ARCHAEOLOGICAL INVESTIGATIONS AT A PROTOHISTORIC FISH CAMP ON THE RECEDING SHORELINE OF ANCIENT LAKE CAHUILLA, IMPERIAL COUNTY, CALIFORNIA

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Acreage: 0.10
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1. INTRODUCTION

Data recovery at IMP-7750 provided a unique opportunity to excavate the entirety of a rock-lined pit house structure and associated midden on the final receding shoreline of ancient Lake Cahuilla. Radiocarbon dated to approximately A.D. 1700, the site represents one of many rock- lined structures recorded in the vicinity of Salton City (Figure 1). Several rock structures are associated with fish traps at the lowest recorded elevations for this feature in the Salton Trough, well exceeding 30 m (100 feet) below sea level. This site is one of those fish camps, probably occupied by protohistoric Cahuilla or Kumeyaay who exploited a final phase of Lake Cahuilla in the late 17^{th} century. Abundant fish bone and macrobotanical remains indicate a specialized subsistence base of fish from the receding lake and salt-resistant plants that thrived on the newly exposed lake bed. Discoveries of ceramics, milling equipment, beads, projectile points, and lithic debitage indicate the extent of discarded material remains from a single domestic unit that occupied this location for several weeks of a single season. A level of discrimination was therefore possible that cannot be made at multi-component residential sites. Applying environmental data from the historic Salton Sea, settlement and subsistence patterns are reconstructed from the analysis of artifacts and ecofacts. Carrying capacity simulations based on faunal and floral finds are used to interpret the site as a specialized extractive site where a domestic group lived while they processed fish for transport to another location.

This project was undertaken in response to the Imperial Irrigation District's L-Line pole replacement project and for compliance with Section 106 of the National Historic Preservation Act. A total of 32 sites and 20 isolates were encountered or previously recorded during an intensive Class II survey of the project Area of Potential Effect (APE) (Schaefer et al. 1998). Of the 20 sites determined by the BLM to be eligible for the National Register of Historic Places, four could not be avoided through project design and monitoring because of their proximity to poles or access roads (Figure 2). A data recovery treatment plan and research design was prepared to mitigate impacts to these sites (Schaefer 1998) and following consultation with the Torres-Martinez Band of Cahuilla Indians, an ARPA permit for data recovery was issued by the BLM. The Torres-Martinez Reservation provided monitoring services and will ultimately curate the archaeological collection in cooperation with the Agua Caliente Band of Cahuilla Indians. In addition to the fish camp at IMP-7750, one other artifact scatter related to Lake Cahuilla was also recovered. Three additional sites were found to be not significant.

