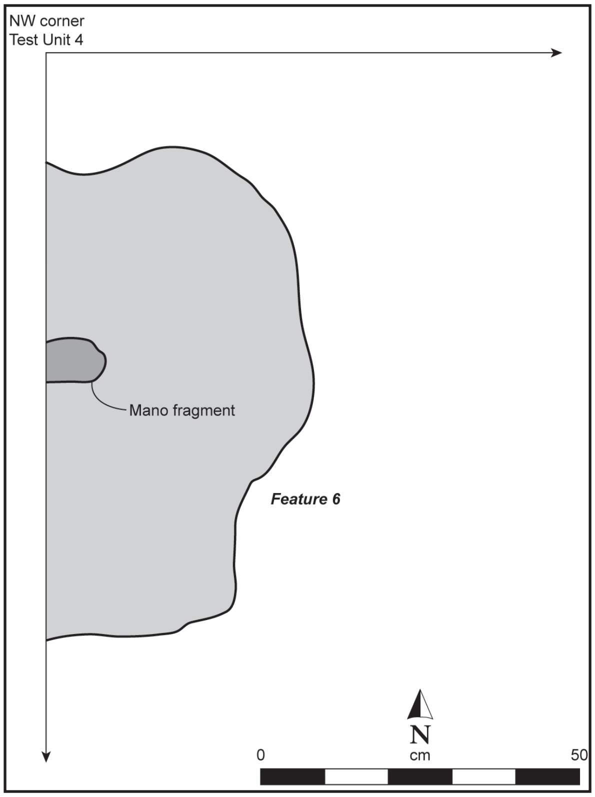


Figure 14. Map of Feature 6 at the Manifold site (CA-KER-4220).

the feature, for a combined volume of 575 ml. The feature consisted entirely of *Anodonta* shell, a sample of which was submitted for radiocarbon assay. The sample assay returned a date of 4050 ± 40 RCYBP, corrected to 3750 ± 40 RCYBP and calibrated to between 4480 and 4440 cal BP.

Feature 13

This feature was also northwest of Datum B, just north of Feature 12 (see Figure 18). It measured about 24 x 22 cm, and there did not appear to be any blackened soil within it. Two samples were collected from the feature from its north and south ends. The combined volume of the samples was 450 ml. With the exception of a granitic rock with crystalline inclusions (which does not appear to be cultural), the contents of Feature 13 consisted of almost 700 g of *Anodonta* shell. A sample was submitted for radiocarbon assay, which returned a date of 4030 ± 40 RCYBP, corrected to 3730 ± 40 RCYBP and calibrated to between 4540 and 4430 cal BP.

Material Culture

Artifacts from the site surface, the TUs, and the column sample include flaked and ground stone tools, shell and stone beads, awls, a charmstone, and miscellaneous items. Other than the mano fragment from Feature 6 (Cat. No. 435) and the small obsidian flake from Feature 7 (Cat. No. 007B-007), no other artifacts were recovered from either the surface or subsurface features. The vast majority of artifacts were found on the surface. The level bags for the top 20 cm of TU-3 went missing from the collection subsequent to being catalogued, and consequently none of the items from these levels could be double checked for the accuracy of their descriptions in the catalogue or to fill in any missing data.

Ground Stone Artifacts

Forty-one ground stone fragments were collected, 38 from the site surface and three from the TUs (Table 3). These include two metate fragments, one possible metate fragment, 12 mano fragments, three possible mano fragments, two pestle fragments, six steatite bowl fragments, one charmstone fragment, and 14 unidentified fragments.

Metate and Mano Fragments

Three metate fragments were found on the surface. All are granitic, burned, and too small to classify to type (e.g., Adams 2014). Fifteen mano fragments were also recovered, 14 from the surface and one from Feature 6 (Cat. No. 435; Figure 19a). Of these 15 specimens, 13 are granitic, one is sandstone, and one is rhyolite. With the exception of Cat. No. 076, all the mano fragments are burned, and most are too small to determine their original shape.

Table 2. Attributes of Surface Shell Dump Features at the Manifold Site (CA-KER-4220).

Surface Feature No.	Dimensions (cm)	Cat No.	Soil Samples	Materials Recovered	Comments
7	~24 x 14	007	A, 100.0 ml, 57.0 g	*Anodonta* shell	from north half of feature
			B, 100.0 ml, 72.0 g	*Anodonta* shell, 13 fish bones, 1 obsidian flake	from south half of feature, subsample sent for radiocarbon assay
8	~18 x 20	008	A, 100.0 ml, 61.0 g	*Anodonta* shell, 1 snake vertebra	from north half of feature
			B, 100.0 ml, 93.0 g	*Anodonta* shell	from south half of feature, subsample sent for radiocarbon assay
9	~20 x 24	009	A, 100.0 ml, 82.0 g	*Anodonta* shell	from north half of feature
			B, 150.0 ml, 111.0 g	Anodonta shell	from south half of feature, subsample sent for radiocarbon assay
10	~10 x 12	010	A1 and A2, 100.0 ml, 56.0 g	*Anodonta* shell	from center of feature, subsample sent for radiocarbon assay
11	~16 x 20	518	A, 25.0 ml, 24.0 g	*Anodonta* shell	from north half of feature
			B, 72.0 ml, 69.0 g	*Anodonta* shell	from north half of feature
12	~24 x 22	005	A, 300.0 ml, 308.0 g	*Anodonta* shell	from north half of feature
			B, 275.0 ml, 288.0 g	*Anodonta* shell, 23 fish bones	from south half of feature, subsample sent for radiocarbon assay
13	~24 x 22	006	A, 200.0 ml, 133.0 g	*Anodonta* shell	from north half of feature
			B, 250.0 ml, 206.0 g	*Anodonta* shell, granitic rock (possibly noncultural)	from north half of feature, subsample sent for radiocarbon assay

Notes: Total *Anodonta* weight in surface features = 1,560.0 g. All soil samples from the surface shell dump features were screened through Nos. 10 and 35 mesh, and all were washed in distilled water and stored in foil. Refer to Table 18 for radiocarbon results.

Pestle Fragments

Two pestle fragments were recovered from the surface, and both are distal end pieces. Cat. No. 351 (Figure 19b) is the end of a highly polished, longitudinally split fragment with well-shaped margins. It is burned completely black. Cat. No. 383 is also the end of a polished, longitudinally split, well-shaped fragment that is slightly burned.

Stone Bowl Fragments

Six small steatite bowl fragments were retrieved from the site, five from the surface and one from TU-1 (0–10 cm). These fragments are too small to determine original bowl shapes. One surface specimen is a rim fragment (Cat. No. 186), and the specimen from TU-1 (Cat. No. 200) is a body sherd with a hole drilled from both sides that may represent an attempted repair. All the bowl fragments are partially burned.

Charmstone Fragment

A fragment of a possible charmstone (Cat. No. 189) (Figure 19c) from the surface is a small, elongate granite piece that is highly polished and burned. Charmstones are plummet-shaped stones sometimes found in central California (e.g., Gifford and Schenck 1926; Wedel 1941; Elsasser and Rhode 1996; Sutton 1996; Sharp 2000). They are often perforated and/or grooved, although there is no evidence of such modification on this specimen. While their purpose is uncertain, charmstones are typically considered to have some religious, ritual, or functional use, such

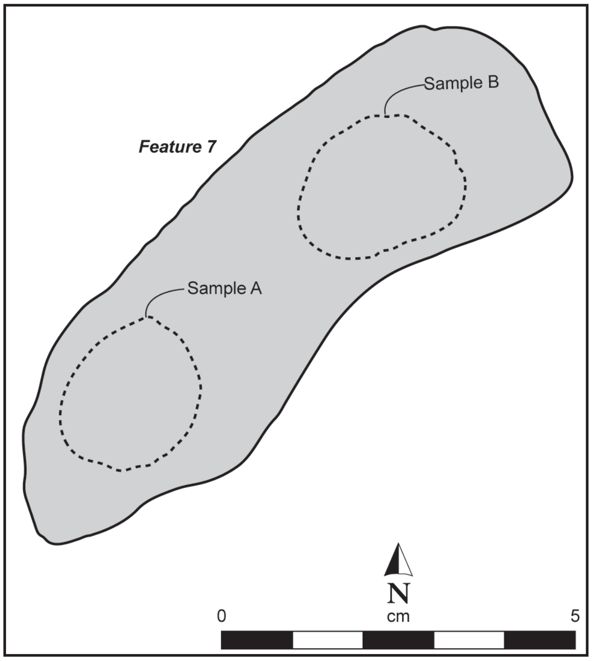


Figure 15. Map of Feature 7 at the Manifold site (CA-KER-4220).

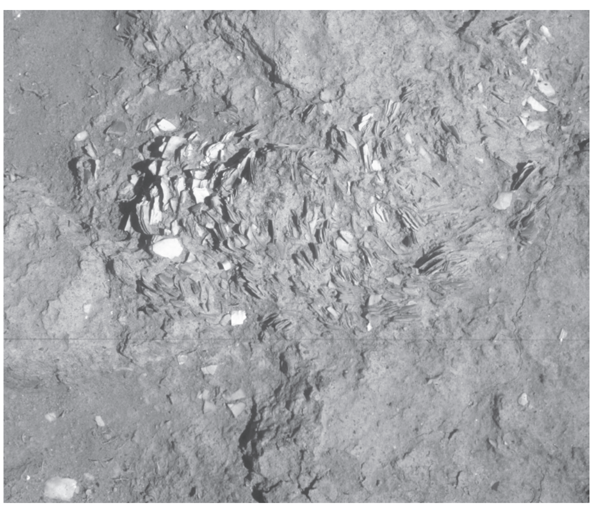


Figure 16. Photograph of Feature 8 at the Manifold site (CA-KER-4220).

as influencing weather or hunting success, serving medicinal purposes, and functioning as fishing net weights (Kroeber 1925; Barrett and Gifford 1933; Gayton 1948; Latta 1977; Sutton 1996; Sharp 2000).

Unidentified Ground Stone

Fourteen unidentified ground stone fragments were also recovered, 13 from the surface and one from TU-3 (10–20 cm). Of the 13 surface specimens, eight are granitic, two are sandstone, one is rhyolite, one is quartzite, and one is steatite. Cat. No. 129 may be part of a mano, but no determination could be made regarding the function or original shape of the other fragments.

Discussion of Ground Stone Artifacts

Ground stone artifacts recovered from the Manifold site include metates, manos, pestles, bowls, a charmstone, and unidentified fragments. The use of manos and metates has typically been associated with the processing of small seeds, while pestles (along with mortars, which were not identified at the site) are generally associated with the processing of larger resources such as acorns. Both of these technologies were also likely used to process small animals (see Yohe et al. 1991). Since no identifiable botanical remains were recovered and no protein residue analysis was performed, it could not be determined which plants or animals may have been processed with these tools. Nevertheless, given the highly fragmentary nature of the majority of the remains (except the fish vertebrae), it is likely that at least some small animals were so processed.

One of the interesting results of the excavations is that no complete milling tools were recovered, and almost all the fragments are so small that in most cases their original morphologies could not be determined. While this may be due to the collection methodology, it may also be the consequence of taphonomic and/or cultural processes. With one exception, all the ground stone artifacts were burned to some degree (some completely black). Stone artifacts typically preserve better in archaeological deposits than those made of bone or wood, but even stone decomposes and erodes given enough time, especially when

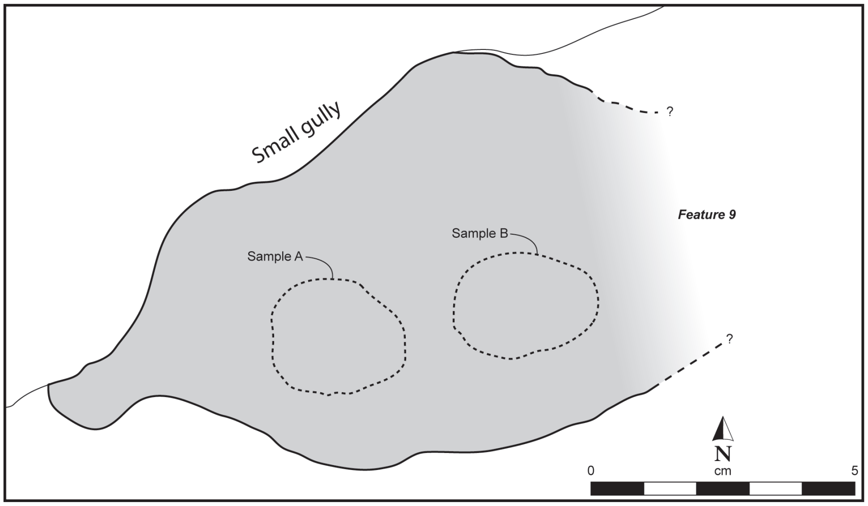


Figure 17. Map of Feature 9 at the Manifold site (CA-KER-4220).

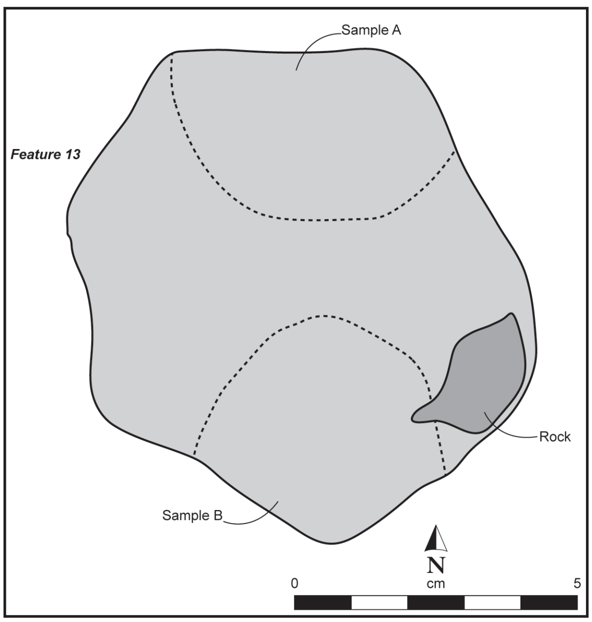


Figure 18. Map of Feature 13 at the Manifold site (CA-KER-4220).

it is burned, which "greatly accelerates the process of weathering" (Schneider 2009:76). The nature and extent of thermal damage to ground stone (and other artifacts) are influenced by the intensity and duration of the fire and whether the heat penetrates the soil (Deal 2012:110).

Fire affects stone artifacts in a number of ways, including breakage, spalling, potlidding, pitting, and discoloration (Deal 2012:98). Artifacts on the surface of sites are typically affected more than subsurface artifacts, "with protection often afforded by even a few centimeters of soil" (Deal 2012:98). While it can be complicated to differentiate between cultural and natural burning, it can sometimes be determined based on fracture patterns and other factors. For example, granitic rocks used to line thermal features (such as roasting pits and hearths) sometimes crack along the edge that is parallel to the fire (Deal 2012:108). This may be the case for at least two of the more complete but still fragmentary artifacts at the Manifold site, one of the manos (Cat. No. 435) and one of the pestles (Cat. No. 351), both split lengthwise and burned.

Flaked Stone Artifacts

While most of the flaked stone artifacts were found on the site surface, a few were also recovered from the test units and the column sample. These artifacts include projectile points, bifaces, cores, hammerstones, a uniface, a drill, two probable awls (one stone and one bone, considered together below), and debitage.

Table 3. Provenience and Attributes of Ground Stone Artifacts from the Manifold Site (CA-KER-4220).

Cat. No.	Artifact Type	Provenience	Material	Wt	L	W	T	Comments	Fig.
059	metate	surface	granitic	61.06	63.3	37.9	25.7	highly polished; burned	–
060	metate	surface	granitic	1,133.9	100.0	93.3	61.9	burned	–
301	metate?	surface	granitic	175.4	61.0	46.0	55.7	highly polished, burned black	–
066	mano	surface	granitic	67.2	47.0	50.2	29.6	burned?	–
072	mano	surface	granitic	86.6	62.7	51.4	25.9	burned	–
073	mano	surface	granitic	25.6	39.1	34.1	13.9	burned	–
075	mano	surface	granitic	37.1	57.3	32.6	24.8	polished, burned	–
076	mano?	surface	sandstone	20.7	35.7	26.8	17.4	red hue, unburned	–
087	mano	surface	granitic	27.2	42.9	30.6	20.6	burned?	–
089	mano	surface	granitic	181.2	60.0	69.2	37.4	burned?	–
122	mano	surface	rhyolite	643.1	~103.0	~87.0	~63.0	many small fragments of same artifact, burned	–
129	mano?	surface	granitic	81.5	48.2	42.5	31.8	burned black	–
146	mano	surface	granitic	68.9	33.6	44.8	34.0	burned	–
162	mano	surface	granitic	148.5	76.3	54.7	33.0	burned?	–
194	mano	surface	granitic	66.9	56.7	36.5	25.1	burned	–
278	mano?	surface	granitic	162.7	65.5	53.7	43.9	burned	–
435	mano	TU-4, 30–40	granitic	410.0	122.2	56.2	52.7	split, burned	19a
516	mano	surface	granitic	129.2	73.9	32.9	43.7	end portion, shaped, burned	–
351	pestle	surface	granitic	140.0	76.1	62.4	17.3	highly polished, burned black	19b
383	pestle	surface	granitic	130.1	61.8	57.9	25.8	polished, burned	–
090	bowl	surface	steatite	11.7	55.1	27.3	6.1	polished, burned	–
092	bowl	surface	steatite	3.9	32.4	16.9	6.3	3 burned fragments	–
186	bowl	surface	steatite	11.1	31.7	27.1	7.6	rim sherd, burned	–
200	bowl	TU-1, 0–10	steatite	8.2	36.0	16.2	7.9	body sherd, both sides drilled	–
295	bowl	surface	steatite	14.4	48.2	28.3	8.1	highly polished, burned	–
338	bowl	surface	steatite	17.4	32.5	24.4	11.2	burned	–
189	charmstone?	surface	granite	62.3	26.9	19.6	30.5	elongate, highly polished, burned	19c
118	unidentified	surface	quartzite	94.2	62.7	44.5	25.5	burned?	–
198	unidentified	surface	granitic	14.9	74.8	61.5	28.7	burned	–
268	unidentified	surface	sandstone	37.6	56.1	21.8	26.2	slightly burned	–
277	unidentified	surface	sandstone	223.1	59.3	64.1	59.6	slightly burned	–
358	unidentified	surface	granitic	276.9	85.2	63.2	44.4	burned	–
363	unidentified	surface	granitic	115.9	94.1	37.2	34.4	polished, burned black	–
364	unidentified	surface	granitic	106.6	63.5	43.6	28.4	slightly burned	–
370	unidentified	surface	rhyolite	206.0	71.8	65.9	33.3	burned	–
371	unidentified	surface	granitic	31.1	33.8	32.7	22.8	burned	–
376	unidentified	surface	granitic	260.9	69.6	53.6	38.8	burned black	–

Table 3. Continued.

Cat. No.	Artifact Type	Provenience	Material	Wt	L	W	T	Comments	Fig.
378	unidentified	surface	granitic	87.5	49.1	34.6	35.3	burned	–
390	unidentified	surface	granitic	17.3	36.8	27.7	18.1	burned black	–
396	unidentified	surface	steatite	6.1	35.1	21.2	5.3	highly polished, burned black	–
–	unidentified	TU-3, 10–20	–	–	–	–	–	Item 3 on level map	–

Notes: Wt = weight; L = length; W = width; T = thickness. TU levels are in cm; other metric measurements are in g and mm. All the ground stone artifacts are fragmentary; no complete specimens were recovered. See Figure 19 for selected ground stone artifacts.

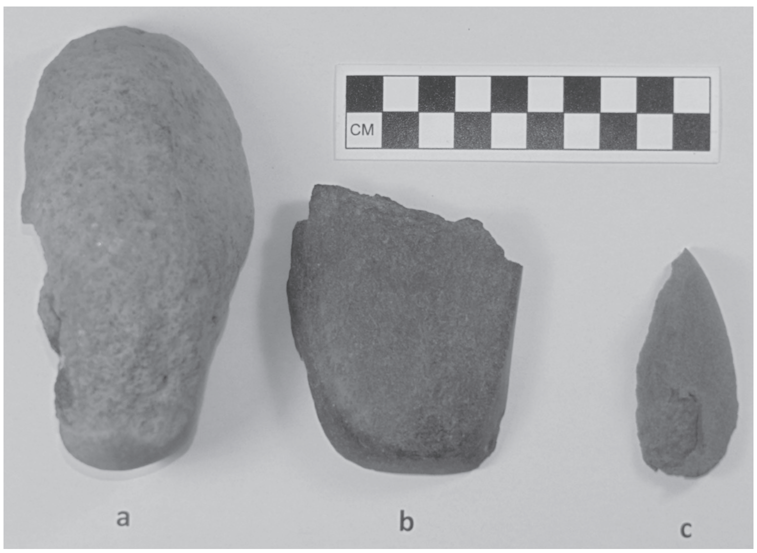


Figure 19. Selected ground stone artifacts from the Manifold site (CA-KER-4220): (a) mano fragment (Cat. No. 435); (b) pestle fragment (Cat. No. 351); (c) charmstone fragment (Cat. No. 189).

Projectile Points

Twenty-four projectile points were recovered, 20 from the surface and four from the TUs (Table 4, Figure 20). The types include Cottonwood Triangular, Rose Spring, Humboldt, and contracting stem. All but one are fragmentary.

The Cottonwood (and Cottonwood-like) projectile points (Figure 20a–f) include 11 from the surface and two from TU-1 (10–20 cm). The types consist of two Cottonwood Triangular specimens, eight similar to Cottonwood Triangular points, two Cottonwood Leaf-shaped examples, and one similar to a Cottonwood Leaf-shaped point. Eight of the points are made of chert, three of obsidian, and two of chalcedony. One complete finely serrated obsidian point (Cat. No. 511) found north of the site boundary was collected and is included here because it was submitted for obsidian hydration analysis (see results below).

Six points have been classified as either Rose Spring or as Rose Spring-like (Figure 20g, h). With the exception of Cat. No. 333 (made of chert), all are made of obsidian. Five specimens were found on the surface, and one (Cat. No. 504) was retrieved from TU-3 (40–50 cm).

One possible Humboldt projectile point (Cat. No. 104) made of Franciscan chert was identified on the surface of the site. It is notched and has a concave base.

Table 4. Provenience and Attributes of Projectile Points from the Manifold Site (CA-KER-4220).

Cat No.	Type	Provenience	Material	L	W	T	Wt	Comments	Fig.
056	Cottonwood Triangular?	surface	tabular chert	17.3	9.4	3.1	0.4	missing base, unifacial, tip broken off but retained, finely serrated	–
080	Cottonwood Triangular?	surface	chert	17.5	8.7	4.2	0.6	distal end, tip and base missing, finely serrated	20a
103	Cottonwood Triangular?	surface	chert	19.1	15.7	3.9	0.8	cortex present, convex base	20b
121	Cottonwood Triangular?	surface	chert	21.6	9.3	3.3	0.8	base and tip missing but most of mid-section present	20c
142	Cottonwood Leaf-shaped?	surface	chert	19.7	11.6	3.8	0.7	finely serrated, convex base, tip missing, possible potlidding	–
160	Cottonwood Triangular?	surface	chert	25.4	12.4	7.3	1.5	base missing, broken during manufacture?	–
197	Cottonwood Leaf-shaped	surface	obsidian	20.2	10.0	3.8	0.6	convex base, cortex on one face	–
315	Cottonwood Triangular?	surface	chalcedony	21.1	15.9	4.9	1.6	concave base? (may be broken), tip and part of base missing, potlidding	20d
342	Cottonwood Triangular?	surface	obsidian	23.8	15.3	8.1	2.0	unfinished, distal end, cortex on both sides, base missing	–
362	Cottonwood Triangular?	surface	chalcedony	30.9	9.5	4.1	1.2	long, finely serrated, part of base missing	20e
511	Cottonwood Leaf-shaped	surface	obsidian	32.3	11.5	3.8	1.1	found north of site; complete, finely serrated, convex base	20f
221	Cottonwood Triangular	TU-1, 10–20	tabular chert	9.2	11.3	3.4	1.0	base?, cortex on both sides, missing from collection	–
221L	Cottonwood Triangular	TU-1, 10–20	tabular chert	15.6	11.2	5.2	1.0	base, missing from collection	–
083	Rose Spring?	surface	obsidian	13.2	9.7	3.3	0.4	tiny, extreme tip missing, made from flake	–
109	Rose Spring?	surface	obsidian	11.2	14.1	2.8	0.4	bending fracture, one corner notch; broken during manufacture?	–
296	Rose Spring	surface	obsidian	24.6	14.6	4.1	0.9	one corner of base is missing, corner notched, neck width = 7.06 mm	–
317	Rose Spring?	surface	obsidian	21.9	14.5	5.9	1.5	extreme tip missing, made from flake; may be a Rose Spring in progress	–
333	Rose Spring	surface	chert	20.2	9.5	3.5	0.5	stemmed, neck width = 5.03 mm, serrated, made from flake, small part of tip and one margin missing	20g
504	Rose Spring	TU-3, 40–50	obsidian	15.5	13.8	3.4	0.7	distal, Item A on level map	20h
104	Humboldt?	surface	Franciscan chert	17.6	25.9	8.4	3.8	bending fracture, cortex, notched, concave base	20i
490	contracting stem	TU-3, 50–60	chert	43.1	28.2	7.5	7.0	dart-sized	20j
099	unclassified	surface	rhyolite	14.1	13.7	4.1	0.4	proximal end with notching, missing from collection	–
153	unclassified	surface	Franciscan chert	31.6	13.1	7.4	3.7	midsection, serrated, missing tip and base	–
292	unclassified	surface	obsidian	12.6	6.7	3.8	0.2	missing from collection	–

Notes: L = length; W = width; T = thickness; Wt = weight. TU levels are in cm; other metric measurements are in mm and g.

Figure 20. Selected projectile points from the Manifold site (CA-KER-4220). Cottonwood Triangular: (a) Cat. No. 080; (b) Cat. No. 103; (c) Cat. No. 121; (d) Cat. No. 315; (e) Cat. No. 362; (f) Cat. No. 511 (found just north of the site). Rose Spring: (g) Cat. No. 333; (h) Cat. No. 504. Humboldt: (i) Cat. No. 104. Contracting stem: (j) Cat. No. 490.

A single contracting stem projectile point (Cat. No. 490) was recovered from TU-3 (50–60 cm). It is made of chert and is dart-sized.

Three projectile points from the surface of the site could not be classified. Two of these points (Cat. No. 099 and 292) disappeared from the collection before they could be classified.

Bifaces

Fifteen fragmentary bifaces were collected from the site surface, and one was recovered from TU-3 at 30–40 cm (Table 5; Figure 21). Six of the bifaces are made of obsidian, nine of chert, and one of chalcedony. Three specimens are early stage, three are early-middle stage, one is middle stage, and nine are late stage. Three chert bifaces are heat treated (Cat. Nos. 131, 310, and 360).

Cores

Eleven cores were recovered from the surface. Seven specimens are chert, two are quartzite, one is chalcedony, and one is obsidian (Table 6; Figure 22). Eight are multidirectional and three are unidirectional. One of the cores (Cat. No. 344) was also used as a hammerstone (Figure 22d), as demonstrated by one rounded end with multiple small pits from stone-on-stone contact. The sole obsidian specimen (Cat. No. 321) is a bipolar core (Figure 22c). All but two of the cores show evidence of heat treatment.

Hammerstones

Eight hammerstones were found on the surface (Table 7; Figure 23). Three are quartzite, two are sandstone, two are granitic, and one is quartz. Six are burned.

Uniface

A chert uniface fragment (Cat. No. 356) was also found on the surface. It measures 36.8 x 24.7 x 12.4 mm and weighs 11.0 g. It is heat treated and retains a high gloss. When made from flakes, such as this specimen, unifaces are sometimes referred to as flake tools.

Table 5. Provenience and Attributes of Bifaces from the Manifold Site (CA-KER-4220).

Cat. No.	Provenience	Material	Wt	L	W	T	Comments	Fig.
068	surface	obsidian	0.8	19.5	10.8	4.4	late stage, possible incipient projectile point	–
127	surface	chert	10.1	26.7	32.7	11.9	early-middle stage, base section, end shot?	21a
131	surface	chert	2.8	11.9	25.9	7.1	early-middle stage, possible end shot, edge modified, heat treated	–
155	surface	chert	5.3	34.2	16.5	10.9	late stage, possible incipient projectile point damaged during manufacture	–
159	surface	obsidian	4.5	26.2	14.1	13.2	early stage, chunky fragment	–
285	surface	chert	14.6	28.0	37.0	16.6	early-middle stage, partial cortex, distal end, no platform	21b
308	surface	chert	12.6	26.8	25.0	14.2	early stage, partial cortex, chunky fragment, Franciscan chert	–
310	surface	chert	0.5	20.4	10.0	3.5	late stage, potlidding from heat treatment	–
324	surface	obsidian	1.9	21.5	11.4	8.2	middle stage, chunky fragment	–
329	surface	obsidian	1.6	16.3	9.6	8.7	late stage, small chunky fragment	–
336	surface	obsidian	0.6	11.3	13.1	5.1	late stage, small fragment, possible incipient projectile point	–
360	surface	chert	1.2	20.8	12.1	4.9	late stage, possible incipient Rose Spring point broken during manufacture, heat treated	–
369	surface	chalcedony	48.2	59.2	40.7	20.8	early stage, unusual inclusion (possibly a very small fossil), minimal cortex	21c
384	surface	obsidian	1.0	13.2	13.3	6.5	late stage, small fragment, possible incipient projectile point broken during manufacture	–
467	TU-3, 30–40	chert	15.5	40.6	27.1	13.2	nearly complete, white, Item N on level map	–
515	surface	chert	0.9	18.7	11.5	4.3	late stage, possible incipient projectile point, found near east wall of TU-4	–

Notes: Wt = weight; L = length; W = width; T = thickness. TU level is in cm; other metric measurements are in mm and g.

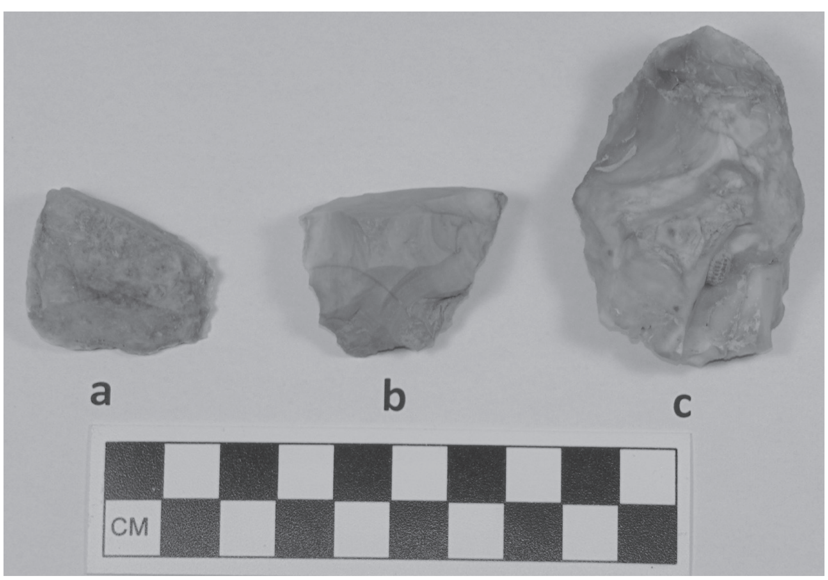


Figure 21. Selected bifaces from the Manifold site (CA-KER-4220): (a) Cat. No. 127; (b) Cat. No. 285; (c) Cat. No. 369.

Table 6. Attributes and Descriptions of Cores from the Surface of the Manifold Site (CA-KER-4220).