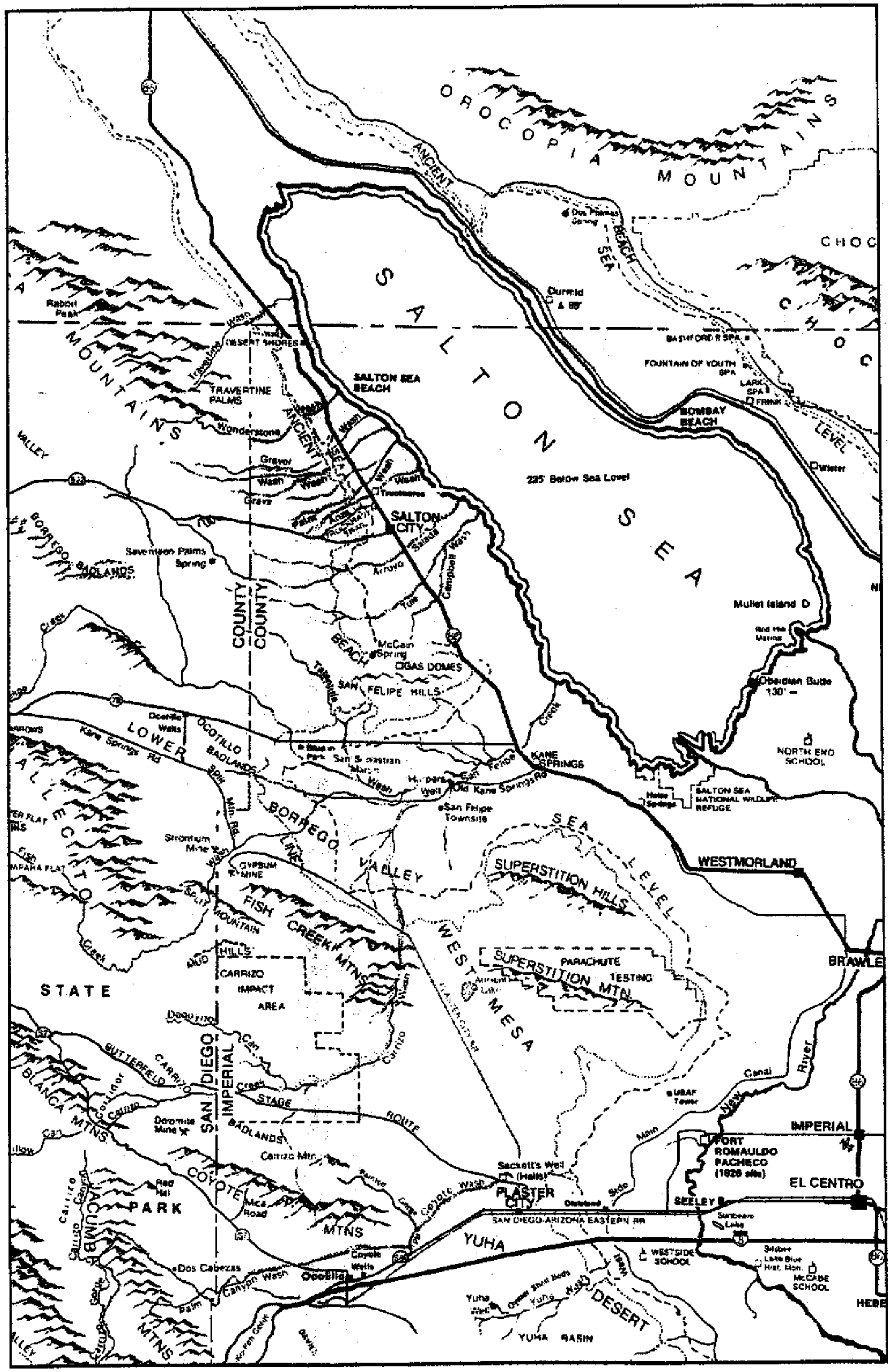


Figure 1. Regional context of sites.