Cat. No.	Material	Wt	L	W	T	Comments	Fig.
123	chert	25.3	44.1	31.6	18.1	multidirectional, heat treated	–
126	chert	22.5	27.2	42.9	16.2	multidirectional, cortex present, heat treated	–
192	chalcedony	26.7	27.2	31.0	26.9	multidirectional, cortex present, heat treated	22a
283	quartzite	57.5	34.0	42.8	29.0	unidirectional, partially burned, heat treated	22b
321	obsidian	1.3	13.7	13.0	7.2	multidirectional, bipolar, small fragment	22c
344	chert	136.9	53.6	48.9	43.4	multidirectional, also used as a hammerstone, partially cortical, heat treated	22d
346	quartzite	131.9	39.1	55.4	44.7	unidirectional	–
348	chert	15.53	38.0	26.5	21.4	multidirectional, heat treated	–
349	chert	8.96	24.0	21.0	15.2	unidirectional, heat treated	–
354	chert	26.3	28.2	36.0	21.7	multidirectional, heat treated	–
512	chert	55.3	60.4	52.7	18.6	multidirectional, found near NW corner of TU-2, heat treated	–

Notes: WT = weight; L = length; W = width; T = thickness. Metric measurements are in mm and g.

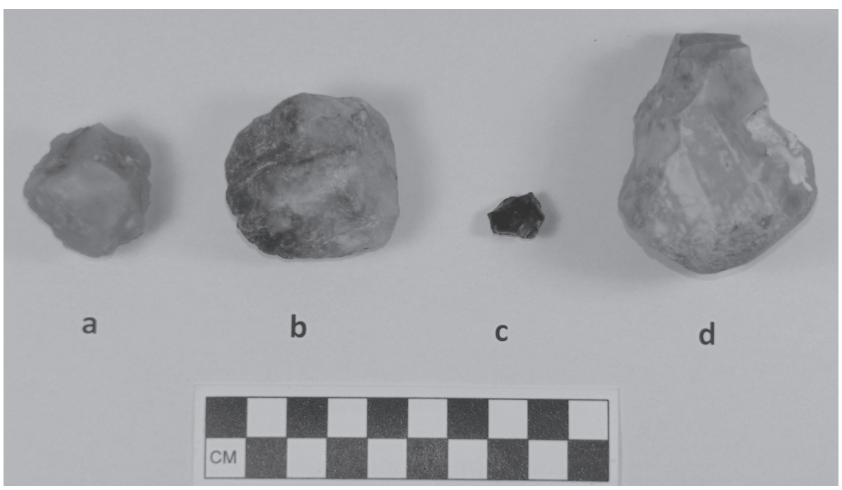


Figure 22. Selected cores from the Manifold site (CA-KER-4220): (a) Cat. No. 192; (b) Cat. No. 283; (c) Cat. No. 321; (d) Cat. No. 344.

Drill

One chert drill fragment (Cat. No. 381) (Figure 24a) was discovered on the surface. It measures 26.3 x 21.0 x 8.0 mm and weighs 3.6 g. Drills were used to perforate a variety of materials, such as pendants, pipes, and beads.

Awls

Two probable awl fragments, one of stone (Cat. No. 328) and the other of bone, are discussed together here for context and comparison. The first is a basalt tip fragment (Figure 24b) that was found on the surface. It measures 18.5 x 3.4 x 2.1 mm and weighs 0.2 g. It is very thin with a clearly defined tip. It may have been used to puncture some of the shell beads during manufacture.

The bone awl fragment (Cat. No. 483), a partial midsection with a blunt tip at one end (Figure 24c), was recovered at 30–40 cm in TU-3. The specimen is 17.4 mm long and 6.0 mm wide, and it weighs 0.6 g.

Table 7. Attributes and Descriptions of Hammerstones from the Surface of the Manifold Site (CA-KER-4220).

Cat. No.	Material	Wt	L	W	T	Comments	Fig.
074	sandstone	53.4	53.0	48.2	19.5	flat in profile, pitted, unburned	–
164	granitic	125.6	53.0	50.7	39.9	round cobble, burned	–
190	sandstone	41.6	39.6	30.1	27.5	red coloration on battered end, partially burned	–
266	quartz	81.8	44.3	43.5	33.3	battered on one end, smooth on the other end, unburned	–
302	granitic	107.5	51.1	46.3	35.9	nearly complete, small round cobble, both ends battered, burned	23a
314	quartzite	125.8	64.6	46.5	35.3	battered on one end, burned	23b
318	quartzite	147.3	75.6	65.2	31.6	battered on one end, burned, smooth margin	
327	quartzite	100.7	76.2	27.9	29.7	shaped margin, burned	23c

Notes: Wt = weight; L = length; W = width; T = thickness. Metric measurements are in mm and g.

Figure 23. Selected hammerstones from the Manifold site (CA-KER-4220): (a) Cat. No. 302; (b) Cat. No. 314; (c) Cat. No. 327.

It is burned completely black and has no distinct landmarks to determine the species or element of the bone. The tip is too thick and dull to have been used to perforate shell beads.

Debitage

From the site surface, the TUs, Feature 7, and the column sample, 685 flakes were recovered (Table 8). Of that number, 74 were collected from the surface, including 55 of obsidian, 16 of cryptocrystalline stone (CCS), and one each of rhyolite, quartzite, and basalt. The CCS materials include chert, chalcedony, and jasper, the vast majority being chert. In addition, five chert flakes were retrieved from the TU-1 column sample, and one was found in Feature 7.

The TUs produced 605 flakes, of which 564 were CCS, the remaining materials being obsidian (n = 22), shale (n = 13), quartz (n = 3), and one each of rhyolite, quartzite, and basalt (see Table 8). Only a few of the flakes, all chert, are visibly heat treated.

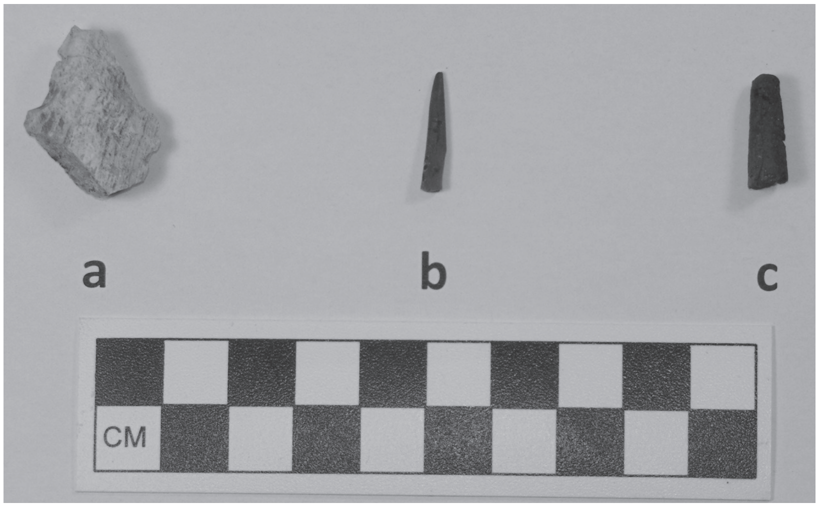


Figure 24. Drill and awl fragments from the Manifold site (CA-KER-4220): (a) drill, Cat. No. 381; awl fragments, (b) Cat. No. 328, (c) Cat. No. 483.

The debitage analytical sample (n = 296) came solely from TU-1, which had the vast majority of flakes of the four TUs and was the most diverse in terms of toolstone type. Using the debitage classificatory system detailed in Yohe (1998:41; Table 9), 26 of the specimens were categorized as biface thinning/early percussion flakes, 12 as biface thinning/late percussion flakes, two as partially cortical/nonbiface reduction flakes, 26 as noncortical/nonbiface reduction flakes, eight as pressure flakes, five as partially cortical shatter, and 217 as noncortical shatter (Table 10). What is immediately obvious is that the greatest quantity of debitage (95 percent) occurred in the first 30 cm of TU-1. As expected, a significant percentage of flakes are nondiagnostic, partially cortical and noncortical shatter (75 percent).

Of the diagnostic debitage in the sample (n = 74), biface thinning flakes make up about half (n = 38) of the specimens. This suggests that bifacial cores were commonly manufactured at the site. The absence of cortical flakes and the near absence of partially cortical flakes suggest that the primary reduction activities were most likely conducted off-site. Moreover, all the flakes in the debitage sample were small to tiny, which also indicates that the early stages of the manufacturing process were occurring at a different location. The presence of eight pressure flakes illustrates fine finishing of the bifaces and projectile points.

The debitage analysis indicates that unrefined materials were not transported to the Manifold site and that primary lithic reduction activities were not conducted there. On the other hand, the admittedly small number of partially cortical flakes—along with the early stage biface thinning flakes—suggests that rough bifaces (or preforms) may have occasionally been brought to the site for further refinement.

Olivella Shell Beads

Ninety-four *Olivella* beads were collected, 86 from the surface and eight from the TUs (Table 11, Figure 25). Using the typology of Bennyhoff and Hughes (1987; also see Milliken and Schwitalla 2012), the recovered bead types include seven Type A1a small spire-removed beads (Figure 25a), one Type E2a1 full thick-lipped bead, two Type F2b saddles (Figure 25b), 11 Type G1 tiny saucers (Figure 25c), one Type G2 normal saucer, five Type G4 ground saucers (Figure 25d), 23 Type H1a ground disks (Figure 25e), three Type H1b semi-ground disks (Figure 25f), four Type H2 rough disks (Figure 25g), 21 Type H3 chipped disks (Figure 25h), 12 Class J wall disks (Figure 25i),

Table 8. Distribution of Debitage from the Manifold Site (CA-KER-4220).

Provenience	Obsidian	CCS	Rhyolite	Quartz	Quartzite	Basalt	Shale	Total
Surface	55/32.3	16/257.1	1/0.7	–	1/19.6	1/17.3	–	74/327.0
Column Sample	–	5/0.42	–	–	–	–	–	5/0.42
Feature 7	1/<0.1	–	–	–	–	–	–	1/<0.1
TU-1								
0–10 cm	1/<0.1	72/5.8	–	–	–	–	–	73/~5.8
10–20 cm	8/<0.1	137/26.0	–	–	–	–	13/2.0	158/~28.0
20–30 cm	1/<0.1	43/9.3	1/<0.1	2/2.0	1/<0.1	1/<0.1	–	49/~11.5
30–40 cm	–	9/2.0	–	1/<0.1	–	–	–	10/~2.0
40–50 cm	–	2/<0.1	–	–	–	–	–	2/<0.1
50–60 cm	–	1/<0.1	–	–	–	–	–	1/<0.1
60–70 cm	–	3/<0.1	–	–	–	–	–	3/<0.1
Unit Total	10/~0.1	267/~43.2	1/<0.1	3/~2.0	1/<0.1	1/<0.1	13/2.0	296/~48.3
TU-2								
0–10 cm	3/0.4	103/47.0	–	–	–	–	–	106/47.4
10–20 cm	–	30/4.9	–	–	–	–	–	30/4.9
20–30 cm	1/0.1	6/0.7	–	–	–	–	–	7/0.8
Unit Total	4/0.5	139/52.6	–	–	–	–	–	143/53.1
TU-3								
0–10 cm	1/–	2/–	–	–	–	–	–	3/–
10–20 cm	–	2/–	–	–	–	–	–	2/–
20–30 cm	2/0.3	5/3.0	–	–	–	–	–	7/3.3
30–40 cm	–	19/13.6	–	–	–	–	–	19/13.6
40–50 cm	–	6/5.7	–	–	–	–	–	6/5.7
50–60 cm	–	15/7.8	–	–	–	–	–	15/7.8
60–70 cm	1/<0.1	–	–	–	–	–	–	1/<0.1
Unit Total	4/~0.3	49/~30.2	–	–	–	–	–	53/~30.5
TU-4								
0–10 cm	–	65/53.0	–	–	–	–	–	65/53.0
10–20 cm	1/0.6	35/26.4	–	–	–	–	–	36/27.0
20–30 cm	2/2.9	–	–	–	–	–	–	2/2.9
30–40 cm	–	5/6.9	–	–	–	–	–	5/6.9
40–50 cm	–	2/0.5	–	–	–	–	–	2/0.5
50–60 cm	1/0.1	2/2.1	–	–	–	–	–	3/2.2
Unit Total	4/3.6	109/88.9	–	–	–	–	–	113/92.5
Grand Total	78/~36.8	585/~473.0	2/<0.8	3/~2.1	2/<19.7	2/<17.4	13/2.0	685/~551.8

Notes: Toolstone columns reflect number/weight (g). CCS (cryptocrystalline) includes chert, chalcedony, and jasper. Since the artifacts from the 0–10 and 10–20-cm levels are missing from the collection, the weights are unknown for some of the flakes.

Table 9. Key to Flake Types for the Debitage from TU-1 at the Manifold Site (CA-KER-4220).

Code	Flake Type	Significance
BT/EP	biface thinning/early percussion	early stage of biface thinning
BT/LP	biface thinning/late percussion	late stage of biface thinning
PC/NB	partially cortical/nonbiface reduction	early stage of nonbiface reduction
NC/NB	noncortical/nonbiface reduction	later stage of nonbiface reduction
PRES	pressure flake	final stage of tool production
PC/SH	partially cortical shatter	early stage reduction
NC/SH	noncortical shatter	early/late stage reduction

Note: The information in this table was adapted from Yohe (1998:41).

Table 10. Classification of the Debitage from TU-1 at the Manifold Site (CA-KER-4220).

Level (cm)	BT/EP	BT/LP	PC/NB	NC/NB	PRES	PC/SH	NC/SH	Totals
0–10	8	3	1	6	3	2	51	74
10–20	15	7	–	13	3	2	116	156
20–30	2	2	1	5	1	1	37	49
30–40	1	–	–	1	–	–	8	10
40–50	–	–	–	1	–	–	1	2
50–60	–	–	–	–	1	–	1	2
60–70	–	–	–	–	–	–	3	3
Totals	26	12	2	26	8	5	217	296

one Type K2 bushing, one Type K3 cylinder (with a cross-hatch pattern, Figure 25j), and two that could not be typed.

In addition, the column sample from TU-1 yielded one very small but complete *Olivella* barrel shell (Cat. No. 019) that is cracked at the spire. It may have been intended as a spire-removed bead but was damaged during manufacture (obscuring evidence of modification of the spire), or it may simply have been brought to the site incidentally and never intentionally modified.

Other Beads

Seven additional beads (or possible beads) not made of *Olivella* shell were collected from the site surface (Table 12, Figure 26). Five are easily recognizable as beads, including a bone bead (Cat. No. 070), a probable bone bead (Cat. No. 097), a clamshell bead (Cat. No. 180), and two steatite disk beads (Cat. Nos. 169 and 365). The other two specimens are made of baked clay (Cat. Nos. 182 and 397) and are similar in appearance. They may actually be buttons rather than beads as both appear to be historic, perhaps even modern.

Miscellaneous Items

A number of miscellaneous items were found on the surface (Table 13). These include two stone chunks that may be shatter (Cat. Nos. 167 and 281) and one piece of possible shatter (Cat. No. 463). Two obsidian pebbles

Table 11. Provenience and Attributes of *Olivella* Shell Beads from the Manifold Site (CA-KER-4420).

Cat. No.	Provenience	Class/Type	Period	OD	PD	Wt	Comments	Fig.
288	surface	Type A1a (small spire-removed)	L/M/E	–	–	0.2	total length = 7.07 mm, maximum diameter = 5.06 mm, charred	–
330	surface	Type A1a (small spire-removed)	L/M/E	–	–	0.2	nearly complete, total length = 7.45 mm, maximum diameter = 6.16 mm, charred	–
340	surface	Type A1a (small spire-removed)	L/M/E	–	–	0.1	total length = 5.7 mm, maximum diameter = 5.0 mm, highly polished	–
353	surface	Type A1a (small spire-removed)	L/M/E	–	–	0.2	total length = 8.59 mm, maximum diameter = 5.48 mm	29a
430	TU-4, 20–30	Type A1a (small spire-removed)	L/M/E	–	–	0.1	total length = 7.82 mm, maximum diameter = 4.89 mm, burned nearly black	–
491A	TU-3, 50–60	Type A1a (small spire-removed)	L/M/E	–	–	0.1	total length = 7.87 mm, maximum diameter = 5.03 mm	–
491B	TU-3, 50–60	Type A1a (small spire-removed)	L/M/E	–	–	0.1	total length = 6.8 mm, maximum diameter = 4.7 mm, small piece broken off	–
185	surface	Type E2a1 (full thick-lipped, normal variant)	L(M)	12.2 x 10.1	2.0	0.3	burned black and white	–
112	surface	Type F2b (round saddle)	M(M)	7.9 x 8.4	1.1	0.1	burned uniformly white, highly polished	25b
137	surface	Type F2b (round saddle)	M(M)	11.2 x 10.6	2.0	0.3	partially burned black	–
064	surface	Type G1 (tiny saucer)	None	4.2	1.2	0.03	burned nearly black	–
132	surface	Type G1 (tiny saucer)	None	5.2	1.2	0.2	burned uniformly white?	–
140	surface	Type G1 (tiny saucer)	None	4.1	1.3	0.02	burned uniformly white?	–
141	surface	Type G1 (tiny saucer)	None	4.9	1.2	0.05	charred, highly polished	–
152	surface	Type G1 (tiny saucer)	None	4.5	1.1	0.05	burned	–
156	surface	Type G1 (tiny saucer)	None	4.5	1.4	0.03	weathered	–
172	surface	Type G1 (tiny saucer)	None	4.5	1.9	0.02	nearly complete, highly weathered	25c
188	surface	Type G1 (tiny saucer)	None	3.1	1.3	0.1	highly polished	–
312	surface	Type G1 (tiny saucer)	None	3.4	1.2	0.02	charred, weathered	–
337	surface	Type G1 (tiny saucer)	None	3.9	1.0	0.02	charred	–
514	surface	Type G1 (tiny saucer)	None	5.7	0.8	0.05	burned black	–
304	surface	Type G2 (normal saucer)	M(M)	5.9	1.5	0.1	charred	–
187	surface	Type G4 (ground saucer)	ME(M)	5.5	1.1	0.05	burned white, well polished	25d
286	surface	Type G4 (ground saucer)	ME(M)	7.6	1.9	0.1	charred, weathered	–
326	surface	Type G4 (ground saucer)	ME(M)	7.07	1.5	0.07	burned black, nearly complete	–
128	surface	Type G4 (ground saucer)	ME(M)	7.4	1.8	0.1	charred	–
157	surface	Type G4 (ground saucer)	ME(M)	7.7	1.4	0.1	burned white, well polished	–
085	surface	Type H1a (ground disk)	Mission1	5.6	1.4	0.04	burned black and white	–
098	surface	Type H1a (ground disk)	Mission1	4.7	0.9	0.04	charred	–
101	surface	Type H1a (ground disk)	Mission1	4.8	1.2	0.04	well polished	–
107	surface	Type H1a (ground disk)	Mission1	4.9	1.2	0.05	burned	25e

Table 11. Continued.

Cat. No.	Provenience	Class/Type	Period	OD	PD	Wt	Comments	Fig.
108	surface	Type H1a (ground disk)	Mission1	4.5	1.1	0.04	slightly charred	–
147	surface	Type H1a (ground disk)	Mission1	7.1	1.7	0.1	burned almost black on one side	–
161	surface	Type H1a (ground disk)	Mission1	4.5	1.5	0.03	small portion of edge chipped	–
175	surface	Type H1a (ground disk)	Mission1	4.5	1.1	0.03	highly polished	–
211	TU-1, 0–10	Type H1a (ground disk)	Mission1	4.6	1.5	0.9	concave on one side, convex on the other side, charred	–
265	surface	Type H1a (ground disk)	Mission1	5.5	1.4	0.04	burned, weathered	–
309	surface	Type H1a (ground disk)	Mission1	4.1	1.1	0.03	burned	–
313	surface	Type H1a (ground disk)	Mission1	5.3	1.3	0.04	small portion of edge chipped	–
316	surface	Type H1a (ground disk)	Mission1	3.6	1.1	0.03	burned on one side	–
320	surface	Type H1a (ground disk)	Mission1	~6.6	~1.0	0.03	half bead, measurements extrapolated	–
322	surface	Type H1a (ground disk)	Mission1	3.6	1.2	0.02	burned nearly black	–
325	surface	Type H1a (ground disk)	Mission1	~6.0	~1.0	0.01	half bead, measurements extrapolated	–
331	surface	Type H1a (ground disk)	Mission1	4.9	1.3	0.04	burned, highly polished	–
350	surface	Type H1a (ground disk)	Mission1	6.8	1.2	0.1	chipping of perforation edge	–
357	surface	Type H1a (ground disk)	Mission1	5.3	1.0	0.03	well polished	–
389	surface	Type H1a (ground disk)	Mission1	6.2	1.4	0.1	burned black and white	–
403	TU-2, 0–10	Type H1a (ground disk)	Mission1	5.8	1.4	0.05	burned	–
480	TU-3, 30–40	Type H1a (ground disk)	Mission1	4.7	1.5	0.1	burned	–
513	surface	Type H1a (ground disk)	Mission1	5.5	0.9	0.1	burned gray	–
063	surface	Type H1b (semi-ground disk)	Mission2	5.7	1.5	0.04	burned nearly black	–
298	surface	Type H1b (semi-ground disk)	Mission2	6.4	1.8	0.1	burned black and white	–
143	surface	Type H1b (semi-ground disk)	Mission2	5.4	1.0	0.05	slightly charred	29f
114	surface	Type H2 (rough disk)	Mission3	5.5	1.2	0.1	burned black	–
148	surface	Type H2 (rough disk)	Mission3	7.0	1.3	0.1	burned, irregular edges	–
151	surface	Type H2 (rough disk)	Mission3	7.1	1.5	0.1	highly weathered	29g
355	surface	Type H2 (rough disk)	Mission3	6.7	0.9	0.1	scratched, weathered	–
065	surface	Type H3 (chipped disk)	post-M	7.1	1.4	0.1	burned black and white	–
069	surface	Type H3 (chipped disk)	post-M	7.6	1.3	0.1	burned uniformly white?	–
079	surface	Type H3 (chipped disk)	post-M	8.7	1.2	0.1	burned uniformly white?	–
086	surface	Type H3 (chipped disk)	post-M	10.3	1.5	0.2	burned gray, well polished, irregular disk	–
115	surface	Type H3 (chipped disk)	post-M	7.8	1.1	0.1	weathered	–
120	surface	Type H3 (chipped disk)	post-M	~8.0	~1.0	0.1	half bead, measurements extrapolated	–
133	surface	Type H3 (chipped disk)	post-M	8.8	1.5	0.1	highly weathered	–
134	surface	Type H3 (chipped disk)	post-M	10.1	1.5	0.2	slightly charred, irregular disk	–
135	surface	Type H3 (chipped disk)	post-M	9.0	1.5	0.2	well polished	–
144	surface	Type H3 (chipped disk)	post-M	8.6	1.9	0.1	irregular disk, weathered	–
145	surface	Type H3 (chipped disk)	post-M	11.2	1.2	0.2	burned uniformly white	–

Table 11. Continued.

Cat. No.	Provenience	Class/Type	Period	OD	PD	Wt	Comments	Fig.
178	surface	Type H3 (chipped disk)	post-M	7.9	1.3	0.1	partially burned, well polished	–
181	surface	Type H3 (chipped disk)	post-M	10.8	1.3	0.2	charred, weathered	–
291	surface	Type H3 (chipped disk)	post-M	9.8	1.7	0.2	charred, weathered	–
297	surface	Type H3 (chipped disk)	post-M	10.6	1.8	0.2	burned white, irregular disk	–
305	surface	Type H3 (chipped disk)	post-M	7.8	1.8	0.1	charred	–
341	surface	Type H3 (chipped disk)	post-M	9.5	1.7	0.1	burned almost black on one side	–
345	surface	Type H3 (chipped disk)	post-M	7.6	1.9	0.1	irregular disk	–
347	surface	Type H3 (chipped disk)	post-M	6.9	1.5	0.1	heavily weathered	–
359	surface	Type H3 (chipped disk)	post-M	8.6	1.7	0.1	weathered	29h
421	TU-4, 0–10	Type H3 (chipped disk)	post-M	8.4	1.7	0.1	Item A on level map, heavily weathered	–
061	surface	Class J (wall disk)	PH	9.0	2.0	0.2	burned gray, highly polished	–
067	surface	Class J (wall disk)	PH	7.8	1.8	0.1	burned	–
119	surface	Class J (wall disk)	PH	~12.0	~2.0	0.2	half bead, measurements extrapolated	–
071	surface	Class J (wall disk)?	PH	~8.5	~1.0	0.06	half bead, measurements extrapolated	–
077	surface	Class J (wall disk)	PH	11.4	2.1	0.2	highly weathered	–
136	surface	Class J (wall disk)	PH	11.6	1.6	0.2	highly polished	–
149	surface	Class J (wall disk)	PH	10.0	2.1	0.2	slightly charred	29i
165	surface	Class J (wall disk)	PH	9.1	1.8	0.2	partially burned	–
176	surface	Class J (wall disk)	PH	~12.0	~2.5	0.2	half bead, measurements extrapolated	–
191	surface	Class J (wall disk)	PH	~11.0	~2.0	0.2	half bead, measurements extrapolated	–
196	surface	Class J (wall disk)	PH	11.5	1.4	0.3	burned black, highly polished	–
394	surface	Class J (wall disk)	PH	9.0	1.8	0.1	burned white	–
334	surface	Type K2 (bushing)	L(M)	2.7	1.6	0.01	well polished	–
150	surface	Type K3 (cylinder with cross-hatch pattern)	L(M)	3.1	1.8	0.05	well polished	29j
352	surface	unclassified	–	–	–	0.1	less than half a bead, insufficient to determine complete metrics or type	–
508	TU-3, 0–10	unclassified	–	–	–	–	2 beads, field notes say probably *Olivella* (missing from collection)	–

Key for periods (per Bennyhoff and Hughes 1987:128–137): L/M/E = Late, Middle, and Early periods; L(M) = late Phase 2 of Late period, continuing to historic period [(M) = marker type]; M(M) = Middle period (marker), but continues through late phase; None = no temporal significance; ME(M) = early phase of Middle period (marker type); Mission1 = Early Mission period (ca. AD 1770–1800); Mission2 = Late Mission period (ca. AD 1800–1816); Mission3 = Terminal Mission period (marker type; AD 1816–1834); post-M = post-Mission period (ca. AD 1834 to at least AD 1900); PH = Protohistoric marker type in the San Joaquin Valley, continues to ca. AD 1816; L(M) = Phase 2 of Late period (marker types).

Notes: OD = outside diameter; PD = perforation diameter; Wt = weight. TU levels are in cm; other metric measurements are in mm and g. Except where noted, all beads are complete.

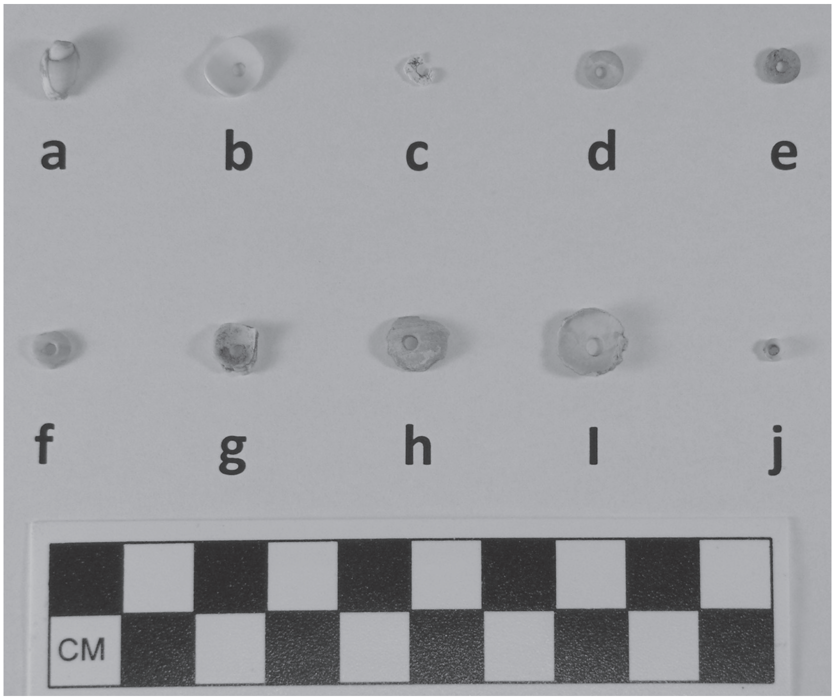


Figure 25. Selected *Olivella* beads from the Manifold site (CA-KER-4220): (a) A1a spire-removed, Cat. No. 353; (b) F2b round saddle, Cat. No. 112; (c) G1 tiny saucer, Cat. No. 172; (d) G4 ground saucer, Cat. No. 187; (e) H1a ground disk, Cat. No. 107; (f) H1b semi-ground disk, Cat. No. 143; (g) H2 rough disk, Cat. No. 151; (h) H3 chipped disk, Cat. No. 359; (i) Class J wall disk, Cat. No. 149; (j) K3 cylinder, Cat. No. 150.

Table 12. Attributes and Descriptions of Other Beads from the Surface of the Manifold Site (CA-KER-4220).

Cat. No.	Material	Type	OD	PD	T	Wt	Comments	Fig.
070	bone	small ring	3.4	1.2	2.2	0.03	polished	26a
097	bone?	small ring	2.9	1.2	0.9	0.01	polished	26b
180	clamshell	unknown	3.4	–	1.4	0.01	missing from collection	–
169	steatite	disk	3.5	1.0	1.6	0.02	chipped	26c
365	steatite	disk	3.4	1.3	1.7	0.02	well shaped	26d
182	baked clay	"button"	17.8	2.5	11.4	2.7	perforation wider on one side than the other, looks similar to Cat. No. 397	26e
397	baked clay	"button"	20.6	2.5	8.7	1.9	looks similar to Cat. No. 182	26f

Notes: OD = outside diameter; PD = perforation diameter; T = thickness; Wt = weight. Metric measurements are in mm and g.

(Cat. No. 235A) were retrieved from TU-1 (20–30 cm), and one quartz pebble (Cat. No. 055) was found in TU-3 (10–20 cm). Although they are unmodified, the obsidian pebbles were likely imported to the site for trading purposes as the closest source of this toolstone (Coso Volcanic Field) is roughly 100 miles to the northeast. It is uncertain whether the quartz pebble is cultural. Also identified were five shaped and/or modified stones of unknown function, including a small, spherical, black basalt stone (Cat. No. 084) that appears to have been intentionally split in half, purposefully rounded, and highly polished; a chunky granitic fragment (Cat. No. 105) with one smooth end; a tabular chert fragment (Cat. No. 130); a tabular steatite fragment (Cat. No. 117) with a smooth surface; and a complete flat, narrow stone (Cat. No. 307) with red coloration.

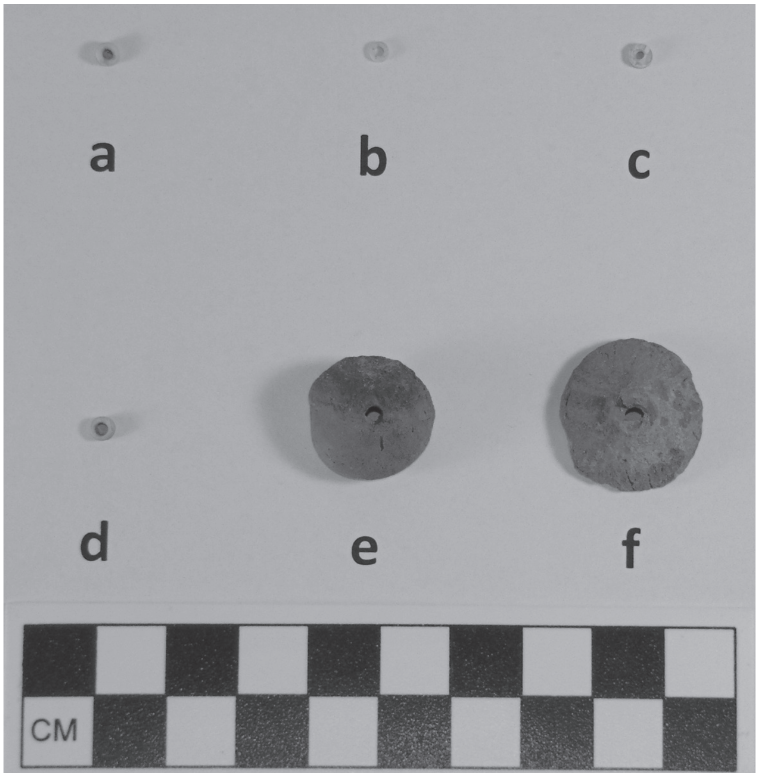


Figure 26. Other beads from the Manifold site (CA-KER-4220): (a) Cat. No. 070 (bone bead); (b) Cat. No. 097 (bone bead); (c) Cat. No. 169 (steatite bead); (d) Cat. No. 365 (steatite bead); (e) Cat. No. 182 (baked clay bead/button); (f) Cat. No. 397 (baked clay bead/button).

Sixteen small and amorphous fragments of baked clay (see Table 13) were identified, 13 from the surface and three from TU-1 (10–20 cm). Two surface fragments and two from TU-1 have indistinct plant impressions. Within the Central Valley, baked clay fragments have been interpreted variously as anthropomorphic figurines, parts of daub structures, cooking stones, and net weights (e.g., Heizer 1937; Beardsley 1948, 1954; Cook and Heizer 1951; Olsen and Payen 1968, 1969; Pritchard 1970; Scientific Resource Surveys 1979; Delacorte 2001; Gardner 2005). Three fragmentary fire-affected rocks were also surface recovered.

Faunal Remains

A variety of faunal remains was recovered from the Manifold site, including invertebrates (freshwater bivalves and land snails) and vertebrates (fish, reptiles, birds, and mammals). Each category is discussed below.

Invertebrate Remains

The invertebrate remains from the site consist of freshwater bivalves (cf. *Anodonta* spp.) and land snails (*Helminthaglypta* spp.). As with other sites in the region, bivalves dominate the invertebrate category.

Freshwater Bivalves

The remains of freshwater bivalves are ubiquitous at Manifold and come from the features, TUs, and column sample. Virtually all the freshwater shell was highly fragmented, and no hinges were recovered, precluding definitive identification to taxa. It is likely that the shell is *Anodonta*, *Margaritifera falcata*, and/or *Gonidea angulata*, all of which are found in California

Table 13. Provenience and Attributes of Miscellaneous Items from the Manifold Site (CA-KER-4220).

Cat. No.	Provenience	Artifact/ Ecofact	Material	L	W	T	Wt	Comments
167	surface	chunk	chalcedony	33.0	26.9	19.4	21.2	probably shatter
281	surface	chunk	quartzite	69.4	31.9	47.1	61.7	probably shatter
463	TU-3, 30–40	shatter	–	–	–	–	–	Item J on level map (missing from collection)
055	TU-3, 10–20	pebble	quartz	–	–	–	–	Item 4 on level map
235A	TU-1, 20–30	pebbles	obsidian	–	–	–	–	2 cortical obsidian pebbles
084	surface	unknown	basalt	15.2	14.4	5.3	1.2	rounded half section of unknown small spherical object, smooth on dorsal aspect
105	surface	unknown	granitic	–	–	–	20.3	shaped stone fragment
117	surface	unknown	steatite	–	–	–	5.6	shaped stone fragment
130	surface	unknown	chert	38.1	17.8	5.3	4.8	smooth, tabular fragment
307	surface	unknown	granite	56.1	52.7	24.4	77.3	red coloration on one side, shaped stone, fits in the palm of the hand
081	surface	baked clay	clay	–	–	–	2.6	fragment
221E	TU-1, 10–20	baked clay	clay	–	–	–	–	3 fragments (2 with botanical impressions)
271	surface	baked clay	clay	65.2	52.4	33.4	62.7	burned fragment
282	surface	baked clay	clay	60.8	39.6	29.3	42.0	fragment, burned, botanical impression, bits of shell
300	surface	baked clay	clay	24.7	11.5	17.7	2.4	fragment, botanical impressions
367	surface	baked clay	clay	48.6	38.2	28.1	37.2	fragment
372	surface	baked clay	clay	37.1	24.4	15.0	9.2	fragment
374	surface	baked clay	clay	–	–	–	19.5	2 fragments
375	surface	baked clay	clay	21.0	17.4	14.5	4.3	fragment
386	surface	baked clay	clay	–	–	–	30.3	4 fragments
094	surface	FAR	sandstone	54.0	45.0	9.9	43.2	fragment
168	surface	FAR	granitic	43.5	25.6	19.6	14.4	fragment
377	surface	FAR	vesicular basalt	85.6	78.4	72.1	325.1	fragment

Notes: FAR = fire-affected rock; L = length; W = width; T = thickness; Wt = weight. TU levels are in cm; other metric measurements are in mm and g.

waters. However, the latter two bivalves prefer cold, clean water, while *Anodonta* inhabits the warm and sluggish lakes and sloughs of the San Joaquin Valley (Jepsen et al. 2010:1). As the source of the shell is undoubtedly nearby Buena Vista Lake, it is presumed that most (if not all) of the freshwater bivalves are *Anodonta californiensis* and/or *A. nuttalliana,* species that are very difficult to differentiate even in their intact forms (Jepsen et al. 2010:1). Moreover, *Anodonta* is frequently identified in archaeological contexts in and around the lake basin.

From the seven surface shell dump features, the TUs, and the column sample, a total of ≈5,500.0 g of *Anodonta* was recovered. Features 12 and 13, which were both located within about 40 m northwest of Datum B, contained the greatest quantity (by weight) of shell (596.0 and 339.0 g, respectively) (see Table

2). Features 7 through 11 were all located between 21 and 63 m of Datum A and ranged in *Anodonta* weight between 56.0 and 193.0 g.

Of the four test units, TUs 1 and 2 produced the smallest quantities of *Anodonta*. At 10–20 cm in TU-1, 69.0 g of *Anodonta* were recovered, with each of the remaining levels consisting of less than 17.0 g (in some cases less than 1.0 g). The largest quantity of *Anodonta* within TU-2 came from the first 10 cm (254.9 g), with small to trace amounts in the other levels. TU-3 contained the vast majority of the *Anodonta* shell (≈3,800.0 g) and virtually all of it was recovered between 30 and 50 cm below the surface (≈3,700.0 g between those two levels, 732.0 g of which came from Feature 1). TU-4 had the second largest quantity (≈1,245.0 g), most of it recovered between 10 and 30 cm (1,072.0 g between those two levels). The column sample from TU-1 contained a total of ≈80.0 g of *Anodonta*, most of it coming from the upper 30 cm.

This distribution suggests that the north-central part of the site (associated with Datum B), which includes TUs 3 and 4 and Features 12 and 13, was the focus of activity for processing and consuming *Anodonta*. Given the presence of a small gully (which may have been larger in prehistory) west of Datum A, where Features 9 and 10 were located, the scarcity of *Anodonta* (and absence of anything else) in these features suggests that the materials in this area may be secondary deposits and/or that some materials have been washed away from the site. There is support for this suggestion specifically from Feature 9 because it showed evidence of erosion around its edges.

Land Snails

Very small quantities (less than 20 g) of unburned complete and fragmentary land snail shells (*Helminthaglypta* spp.) were distributed throughout all the test units and the column sample, while none were recovered from any of the features. Given the extremely small quantity and lack of apparent cultural modification of these snail shells, they are not considered culturally significant.

Vertebrate Remains

Vertebrate remains were recovered from three of the surface features, all the TUs, and the column sample from TU-1. These include the remains of fish, reptiles, birds, and various mammals. With the exception of most of the fish vertebrae and otoliths, the majority of the remains are so highly fragmented that they could not be identified beyond class or could only be listed as indeterminate. In fact, they are so fragmentary (often fleck-sized and mostly burned) that in some cases they could not be precisely quantified. As such, many of the fragmentary remains are not included in this analysis, but those that were identified to at least class are discussed.

Fish (Class Actinopterygii)

Fish materials were identified by one of us (KWG) based on element morphology along with a consideration of historic distribution of the fishes. The recovered elements were compared with skeletons housed at the California Academy of Sciences in San Francisco. Since Sacramento perch (*Archoplites interruptus*) are the only member of the family Centrarchidae native to the fresh waters west of the Rocky Mountains and then only in the Central Valley of California (Moyle 2002), the distinctive morphology of the bones makes identification simple. The same distributional exclusivity exists for tule perch (*Hysterocarpus traskii*), the only member of the family Embiotocidae that lives in fresh water (Love 2011). Considering the distance from the Pacific Ocean or the San Francisco Estuary, it is extremely unlikely that any of the 18 marine members of the family in Pacific coast waters would be represented among archaeological materials in the southern San Joaquin Valley.

Distinguishing minnow (Cyprinidae) vertebrae from sucker (Catostomidae) vertebrae is accomplished utilizing the features described by Gobalet et al. (2005). The only sucker documented in the Sacramento and San Joaquin rivers is Sacramento sucker (*Catostomus occidentalis*), simplifying its designation when similar cyprinid vertebrae have been excluded from consideration. It is challenging to distinguish cyprinids on the basis of their vertebrae. The task is time-consuming, and except for select vertebrae of splittail (*Pogonichthys macrolepidotus*), Sacramento pikeminnow (*Ptychocheilus grandis*), and blackfish (*Orthodon microlepidotus*), it is not accomplished with great confidence. Because there are six large native cyprinids in the Central Valley (Moyle 2002) and vertebrae are the predictable elements recovered, Cyprinidae is by default the appropriate designation.

Other than vertebrae, diagnostic elements (e.g., basioccipital, pharyngeal, cleithrum) are rare among the remains at the Manifold site. Because of this, only three species were identified (*Archoplites interruptus*, *Catostomus occidentalis*, and *Hysterocarpus traskii*). Hitch (*Lavinia exilicauda*), pikeminnow, splittail, blackfish, thicktail chub (*Gila crassicauda*), and hardhead (*Mylopharodon conocephalus*) are likely represented but cannot be confirmed among the remains. All six of these large cyprinids have been identified among archaeological remains in Kern County (Gobalet et al. 2004; Bernard 2015). The common and technical nomenclature for these fishes follows the American Fisheries Society standard of Page et al. (2013).

Of the selected fish specimens (mostly vertebrae) that were identified to at least Actinopterygii (n = 597), 32 came from Features 7 and 12 (Table 14), 22 came from TU-1, 31 came from TU-2, 202 came from TU-3 (with no direct feature association), 226 came from Features 1 and 2 in TU-3, 71 came from TU-4 (see Table 15), and 13 came from the column sample (see Table 16). Of the fish remains identified to species, 133 are *Archoplites interruptus*, 43 are *Hysterocarpus traskii*, and 39 are *Catostomus occidentalis*. The remaining specimens that could not be more precisely identified are listed as Actinopterygii (n = 177) or Cyprinidae (n = 201). The vast majority of the fish remains are burned, with the exception of the otoliths and a few vertebrae.

Other Vertebrate Remains

Identification of other vertebrate remains was accomplished using the comparative osteological collection belonging to one of us (NV). Additional manuals and publications aided in the identifications (e.g., Lawrence 1951; Olsen 1968; Gilbert 1980). Each specimen was identified to the most specific taxonomic

Table 14. Identification of Fish Remains from the Surface Features at the Manifold Site (CA-KER-4220).

Feature	Taxon (Common Name)	Element	NISP
7	*Archoplites interruptus* (Sacramento perch)	vertebrae	3
	Catostomus occidentalis (Sacramento sucker)	vertebra	1
	Hysterocarpus traskii (tule perch)	vertebra	1
	Cyprinidae	vertebrae	3
12	Actinopterygii	unidentified elements	24

Notes: NISP = number of identified specimens. All the fish remains were burned. Features 8, 9, 10, 11, and 13 did not contain any fish remains.

Table 15. Provenience and Identification of Fish Remains from the Test Units at the Manifold Site (CA-KER-4220).

Unit/Level (in cm)	Taxon (Common Name)	Element	NISP	Burned?
TU-1				
0–10	*Archoplites interruptus* (Sacramento perch)	otolith fragments	4	no
10–20	*Archoplites interruptus* (Sacramento perch)	otolith fragments	12	no
20–30	*Archoplites interruptus* (Sacramento perch)	otolith fragments	4	no
30–40	*Archoplites interruptus* (Sacramento perch)	otolith, otolith fragment	2	yes
TU-2				
surface	*Catostomus occidentalis* (Sacramento sucker)	1 vertebra, 1 dentary	2	yes
	Hysterocarpus traskii (tule perch)	vertebrae	2	yes
	Actinopterygii	1 vertebra, 11 fragments	12	yes
0–10	*Archoplites interruptus* (Sacramento perch)	otoliths, otolith fragments	14	no
10–20	*Archoplites interruptus* (Sacramento perch)	otolith fragment	1	no
TU-3 (no feature association)				
20–30	*Archoplites interruptus* (Sacramento perch)	vertebrae	2	yes
30–40	*Archoplites interruptus* (Sacramento perch)	vertebrae, other fragments	18	yes
	Catostomus occidentalis (Sacramento sucker)	vertebrae, other fragments	11	yes
	Hysterocarpus traskii (tule perch)	19 vertebrae, 1 cleithral	20	yes
	Cyprinidae	vertebral fragments	26	yes
	Actinopterygii	vertebrae, other fragments	33	yes
40–50	*Archoplites interruptus* (Sacramento perch)	17 vertebrae, 1 posttemporal	18	yes
	Catostomus occidentalis (Sacramento sucker)	vertebrae	3	yes
	Cyprinidae	26 vertebrae, 2 plural ribs	28	yes
	Actinopterygii	fragments	5	yes
50–60	*Archoplites interruptus* (Sacramento perch)	vertebrae	2	yes
	Catostomus occidentalis (Sacramento sucker)	vertebrae	4	yes
	Cyprinidae	vertebrae	18	yes
	Actinopterygii	vertebral fragments	6	yes
60–70	*Hysterocarpus traskii* (tule perch)	vertebra	1	yes
	Cyprinidae	vertebra	1	yes
70–80	Cyprinidae	vertebrae	2	yes
80–90	unidentified fish	vertebrae	3	yes
	unidentified fish	otolith	1	no
TU-3 (Feature 1)				
40–50	*Archoplites interruptus* (Sacramento perch)	21 vertebrae, 1 hyomandibula, 1 post-temporal, 1 basioccipital, 1 unidentified element	25	yes
	Catostomus occidentalis (Sacramento sucker)	13 vertebrae	13	yes
	Hysterocarpus traskii (tule perch)	12 vertebrae	12	yes
	Actinopterygii	10 vertebral fragments, 3 spine fragments, 38 unidentified fragments	51	yes
	Cyprinidae	90 vertebrae, 1 hypohyal	91	yes

Table 15. Continued.

Unit/Level (in cm)	Taxon (Common Name)	Element	NISP	Burned?
TU-3 (Feature 2)				
40–50	*Archoplites interruptus* (Sacramento perch)	3 vertebrae	3	yes
	Catostomus occidentalis (Sacramento sucker)	1 vertebra, 1 dentary	2	yes
	Hysterocarpus traskii (tule perch)	2 vertebrae	2	yes
	Actinopterygii	1 vertebra, 11 unidentified fragments	12	yes
	Cyprinidae	14 vertebrae, 1 pharyngeal fragment	15	yes
TU-4				
10–20	*Archoplites interruptus* (Sacramento perch)	vertebrae	3	no
	Catostomus occidentalis (Sacramento sucker)	vertebra	1	no
	Cyprinidae	vertebra	1	no
20–30	*Archoplites interruptus* (Sacramento perch)	2 otoliths, 2 otolith fragments	4	no
	Archoplites interruptus (Sacramento perch)	vertebrae	2	yes
	Cyprinidae	vertebra	1	yes
	Actinopterygii	vertebral fragments	2	yes
30–40	*Catostomus occidentalis* (Sacramento sucker)	vertebrae	2	yes
	Archoplites interruptus (Sacramento perch)	vertebrae	6	yes
	Archoplites interruptus (Sacramento perch)	otolith fragments	7	no
	Hysterocarpus traskii (tule perch)	vertebra	3	yes
	Cyprinidae	6 vertebrae, 1 pharyngeal	7	yes
	Actinopterygii	fragments	25	yes
40–50	*Archoplites interruptus* (Sacramento perch)	otolith fragments	2	no
	Actinopterygii	pterygiophore, spine fragment	2	yes
	Cyprinidae	vertebrae	3	yes

Note: NISP = number of identified specimens.

Table 16. Provenience and Identification of Fish Remains from the TU-1 Column Sample at the Manifold Site (CA-KER-4220).

Level (cm)	Taxon (Common Name)	NISP	Weight (g)	Burned	Comments
0–10	*Hysterocarpus traskii* (tule perch)	2	0.01	no	vertebrae
10–20	*Archoplites interruptus* (Sacramento perch)	1	0.04	yes	frontal?
10–20	Cyprinidae	1	0.03	yes	vertebra
10–20	Actinopterygii	1	0.03	yes	vertebra
20–30	Cyprinidae	4	0.01	yes	vertebrae
20–30	Actinopterygii	4	0.02	yes	fragments

Note: NISP = number of identified specimens.

unit possible, and any ambiguity in identification was resolved by placing the specimen designation in the next higher taxonomic category. Whenever possible, recorded specimen attributes included anatomical part, portion, side, size, age/fusion, and cultural and natural modifications (burning, butchering, weathering, and carnivore/rodent gnawing). Each specimen was examined macroscopically and then microscopically using a hand-held magnifying glass.

Quantification of these remains was computed by counting the number of identified specimens (NISP). No attempt was made to determine the minimum number of individuals (MNI) since NISP provides a valid measure of relative abundance of the various groups (Grayson 1984:50). Excluding unidentified mammals of various sizes and indeterminate specimens, the NISP of the non-fish vertebrate remains identified at least to class is 18 (Table 17). Only those elements identified to class or beyond are discussed below.

Two reptiles (class Reptilia) were identified, a western pond turtle (*Actinemys marmorata*) and an unidentified snake or lizard (Lepidosauria). Five fragments of turtle were found (two carapaces, one plastron, and two shell fragments), four of which were found within Feature 1 and are burned. One of these fragments was radiocarbon dated to 2010 ± 40 RCYBP (2000 to 1900 cal BP). Thus, it is clear that turtles were at least occasional constituents of the diet. It is likely that the unburned Lepidosauria vertebrae (n = 3) are intrusive constituents.

Two bird elements (class Aves) were identified, and neither could be identified taxonomically beyond general size (one medium and one small). Both elements (one tibiotarsus and one phalanx) were burned, so they probably represent food remains.

The class Mammalia remains (see Table 17) consist of three orders (Rodentia, Lagomorpha, and Artiodactyla). There are three genera of rodents, including three elements of woodrat (*Neotoma fuscipes*), one of vole (*Microtus californicus*), and one of pocket gopher (*Thomomys bottae*). The single Lagomorpha specimen (family Leporidae) is a molar, and the two Artiodactyla specimens (family Cervidae; *Odocoileus hemionus*) are enamel fragments. Two-thirds of all the remains in Table 17 are burned, including identified and unidentified specimens. There are no signs of butchering on any of the remains, although one bone from Feature 1 in TU-3 has a spiral fracture.

Discussion of the Faunal Remains

The faunal assemblage from the Manifold site is made up almost exclusively of aquatic resources (*Anodonta* and fishes). Identified species occur year-round, so seasonality of site occupation could not be determined. Owing to the fact that no fishing gear was identified, that terrestrial hunting tools (such as projectile points) are typical for this area, and that faunal remains other than *Anodonta* and fishes were scarce and/or highly fragmentary, no new information could be gleaned about animal procurement technologies.

The recovered fish elements reflect extensive exploitation of Sacramento perch, followed in abundance by Sacramento sucker and tule perch in fairly equal proportions. These results compare favorably with the fish recovered at Goose Lake (Jackson et al. 1992) and other sites in the Central Valley. It is important to note that at Manifold and other regional sites (see Gobalet et al. 2004; Bernard 2015) many remains can only be designated to class or family, leaving precise habitat exploitation in doubt.

There is extensive ethnographic and ethnohistoric literature attesting to the exploitation of fish by the Southern Valley Yokuts using various procurement techniques (e.g., Gifford and Schenck 1926:111–112; Gayton 1948:15). Nevertheless, other than the baked clay specimens that could possibly represent net weights (see above), no fishing gear was recovered from the Manifold site, although it is likely that nets

Table 17. Provenience and Identification of Non-Fish Vertebrate Remains from the Test Units and Column Sample at the Manifold Site (CA-KER-4220).

Unit/Level (in cm)	Taxon (Common Name)	Element	NISP	Burned?
TU-1				
10–20	Tetrapod	sacral vertebra	1	yes
	artiodactyl	enamel fragments	2	no
	mammal	tooth fragment	1	no
	Actinemys marmorata (western pond turtle)	shell fragment	1	black
40–50	*Neotoma fuscipes* (dusky-footed woodrat)	astragalus, complete (A)	1	no
	very small mammal	femur, proximal shaft (R)	1	black
50–60	small mammal	thoracic vertebra, complete (A)	1	discolored
60–70	Thomomys bottae (Botta's pocket gopher)	complete humerus, 2 pcs (A) (R)	1	no
TU-1 Column Sample				
20–30	very small mammal	long bones	2	yes
50–60	very small mammal	long bone	1	yes
TU-2				
0–10	Lepidosauria (snake/lizard)	vertebra	1	yes
TU-3 (no feature association)				
0–30	large mammal	unidentified	1	black, calcined
30–40	*Odocoileus hemionus* (mule deer)	tibia, proximal epiphysis (R) (S)	1	black
	Actinemys marmorata (western pond turtle)	carapace, lateral fragment	1	black
	Leporidae (hare/rabbit)	molar tooth, occlusal (R)	1	calcined
	Lepidosauria (snake/lizard)	vertebral fragment	1	no
	medium mammal	unidentified fragments	38	black, discolored
	medium-large mammal	long bone shaft fragments	10	discolored
	medium-large mammal	vertebra, centrum fragment	1	black
	medium-large mammal	unidentified fragments	6	black, discolored
70–80	Tetrapoda	caudal vertebra	1	no
TU-3 (Feature 1)				
40–50	Lepidosauria (snake/lizard)	vertebral fragment	1	no
	Actinemys marmorata (western pond turtle)	plastron fragment	1	discolored
	Actinemys marmorata (western pond turtle)	shell fragments	2	black
	Actinemys marmorata (western pond turtle)	carapace, lateral fragment	1	black
	medium-large mammal	long bone shaft fragment	1	discolored
	mammal	long bone shaft fragments (1 with a spiral fracture)	3	discolored
	mammal	unidentified fragments	2	black, discolored

Table 17. Continued.

Unit/Level (in cm)	Taxon (Common Name)	Element	NISP	Burned?
TU-4				
30–40	*Microtus californicus* (California vole)	femur, proximal shaft (A)	1	black
	Neotoma fuscipes	humerus, distal fragment (L)	1	black
	Neotoma fuscipes	tibia, proximal epiphysis (S) (R)	1	black
	very small mammal	caudal vertebrae, complete (A)	2	black
	Aves (medium)	tibiotarsus, distal shaft (A) (L?)	1	calcined
	Aves (very small)	1st phalanx, distal shaft (S)	1	calcined

Notes: NISP = number of identified specimens. (A) = adult; (S) = subadult; (R) = right side; (L) = left side.

and baskets were used to gather the fish. For smaller fish, fine netting would have been required (e.g., Gobalet 1989), which does not typically preserve in archaeological deposits and would not be recovered without extensive use of 1/16-inch mesh screens.

Archaeological and ethnographic data also attest to the frequent use of *Anodonta* by the prehistoric Yokuts (e.g., Gifford and Schenck 1926; Wedel 1941; Wallace 1978a, 1978b; Jackson et al. 1992; Culleton et al. 2005; Sutton et al. 2012). At Buena Vista Lake specifically, Wedel (1941:10) encountered abundant *Anodonta* remains at CA-KER-39 and -60 (also see Hartzell 1992). At Manifold, *Anodonta* in varying quantities was recovered from all surface shell features, all test units, and the column sample. Given the intentional clustering of shell that made up the surface features, we interpret these clusters as part of one or more large meals that were consumed and then discarded in place. A resident who lived near Tulare Lake between 1853 and 1861 described an "Indian Clam Bake," the term "clam" thought to be synonymous with *Anodonta* due to its ubiquity in the Buena Vista Lake basin prior to modern times:

> … the women slung their conical baskets on their backs … and entered the water fifteen or twenty abreast, carefully treading their way, and feeling with their toes. Whenever they felt a clam they picked it up with their toes, reached down and took it above the surface of the water and tossed it into the basket on their backs. The clams were very numerous for miles in extent at many places along the lake shore. They collected what they deemed sufficient for their purposes. For a big fiesta they collected two or three days at a time. When they got ready for the bake they gathered a quantity of dry tules, laid them smoothly on the ground, a layer about six inches thick. They then laid the clams like pavement on the floor [Latta 1976:70–71].

It is apparent from this narrative as well as from archaeological and ethnographic evidence that *Anodonta* was an important resource for the Yokuts, at least late in time and presumably much earlier when the lake basin contained considerably more water than it does today. Moreover, the description of "laid the clams like pavement on the floor" (Latta 1976:71) is similar to what was observed at the Manifold site and supports our contention that it was used, at least in part, for one or more "clam bakes."

As mentioned previously, analysis of the recovered animal remains indicates that *Anodonta* and fishes were the almost exclusive food sources consumed by Manifold inhabitants. One can picture a scenario in which an aquatic resource feast was coordinated, with clams and fish on the menu. On the other hand, the small number of units placed at the site could explain the lack of other resources, and additional excavations might paint a somewhat different picture. The surface artifacts as well as artifacts from the test units indicate that other activities beyond such a feast took place.

The projectile points in particular demonstrate that terrestrial animals were hunted, but the near absence of large mammal remains suggests that the animals were not butchered on site. The degree and type of processing of faunal remains may be a product of site function, duration of site occupation, nutritional requirements, access to raw materials, and/or other factors (see Gardner 2007:200). Alternatively, the highly fragmentary nature of the remains could indicate that butchering of some animals took place but were processed to the degree that they are difficult to detect. This supports the idea that the milling tools may have been used to grind animal carcasses.

Based on ethnographic and archaeological data regarding the use of waterfowl and other birds by the Yokuts (e.g., Latta 1977; Hartzell 1992), the virtual absence of bird remains from the Manifold site seems unusual, particularly since the site rests within a lacustrine environment where waterfowl would be expected to be present and exploited. For example, in her study of two sites on the south side of Buena Vista Lake (KER-39 and KER-116), Hartzell (1992; also see Fredrickson and Grossman 1977) identified numerous waterfowl remains that included rails, coots, grebes, ducks, geese, herons, and pelicans, among others. Other sites in the area (e.g., CA-KER-60, CA-KER-180, and CA-KER-766), however, have produced far fewer avian remains (Wedel 1941; Hartzell 1992; Jackson et al. 1992). The paucity of such remains from Manifold suggests that waterfowl may not have been a preferred resource over shellfish, fish, and mammals, although sampling bias cannot be discounted.

It is not surprising that beyond the abundance of *Anodonta* in the faunal assemblages at many sites along the shoreline of Buena Vista Lake, freshwater fish are also common constituents, sometimes in great quantities. For example, fish remains from the upper levels of KER-116 consisted of several species, such as thicktail chub, hitch, Sacramento blackfish, Sacramento perch, tule perch, and Sacramento sucker, among others (Hartzell 1992:257–259). At KER-180 (Hartzell 1992:282), while there were relatively few fish remains (NISP = 76), there was a wide diversity of species, including Sacramento perch, hitch, Sacramento blackfish, Sacramento sucker, thicktail chub, Sacramento splittail, and tule perch. In addition, Hartzell (1992:180–182) reported several fish species at KER-39, which also included Sacramento blackfish, Sacramento perch, hitch, Sacramento splittail, tule perch, and Sacramento sucker. At Big Cut (CA-KER-4395) (Sutton et al. 2012), Goose Lake (KER-766) (Jackson et al. 1992), and Bead Hill (KER-450) (Barton et al. 2010), Sacramento perch, tule perch, and/or Sacramento sucker remains were present but generally decreased in abundance with depth of the units.

With respect to mammals in the assemblages at other sites near Manifold, the remains are also generally highly fragmentary and frequently burned. Nevertheless, at KER-116 (Hartzell 1992:254–261), lagomorphs (mostly jackrabbits) made up the majority of mammal remains, followed in abundance by a variety of rodents, artiodactyls (deer and pronghorn), and carnivores (foxes, weasels, and bobcats). While identified remains at KER-180 were few in number, they included pronghorn, lagomorphs, and rodents. At CA-KER-39, Hartzell (1992:192) reported that while the faunal remains were "heavily represented by species from lake and near-lake environments," elk, pronghorn, and deer were also present. A similar pattern was observed at KER-60 (Hartzell 1992:188–191). Identified mammals from the Big Cut site (KER-4395) (Sutton et al. 2012) included lagomorphs, voles, and pocket gophers, although the rodent remains were considered to be natural occurrences. The few faunal remains from the nearby Grasse site (CA-KER-5408)[2] include *Anodonta*, fishes, and small mammals, almost all of which are burned.

In assessing the presence and importance of reptiles within the faunal assemblages in the area, probably the most significant finding is that at several sites (including Manifold, Big Cut, and KER-180), western pond turtles (*Actinemys marmorata*) have been identified. Western pond turtles were particularly abundant at KER-180 (NISP = 2,051) (Hartzell 1992:283). Most of the turtle remains were also burned and highly fragmented, indicating cultural modification. This supports the known ethnographic and archaeological data regarding the value of turtles to the Yokuts (see above). Interestingly, Wallace (1978a:450) reported that when turtles were processed, they "were stabbed under the throat with a sharp stick, put on coals, and roasted." While a few turtle remains were recovered at the Manifold site, no roasting pits (or sharp sticks) were identified, although almost all the remains were burned black. At a minimum, then, this suggests that they were roasted in some manner.

Snakes and lizards are also common constituents in the faunal assemblages of sites in the region, although rarely in abundance. Most such remains have been reported to be unburned and not likely cultural in origin. Moreover, there is almost no ethnographic or archaeological evidence of snakes or lizards as Yokuts food sources, although some snakes were used in ceremonies and rituals (e.g., Gayton 1948; Latta 1977).

Botanical Remains

The small amount (1.08 g) of unidentified, burned plant material retrieved from Feature 1 (TU-3, 40 to 50 cm) was likely introduced unintentionally into the feature at the time of its use or shortly thereafter. No botanical remains were found in any of the other features, test units, or soil/column samples. Moreover, few to no botanical remains were reported at any of the other sites discussed herein. Whether this indicates a lack of usable plant resources, disinterest in such resources by the site inhabitants, or recovery issues is unknown.

Gas Chromatography/Mass Spectrometry Analysis

The Manifold site lies within an active oil field, but has been only slightly damaged by oil-related activities. Site soils range in color from a relatively light tan to almost black. Areas of the very dark soil are discontinuous, at least on the surface, and originally it was thought possible that oil had contaminated the midden deposit, creating the "patches" of dark soil. In order to test this idea, soils from TU-3 were collected for chemical analysis. All the soil from each excavation level was bagged and taken to the CSUB laboratory, where it was soaked in water overnight and wet-screened through 1/8-inch mesh. After a day of soaking, a slight "oily sheen" was visually discernible in the water. Upon closer inspection, an odor akin to rotten fish was detected. Based on these observations, chemical testing was performed on a sample of the dark soil from TU-3 to determine whether petroleum was present (Rogers et al. 2002). No petroleum was detected, so it was concluded that the dark soil was anthropogenic.

Having made that determination, GC/MS testing was conducted to determine whether mollusk and/or fish residues were present and could be identified (Rogers et al. 2002). The sample submitted for the GC/MS analysis consisted of soils from TU-1 and TU-2, which represented both dark and light midden areas within the site. Control samples were included to assess the accuracy of the procedure. The GC/MS test was positive for the presence of *Anodonta* shell in the soils from these two units and was negative for fish and saltwater mollusks. The analysis also demonstrated that there was no possibility of contamination but that there was evidence of degradation of the organic compounds over time.

While it was already known that *Anodonta* was present in the site deposits, the GC/MS signature technique offers the possibility of identifying *Anodonta* in site soils where shell is not observed. This is particularly important in areas such as the Buena Vista Lake basin where it would be unusual for *Anodonta* to be absent at archaeological sites, at least in the form of visible shell. For example, knowing whether a resource was or was not used can provide critical information regarding subsistence practices, processing techniques, and intensity of occupation.

Dating the Site

The site was dated through various means, including radiocarbon assays, obsidian hydration, and the analysis of temporally sensitive artifacts (projectile points and shell beads). Each technique is discussed below.

Radiocarbon Dating

As noted previously, a number of discrete shell dumps were observed on the surface of the site that are believed to represent the remnants of one or more meals. In order to date these surface features, we needed to radiocarbon date the shell, particularly since there were no temporally sensitive artifacts directly associated with the dumps. However, radiocarbon dating of freshwater shell can be difficult due to dissolved carbon in water, similar to the marine reservoir effect (e.g., Stuiver et al. 1986). For this reason, paired samples of bone and shell were required to compute a correction factor for the shell at the Manifold site. While virtually no vertebrate remains were recovered within the surface features, samples of shell and vertebrate bone (large mammal and turtle) retrieved from Feature 1 in TU-3 were paired. Since Feature 1 was presumed to represent a single event, the bones and shell would be expected to be of the same age; the shell would date older, and the difference would be the correction factor. This offered an excellent opportunity to provide a correction factor for dating freshwater shell not only from this site but for the lower Kern River/northern Buena Vista Lake area in general (see Sutton and Orfila 2003:23–24).

The paired samples along with six additional samples of *Anodonta* shell from all but one of the surface features were sent to Beta Analytic for radiocarbon dating (Table 18). The two bone samples returned statistically identical dates, while the shell sample dated about 300 years older, thereby providing a correction factor of minus 300 years. Thus, as a result of the discovery of these shell dumps at the Manifold site, radiocarbon dates on freshwater shell from sites in this vicinity can now be corrected, contributing to a more precise understanding of the regional chronology (see Sutton and Orfila 2003; Culleton et al. 2005:224; Culleton 2006). Based on these radiocarbon assays, the range of time for site occupations date during the Middle Archaic, the Upper Archaic, and the Emergent period, with most dates falling between the latter two time frames.

Comparing these radiocarbon data to other sites in the region, KER-116 produced five dates from freshwater mussel shell that ranged between about 8,000 and 1,300 years ago (Hartzell 1992:216–217; also see Fredrickson and Grossman 1977; Sutton et al. 2012:4). Dates of 1200 cal BP at KER-39 and 180 cal BP at KER-180 were reported by Hartzell (1992:173, 274). At eight Elk Hills sites, Culleton et al. (2005:221; also see Jackson et al. 1998) reported 85 radiocarbon dates spanning the last 8,000 years on freshwater mussel shell, marine shell beads, modern *Olivella* shells, charcoal, and bone. Once again, these results indicate that sites in this region have been occupied at least sporadically throughout much of the Holocene.

Obsidian Studies

One of the projectile points (Cat. No. 511) collected from the site surface was submitted to Pacific Legacy in 1998 for obsidian study. The rim measurement for tthis specimen is 4.64 μ, and it was chemically sourced to the Coso Volcanic Field (CVF) (no

Table 18. Radiocarbon Assays from the Features at the Manifold Site (CA-KER-4220)

Sample	Beta No.	Material	Radiocarbon Age (RCYBP)	Corrected Age	Calibrated Age (cal BP)
001 (Feature 1)	178955	turtle carapace (*A. marmorata*)	2010 ± 40	N/A	2000 to 1900
002 (Feature 1)	178956	large mammal long bone	2030 ± 40	N/A	2010 to 1930
003A-005 (Feature 1)	178957	freshwater shell (*Anodonta*)	2320 ± 50	2020 ± 50	2350 to 2330
007B-003 (Feature 7)	179643	freshwater shell (*Anodonta*)	1090 ± 40	790 ± 40	1050 to 950
008B-003 (Feature 8)	179644	freshwater shell (*Anodonta*)	1110 ± 40	810 ± 40	1060 to 960
009B-001 (Feature 9)	179645	freshwater shell (*Anodonta*)	1170 ± 40	870 ± 40	1160 to 1050
010A-001 (Feature 10)	179646	freshwater shell (*Anodonta*)	1610 ± 40	1310 ± 40	1470 to 1430
005B-001 (Feature 12)	179641	freshwater shell (*Anodonta*)	4050 ± 40	3750 ± 40	4480 to 4440
006A-001 (Feature 13)	179642	freshwater shell (*Anodonta*)	4030 ± 40	3730 ± 40	4540 to 4430

Notes: A correction factor of minus 300 years was applied to the corrected ages of the samples of freshwater shell (per Sutton and Orfila 2003). Calibrated age is at 1 sigma.

subsource identified). In 2015, 17 additional specimens were submitted for analysis to the Northwest Research Obsidian Studies Laboratory (Table 19). The results demonstrated that 15 specimens are from the West Sugarloaf subsource in the CVF, and two are from Casa Diablo (Lookout Mountain).

Of those 17 specimens, one (Cat. No. 159) was excluded from the hydration analysis because it was too badly burned to cut, and six samples that were cut did not produce measurable rims due to heavy surface weathering and/or possible heat exposure. Of the 10 remaining specimens, the rim measurements range between 1.3 μ and 13.7 μ. The obsidian results generally correspond to site use between the Middle Archaic and the Emergent periods, with all but three readings showing the most intense occupation roughly between the Upper Archaic and the Emergent periods. Two of the three readings that fall outside that range (8.4 μ and 10.0 μ) generally correspond to the Middle Archaic, while the third reading of 13.7 μ is consistent with a Lower Archaic time frame. This latter reading may be an outlier since there was no other evidence of an occupation that early. For the most part, these data are consistent with the radiocarbon results.

At other sites in and around the Buena Vista Lake basin, the obsidian hydration rim measurements (Table 20) indicate site occupations between the Lower Archaic and the Emergent period. For example, of the 32 specimens from Goose Lake that were submitted for obsidian studies, 15 produced rim measurements, with eight readings corresponding to the Upper Archaic, six to the Middle Archaic, and one to the Lower Archaic (Moreland 1992:Table 1). Chemical characterization of these specimens indicated that all but seven were from the CVF. Of those seven, five were from Casa Diablo, one was from Truman Meadows, and one was unknown. All six rim measurements from the Big Cut site (KER-4395) (Sutton et al. 2012:24–25) correspond to an Upper Archaic occupation, and all but one unknown were sourced to the CVF.

At KER-116, the hydration rim measurements on 70 specimens ranged between 2.8 μ and 10.0 μ, although most fell between about 4.0 μ and 8.0 μ (Hartzell 1992:Table 6.14). This indicates occupations spanning the Holocene with more intense use between the Middle and Upper Archaic. Five sources were identified for the KER-116 obsidian, including the CVF (87 percent), Casa Diablo, Fish Springs, Obsidian Butte, and Mt. Hicks (Hartzell 1992:219). Obsidian studies at

Table 19. Results of Obsidian Studies at the Manifold Site (CA-KER-4220).

Cat. No.	Lab No.	Artifact	Hydration Rim	Source	Comments
058	1	debitage	8.0 ± 0.1	West Sugarloaf, CVF	–
068	2	biface	5.7 ± 0.1	West Sugarloaf, CVF	–
083	3	cf. RS PT	1.3 ± 0.1	West Sugarloaf, CVF	DFV, appears burned
109	4	cf. RS PT	NM ± NM	West Sugarloaf, CVF	NVH, appears burned
154	5	debitage	10.4 ± 0.1	West Sugarloaf, CVF	WEA; VS is UNR
159	6	biface	NM ± NM	West Sugarloaf, CVF	not cut (burned)
171	7	debitage	NA ± NA	West Sugarloaf, CVF	UNR, burned?
197	8	CLS PT	5.5 ± 0.1	West Sugarloaf, CVF	PAT
276	9	debitage	4.5 ± 0.1	West Sugarloaf, CVF	–
294	10	debitage	13.7 ± 0.1	West Sugarloaf, CVF	REC; rim from glassy dorsal scar
296	11	RS PT	3.9 ± 0.1	West Sugarloaf, CVF	REC; appears burned
317	12	cf. RS PT	5.5 ± 0.1	Casa Diablo (Lookout Mtn.)	–
324	13	biface	NA ± NA	West Sugarloaf, CVF	UNR, WEA
329	14	biface	3.8 ± 0.1	West Sugarloaf, CVF	rim from BRE, DS is WEA, UNR
336	15	biface	NA ± NA	West Sugarloaf, CVF	REC; appears burned
342	16	cf. CT PT	NA ± NA	West Sugarloaf, CVF	UNR, PAT
384	17	biface	NA ± NA	Casa Diablo (Lookout Mtn.)	UNR, WEA, burned?
511	–	CLS	4.64	CVF	Pacific Legacy (PL-98-474-1)

Notes: Rim measurements are in microns. With the exception of Cat. No. 511 (provided by Pacific Legacy), the X-ray fluorescence results were provided by Craig Skinner at the Northwest Research Obsidian Studies Laboratory in Corvallis, Oregon, and the obsidian hydration results were provided by Jennifer Thatcher at Willamette Analytics in Corvallis, Oregon.

Key: PT = projectile point; RS = Rose Spring; CLS = Cottonwood Leaf-shaped; CT = Cottonwood Triangular; NM = not measured; NA = not available; CVF = Coso Volcanic Field; DFV = diffusion front vague; NVH = no visible hydration; WEA = weathered; VS = ventral surface; UNR = unreadable; PAT = patinated; REC = recut; BRE = break; DS = dorsal surface.

KER-180 demonstrated rim values between 2.3 μ and 3.0 μ (n = 14), with one larger value of 4.7 μ (Hartzell 1992:276). This provides a fairly circumscribed time frame of occupation for this site during the Emergent period. All specimens from KER-180 were from the CVF.

At the Grasse site (KER-5408) just south of Manifold, eight rim measurements correspond to the Upper Archaic and six to the Emergent period. The Grasse site, then, illustrates the greatest similarity to the Manifold site in that both witnessed their most intense occupations between the Upper Archaic and the Emergent period. Given the short distance between them, this suggests that they may be different loci of the same site. It is interesting that of the 14 specimens from the Grasse site submitted for obsidian studies, four different sources were identified; CVF (more than half), Casa Diablo, Queen, and Obsidian Butte.

Turning to the Elk Hills sites reported by Culleton et al. (2005), of the hundreds of obsidian specimens submitted for analysis, the vast majority came from one site (CA-KER-5373/H; Culleton et al. 2005:229). The rim measurement readings ranged between about 1.5 μ and 18.5 μ, with one significant peak of about 12.0 μ to 14.0 μ and a smaller peak between about 5.0 μ and 6.0 μ. Once again, the obsidian evidence sug-

Table 20. Obsidian Data from Other Sites in the Buena Vista Lake Area.

Site/Area	Range of Hydration Rims (in microns)	Geologic Source	References
CA-KER-116 (Buena Vista Lake)	10.0 to 2.8 (n = 70)	Coso (87%) Casa Diablo (8%) Fish Spring (2%) Others (3%)	Hartzell 1992:218–229, Table 6.14
CA-KER-180 (Tule Elk Preserve)	4.7–2.3 (n = 15)	Coso (100%)	Hartzell 1992:274–275, Table 7.2
CA-KER-766 (Goose Lake)	4.4–11.5 (n = 15)	Coso (81%) Casa Diablo (16%) Truman Meadows (3%)	Moreland 1992:44, Table 1
CA-KER-1611 (Tule Elk Preserve)	17.0 to 4.9 (n = 8)	Coso (78%) Casa Diablo (22%)	Hartzell 1992:287–288, Table 7.7
CA-KER-3077 (Elk Hills)	6.05–13.19 (n = 5)	Coso (100%)	Culleton et al. 2005
CA-KER-3080 (Elk Hills)	2.18–18.07 (n = 31)	Coso (97%) Casa Diablo (3%)	Culleton et al. 2005
CA-KER-5373/H (Elk Hills)	1.82–15.59 (n = 65)	Coso (98%) Unknown (2%)	Culleton et al. 2005
CA-KER-5392 (Elk Hills)	4.53–13.79 (n = 16)	Coso (94%) Casa Diablo (6%)	Culleton et al. 2005
CA-KER-5404 (Elk Hills)	5.9–14.31 (n = 5)	Coso (100%)	Culleton et al. 2005
CA-KER-4395 (Big Cut site)	4.82–8.34 (n = 6)	Coso (83%) Unidentified (17%)	Sutton et al. 2012
CA-KER-5408 (Grasse site)	2.09–8.66 (n = 14)	Coso (57%) Casa Diablo (14%) Queen (14%) Obsidian Butte (7%) Unidentified (7%)	Unpublished data, report in preparation

Note: From Sutton and Des Lauriers (2002:Table 1).

gests that occupations at the Elk Hills sites spanned the Holocene. All the specimens were chemically characterized to the CVF (Culleton et al. 2005:229).

In their study of obsidian patterns in the southern San Joaquin Valley, Sutton and Des Lauriers (2002:5) pointed out that the average hydration rim values for the Elk Hills sites are significantly higher than those from the valley floor sites. This demonstrates at least two possibilities. The first is that there was "some differential pattern of obsidian use between valley floor and margins" (Sutton and Des Lauriers 2002:5). One scenario is that "villages" were on the valley floor and "special purpose sites" were along the margins (i.e., Elk Hills). In that case, obsidian tools may have been used for different purposes. A second scenario is that the obsidian pattern reflects "a shift in the settlement pattern from the valley margins to the valley floor" (Sutton and Des Lauriers 2002:5).

For sites in that study (Sutton and Des Lauriers 2002), as well as many other sites in the southern valley, the identification of several obsidian sources in far eastern California (CVF, Fish Springs, Casa Diablo), far southern California (Obsidian Butte near the Salton Sea), and far western Nevada (Mt. Hicks) indicates an extensive trading network and/or long-distance travel for direct access (perhaps via middlemen) through the major passes of the Sierra Nevada and from southern California (see Sutton and Des Lauriers 2002). The distance to the source of the obsidian, as well as the possibility of territorial conflicts, would likely dictate the method of obsidian acquisition, either by trade or by direct access (e.g., see Gardner 2007:193).

Projectile Point Typology

Thirteen projectile points fall within the Desert series, including 10 Cottonwood Triangular (or cf. Cottonwood Triangular) and three Cottonwood Leaf-shaped specimens (see Table 4). These points have a wide geographic range within the Great Basin and much of California, including the Buena Vista Lake basin (e.g., Hartzell 1992; Culleton et al. 2005; Barton et al. 2010; Sutton et al. 2012) where they are sometimes referred to as Tulamniu Cottonwood Triangular. The Cottonwood points from Manifold demonstrate site use during the Emergent period.

The six Rose Spring (or cf. Rose Spring) points (five from the surface and one from TU-3) (see Table 4) represent site use beginning in the Upper Archaic and continuing into the early Emergent period. The introduction of Rose Spring points is thought to herald the development of the bow and arrow in the western Great Basin, replacing the atlatl and dart as the primary hunting tool (Yohe 1992, 1998; Sutton et al. 2007). A single possible Humboldt point was also recovered from the surface. It is difficult to assess the age of Humboldt points because they can be found in multiple contexts (e.g., Thomas 1981:17), but they often occur between the Middle and Upper Archaic.

With respect to the contracting stem point from TU-3 (Cat. No. 490) (Table 4, Figure 20j), a variety of such points is known from coastal southern California and have been variously classified as Gypsum series, Elko contracting stem, or Vandenberg contracting stem (e.g., Heizer and Hester 1978:13; Thomas 1981:35; Justice 2002:241–275). Gypsum and Elko series points generally date between 4,000 and 1,800 years ago in the Mojave Desert (e.g., Sutton et al. 2007:241). While relatively rare, contracting stem points have been found in Orange County, including at Landing Hill in Seal Beach (Cleland et al. 2007:193) and at five sites along the coast between Newport and Laguna beaches (Koerper et al. 1994). In the Ballona Wetlands of Los Angeles County, such points have been identified at CA-LAN-61 (Lambert 1983:Figure 2; Van Horn and Murray 1985:95–96), CA-LAN-63 (Lambert 1983:Figure 5; Van Horn 1987:96–97, Figure 31), and CA-LAN-64 (Lambert 1983:Figure 6; Van Horn 1987:247, Figure 92). The Cat. No. 490 specimen appears to most closely resemble a Vandenberg contracting stem, dating it roughly between the Middle and Upper Archaic.

In the Buena Vista Lake basin, Hartzell (1992:230–239) reported stemmed and contracting stem dart points at KER-116 and other sites, which were variously identified as Buena Vista stemmed (similar to Elko and Pinto points), Old River series (bipointed and straight-based leaf-shaped dart forms), Elk Hills series (contracting stem dart points), and Buttonwillow series (large stemmed points). Hartzell (1992:295) suggested that the larger points from her study had temporal affiliations with Martis or Elko points. Similar point forms were also recovered from the nearby Elk Hills sites (Culleton et al. 2005:271–274).

Shell Bead Typology

Using the typology and temporal divisions of Bennyhoff and Hughes (1987), all but a few beads date to the Late period (Emergent period) or later. Some beads are poor temporal indicators (i.e., the Type G1 and A1a beads). Of the 92 *Olivella* beads that were identified to type, almost half (n = 44; 48 percent) were classified as H1a (n = 23) and H3 (n = 21). The H1a beads are thought to date to the early Mission period (ca. AD 1770–1800), and the H1b, H2, and H3 beads date to the late/terminal Mission (ca. AD 1800–1834) or post-Mission periods (ca. AD 1834–1900). The Class J bead is a marker type for the Protohistoric period in the San Joaquin Valley, continuing until about AD 1816 (Bennyhoff and Hughes 1987:136). The Middle period (Upper Archaic) is represented by the F2b, G2, and G4 beads, all of which are marker types (see Table 11).

The classification of 35 *Olivella* beads from the Bead Hill site (Barton et al. 2010:10) and of at least 60 *Olivella* beads from the Grasse site places these artifacts between the Middle Archaic and Emergent periods. The majority of the 35 *Olivella* beads collected from the Big Cut site date between the Upper Archaic and the Emergent periods (Sutton et al. 2012:14–16). For the Elk Hills, radiocarbon assays on numerous *Olivella* beads reported by Culleton et al. (2005:267–269) produced dates throughout the Holocene and into the protohistoric period.

It is interesting to note that at the Grasse site bead detritus and an obsidian drill suggest that the drill may have been used to manufacture beads. When the analysis of the Grasse site is complete, this could support the idea that it is temporally and spatially associated with the Manifold site, perhaps as a locus of bead manufacturing. In her analysis of bead detritus, Hartzell (1991:36–37) offered a technique for reconstructing the manufacturing sequences of shell beads: heat treatment, shell cutting, edge grinding, and ventral face drilling. She further observed that heat treatment can produce a uniformly white shell or a gray-black shell with spalling, depending on temperature (Hartzell 1991:36). At the Manifold and Grasse sites, there is evidence of each level of heat treatment applied to the beads (see Table 11).

Addressing the Research Issues

Several research questions were addressed at the Manifold site. These include whether the site represents a lakeshore occupation and how the mound may have been formed, as well as basic issues of function, chronology, seasonality, economics, ethnic identity, and placement of Manifold within the regional settlement system. Based on the results of the field investigations, each of these research issues is explored below.

Lakeshore Occupation

With respect to whether the Manifold site represents a lakeshore occupation, GC/MS results demonstrated that the dark, oily soils on the site were not the result of modern petroleum-related activities, confirming that there is indeed an extensive archaeological midden throughout. In addition, there is an abundance of *Anodonta* shell that was clearly processed for consumption and discarded immediately adjacent to the relict ≈300-ft shoreline, indicating that the occupants did not “schlepp” these mussels to a different location away from the lake (see Daly 1969). Therefore, given the location of the Manifold site along the northwest shoreline of Buena Vista Lake, the presence of a large and dark midden, the abundance of processed *Anodonta* and fish, and the diversity of artifacts that were recovered, there is little doubt that the site represents a lakeshore occupation. The extent and scope of that occupation is somewhat unclear, although the site appears to have been occupied at least sporadically between the Upper Archaic and Emergent periods.

Mound Formation

The building of artificial mounds was common prehistorically along the waterways of the northern and southern Central Valley for a variety of purposes, such as building house foundations, protecting against flooding, and exploiting particular resources (e.g., Schenck 1926; Schenck and Dawson 1929; Hewes 1941; Cook 1960; Latta 1977; Riddell 2002). Mounds in the Buena Vista Lake basin are not typically as large as those in the northern valley, although they have produced numerous human burials and a diversity of artifacts.

In the Buttonwillow area (about 20 miles west of Bakersfield), for example, Wallace (1971) identified numerous mounds at a number of sites that contained cultural materials and human remains. Two decades later, Sutton (1996:41) described the surface manifestation of the mound as "a relatively low (*ca.* 50 cm.) mound of dark-colored soil some 25 meters in diameter," although the entire site measured 45 m north–south by 35 m east–west. Excavations at that time revealed a deposit more than 2.5 m deep that contained a variety of artifacts, including three charmstones (Sutton 1996:45–46).

Mounds were also reported by Hartzell (1992:144; also see Wedel 1941) at two sites along the 290–300 ft contour of the southwest shoreline of Buena Vista Lake (KER-39 and KER-60), where a "nearly continuous scatter of cultural material" was observed between them. Both sites were "characterized by an extensive shellmound rising above the natural lake terraces" (Hartzell 1992:144). In addition, the Goose Lake site was described as being "atop a low linear mound that runs northwest–southeast" (Sutton 1992:26).

Judging by the significant quantities of *Anodonta* and fish in the subsurface features in TU-3 and within the surface shell features, it appears that the Manifold site was used on a periodic basis to prepare and consume these resources, after which the meal remnants were discarded on site. It is not clear whether these activities played a role in the creation of the mound at Manifold or whether it was artificially constructed for some other purpose.

Site Function and Chronology

The Manifold site is interpreted as a temporary camp that may be a satellite site to the Tulamni village of Tulamniu (Dieckman 1977; see below), the main activity apparently being to obtain, process, and consume *Anodonta* and fish within a group setting. Additional activities at the site included the production and use of flaked stone tools, ground stone tools, and beads. The radiocarbon, obsidian, and typological data indicate that site use took place primarily between the Upper Archaic and Emergent periods.

Seasonality and Economics

While *Anodonta* shell and vertebrate remains (mostly fish) were identified at the site, none provides clear evidence of seasonality. As to their potential significance to the diets of the prehistoric inhabitants, however, most sites near the shores of Buena Vista Lake have yielded considerable data regarding the use of *Anodonta* and fishes (as well as other resources) by the Yokuts (e.g., Gifford and Schenck 1926; Wedel 1941; Wallace 1978a, 1978b; Hartzell 1992; Jackson et al. 1992; also see Sutton et al. 2012:18).

As far as we know, however, Manifold is the only site along the shores of Buena Vista Lake where *Anodonta* shell has been found in discrete surface piles (dumps) that appear to be the collective refuse of meals.[3] We believe these dumps represent preference-related cuisine (e.g., Sutton and Reinhard 1995), as well as an example of discard behavior (i.e., drop and toss zones; Binford 1983:153). In his study of discard behavior of the Nunamiut Eskimo, for instance, Binford (1983:153) observed that larger items were tossed aside during mealtime, an action considered to be "a kind of 'preventive maintenance' of the seating area." Wandsnider (1996:346) noted that preventive maintenance of drop and toss zones "may occur more often at locations where occupations are brief but reoccupation is expected." As occupations at the Manifold site appear to have been intermittent, such preventive maintenance may have taken place.

In relation to ecotone/ecozone utilization and catchment zones, evidence of ecozone utilization by the occupants of the Manifold site includes resources primarily associated with an aquatic habitat (Buena Vista Lake), those being the *Anodonta* and fish. Resources of the Lower Sonoran, Alkali Sink, and Freshwater Marsh associations may have also been available but only consumed occasionally. Once again, sampling bias could account for the absence of plant remains and the near absence of terrestrial faunal remains.

In terms of the catchment zone concept, resources in Zone 1 for the Manifold site would have consisted primarily of the mussels, fishes, and turtles that could be taken along the shoreline of the lake. Zone 2 might include some terrestrial animals, such as deer and rabbit. The most obvious resource for the Manifold site within Zone 3 is obsidian from the Coso Range and Casa Diablo, both located along the eastern slope of the Sierra Nevada in far eastern California. It may be that fish from Zone 1 was traded for obsidian in Zone 3. Catchment zone analysis can also provide the means to evaluate the productivity of resources exploited by the inhabitants of a prehistoric site. At Manifold, as well as at other sites along the shores of Buena Vista Lake, it is clear that fish and *Anodonta* were productive resources that were commonly procured and consumed by the Tulamni.

Ethnicity of the Site Inhabitants

Based on archaeological, ethnographic, and historical data (e.g., Gayton 1948:Map 1; Dieckman 1977; Sutton et al. 2012), the Yokuts occupied several sites immediately adjacent to or very close to the shores of Buena Vista Lake (Kroeber 1925:478; Wallace 1978:448) (see Figure 1). Dieckman (1977:49) reported that journals of early Spanish explorers described a Yokuts village on the northwest shore of the lake that they called Buena Vista Village, known archaeologically as the Bead Hill site (KER-450; Barton et al. 2010). Dieckman (1977:50) suggested that Buena Vista Village was actually the ancient Tulamni village of Tulamniu.[4] Moreover, the Manifold, Bead Hill, Big Cut, and Grasse sites are all within a short walking distance of each other, suggesting that these four sites may represent separate loci of the same site—perhaps Tulamniu. The time depth of any Yokuts occupation of the site is unknown.

Placement of the Manifold Site in a Regional Context

As noted in the research design, in order to place the Manifold site within the regional settlement system that encompasses the Buena Vista Lake basin, comparisons were made with other sites in the area in order to assess how they are similar or dissimilar to Manifold. To do this, we compared several sites along or near the shoreline in terms of their function, chronology, seasonality, and other aspects of culture (see Table 21).

Based on admittedly limited fieldwork, the Big Cut site (KER-4395) was interpreted as a temporary (perhaps seasonal) camp that may have been a satellite to the Bead Hill site (KER-450) (Sutton et al. 2012:25). The site witnessed two significant occupations, one during the Middle Archaic and one during the Emergent period. The Grasse site (report in preparation) also appears to be a temporary (seasonal?) camp that has some evidence of occupation between the Middle Archaic and Emergent periods. The Manifold and Grasse sites could have served as satellites to Bead Hill.

While the Goose Lake site (KER-766) is much further away from Manifold, Big Cut, and Bead Hill (≈25 miles to the northwest), its location at the north end of Goose Lake Slough near the confluence with Buena Vista Slough provides an opportunity to make comparisons with sites along the northwest shore of Buena Vista Lake at the southern end of Buena Vista Slough (also see Peterson and Clift 1992). The site is a “rare example of an intact lakeside site” (Sutton 1992:26) dating between the Lower Archaic and Emergent periods, making it potentially the oldest and perhaps most consistently occupied site along the waterways of the lake country. However, if and how the Goose Lake site is associated with the other sites discussed here remains unknown.

Table 21. Characteristics of Sites In and Around the Buena Vista Lake Basin.

Site	Description/Attributes	Primary Period(s) of Occupation	References
CA-KER-240 (Buena Vista Golf Course)	Site size = ~15 x 10 m; cemetery with at least 7 burials; ocher, tule matting, *Haliotis* pendants, *Olivella* beads, bird skeleton, asphaltum chunks, projectile points (Desert series), fishhook, juniper posts (grave markers); trauma noted on Burial 5 (embedded points, skull depression), variety of other mortuary items	Emergent	von Werlhof 1960; Siefkin et al. 1996
CA-KER-766 (Goose Lake)	Site size = ~240 x 80 m; temporary camp; 8 projectile points (4 Cottonwood Triangular, 1 Elko, 2 unclassified), bifaces, core, hammerstones, debitage, beads (*Olivella*, glass, stone), variety of ground stone tools, ceramic sherd, vertebrate and invertebrate remains	Upper Archaic to Emergent	Laframboise 1992
CA-KER-450 (Bead Hill)	Site size = ~200 x 300 m; possibly the village of Tulamniu; >1,000 beads (*Olivella*, stone, bone, glass), at least 15 projectile points (1 Cottonwood Triangular, several unclassified; see note below), debitage, core, scrapers, drill, a variety of ground stone tools, bone pins and awls, incised bone, ceramics, asphaltum fragments, historic artifacts (screws, wire, glass bottle sherds, straight pins, white glazed china, earthenware), vertebrate and invertebrate remains	Middle Archaic to Emergent	Dieckman 1977; Barton et al. 2010
CA-KER-2720 (Buttonwillow)	Site size = ~45 x 35 m; small habitation site; charmstone cache, milling tools, points, cores, other flaked stone tools, *Anodonta* and vertebrate faunal remains, debitage, human burial	Middle Archaic (?) to Emergent	Sutton 1996
CA-KER-4220 (Manifold)	Site size = ~300 x 120 m; habitation site, primarily used to prepare and consume *Anodonta* and fish (as evidenced by shell features); 24 projectile points (Cottonwood Triangular, Cottonwood Leaf-shaped, Rose Spring, possible Humboldt), bifaces, drills (chert and bone), cores, hammerstone, debitage, a variety of ground stone tools, beads (*Olivella*, bone, clamshell, steatite), charmstone	Upper Archaic to Emergent	Sutton et al. (this report)
CA-KER-4395 (Big Cut)	Site size = ~300 x 200 m; temporary (maybe seasonal) camp; 8 projectile points (4 Cottonwood Triangular, 1 Elko, 1 Gypsum, 1 Humboldt, 1 stemmed), bifaces, debitage, a variety of ground stone tools, beads (*Olivella, Haliotis,* clamshell, stone, glass), steatite pipe, vertebrate and invertebrate remains	Middle Archaic to Emergent	Sutton et al. 2012
CA-KER-5408 (Grasse)	Site size = ~250 x 300 m; temporary camp, possibly a bead manufacturing site (at least 60 *Olivella* beads, bead detritus, obsidian drill tip); 5 projectile points (Desert and Rose Spring series, dart point), debitage, a few bifaces, cores, hammerstones, mano fragments, baked clay fragments (with impressions), small quantities of vertebrate and invertebrate remains	Upper Archaic to Emergent	Unpublished data, report in preparation

Notes: Dieckman (1977:51) recovered 14 projectile points (or fragments thereof) at the Bead Hill site, none of which were classified at that time; Barton et al. (2010:6) identified the Cottonwood Triangular point. Most of the artifacts listed in this table for the Bead Hill site were reported by Dieckman (1969).

Conclusion

The combined data sets from the Manifold site indicate that the most intensive occupation was between the Upper Archaic and Emergent periods, although there is limited evidence of earlier use during the Lower and Middle Archaic and subsequent use during the Mission period and later. This pattern is seen at other sites within the Buena Vista Lake basin, illustrating relatively continuous (albeit likely intermittent) human occupation throughout much of the Holocene, although more data are available for the Upper Archaic and Emergent periods.

The Manifold site appears to represent one aspect of the settlement and subsistence system in the Buena Vista Lake basin, one in which the predominant (and virtually sole) resources were *Anodonta* and fish.

The preparation, consumption, and discard behaviors represented by the small shell dumps that make up the "clam bake" at Manifold are currently unique in the region and provide a glimpse into food preferences and cuisine along the shoreline.

Notes

1. The Manifold site is located within an area protected by the Wildlife and Endangered Species Protection Program implemented by ARCO. As such, work undertaken at the site complied with the requirements of the protection program. Therefore, implementation of the research design included provisions to ensure the safety and well-being of the wildlife and plant life in the area. Moreover, the Native American Heritage Preservation Council of Kern County was contacted regarding any concerns they might have. At the start of the fieldwork some 20 years ago, they responded with a request to be involved and informed, which was happily agreed to. We believe that their involvement and participation in the project was an essential component of this research.

2. The report on the excavations at the Grasse site is in preparation and the authors had access to the collection in preparing this article.

3. It is noted here that numerous subsurface shell concentrations and at least one "shell discard feature" were identified by Culleton et al. (2005) in their Elk Hills study. However, it is important to make the distinction that while their descriptions of the shell concentrations from their test units are very similar to those in TU-3 at the Manifold site, there is no description in their report that even remotely resembles the collective surface shell dumps at Manifold.

4. Currently it is listed as California Historical Landmark No. 374, "Tulamniu Indian Site" (http://ohp.parks.ca.gov/?page_id=21423). Per the OHP website, the "village of Tulamniu was named Buena Vista by Spanish Commander Fages in 1772. Fr. Zalvidea again recorded the site in 1806. This village was occupied for several centuries, and in 1933–34 [it was] excavated by the Smithsonian Institution."

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