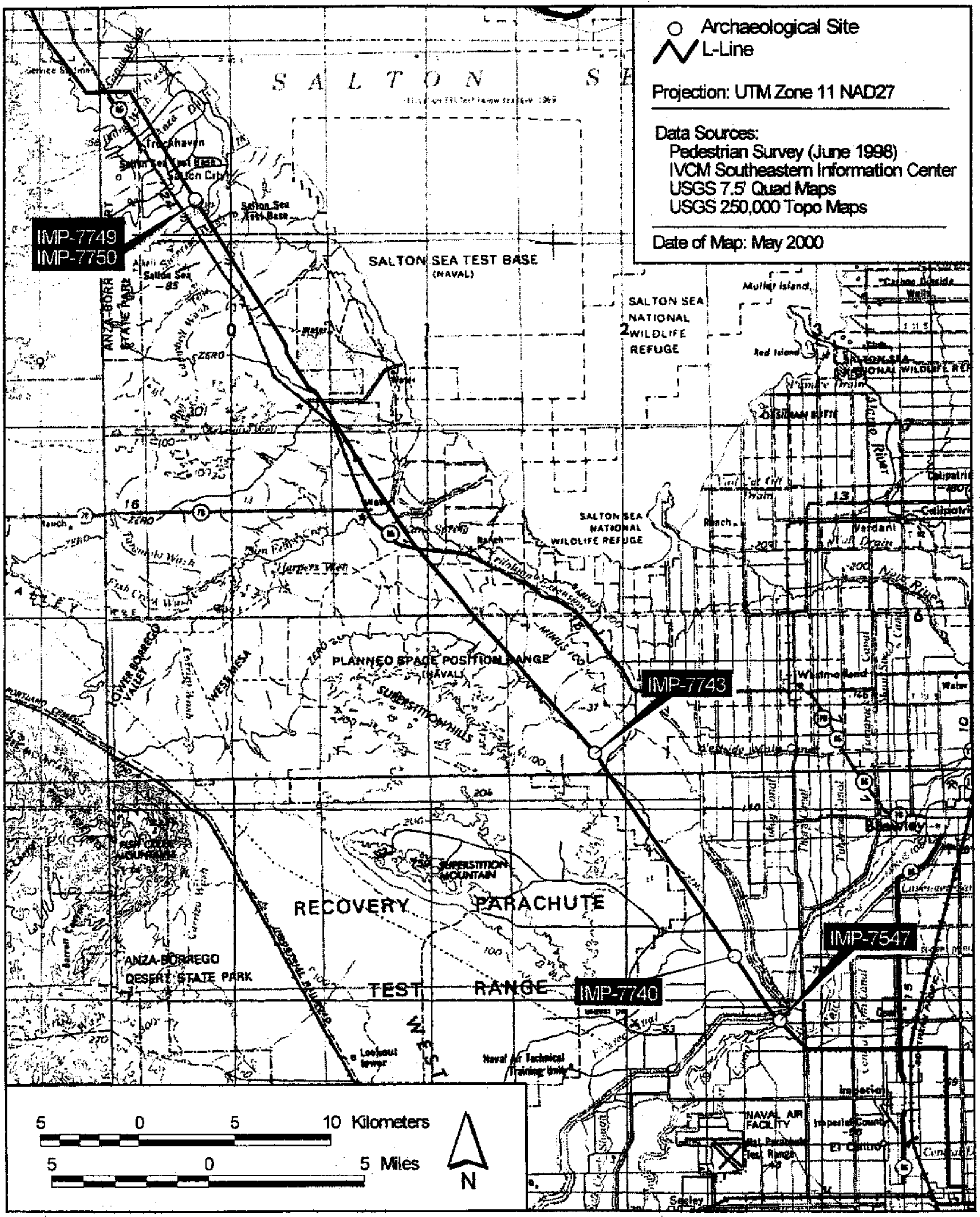


Figure 2. IMP-7750 site location on Truckhaven 7.5' USGS map.

2. BACKGROUND

ENVIRONMENT

The Colorado Desert is characterized by hot, summers, mild winters, and low annual rainfalls. Summer temperatures frequently exceed 115° F, with precipitation averaging only 6.4 cm per annum. Violent summer storms are not unusual, but most of the precipitation falls in mid-winter. Because of the sparse vegetation, runoff associated with these rains is typically severe, especially in the large portions of the central basin characterized by hard lacustrine clays. As a consequence, few permanent water sources are found in this area of the Salton Rift, although seasonal springs and Indian dugwells associated with localized aquifers are irregularly dispersed within the area. Two examples include San Felipe Creek which joins with Carrizo Creek and Fish Creek, several miles southwest of the study area. By far the most dominant lacustrine feature was Lake Cahuilla, a large and extensive freshwater lake that filled the northern part of the Salton Trough for several thousand years and attracted prehistoric peoples for some time.

The entire project area lies within a unique portion of the great Sonoran ecozone known as the Colorado Desert region, which owes many of its characteristic features to its location within the Salton Rift. This distinct geomorphologic feature consists of a massive graben formed by the interface of portions of the North American and Pacific plates. The trough formed by the ongoing movement of these faults and the general subduction of the basement formations has been filled by immense quantities of colluvial and alluvial sediments which, in places, are up to 20,000 ft deep (Morton 1977).

A great quantity of these overlying sediments have been derived from the continuous uplift and erosion of the high Peninsular Range to the west, and the older Chocolate and Cargo Muchacho mountains that lie along the eastern boundary of the rift. However, much of the Tertiary and Quaternary Age materials within the Salton Rift were laid down and reworked by the ancient meanderings of the Colorado River. At the point where the Colorado River empties into the Gulf of Mexico it releases its finer sediments onto a vast and growing delta, while the coarser materials fall out along the bed and nearby floodplains of the river. Thus the trough is being constantly filled with sediments even as it deepens, although portions of the central valley remain well below sea level.

The geology of the project area includes Quaternary lacustrine silts and clays of Lake Cahuilla (Borrego Formation) and overlying older Pleistocene mixed lacustrine/terrestrial facies of sandstone, silts, and clays of the Brawley Formation (Brawley Formation). Surface deposits include Holocene Lake Cahuilla sediments, recent alluvium in shallow washes, and dune sands (Jennings 1967). The pit house at IMP-7750 was build to abut a Brawley Formation sandstone outcrop that forms a solid pavement on the west side. Slabs of this sandstone were used as building materials and for milling equipment. Local Salton Brown Ware ceramics also derive from Brawley Formation clays.

Prior to dam construction on the Colorado River, the slower flow of the river meanderings resulted in the deposition of a great deal of sediment in the lower channels of the delta. This encouraged local flooding, which dropped even more sediments on the fan. This gradual accumulation of silts raised the overall height of the delta and lowered stream channel margins above the average grade of the main river channel to the north, resulting in an impoundment and flooding of the Salton trough. This was particularly common after large flood events, when the receding waters of the Colorado River were unable to find a route back through the newly reworked surface of the delta. The Salton Trough filled with water in about 18 years, it is estimated, to form the largest freshwater lake in California. It was 110 miles long, 32 miles wide, and over 280 feet deep at the center. The lake filled to an elevation of 12 m (40 ft.) above sea level, the height of the delta that acted as a dam and through which there must have been overflow channels.

The lake in all its phases is alternately referred to as the Blake Sea, Lake LeConte, or Lake Cahuilla and is today evidenced by extensive deposits of lacustrine sediments and kilometers of relic shoreline formations. The typical late Holocene stand is marked by extensive beach formations at approximately 12 m (40 ft) above sea level, while the higher stands typical of the late Pleistocene and early Holocene extended to over 30 m above sea level. These landforms can be found along the appropriate contours throughout the Salton Trough. Today, only two smaller saline bodies of water, the Salton Sea and Laguna Salada, remain as echos of the ancient lakes.

Eventually the Colorado River would find its natural course through the delta again and the lake waters gradually receded in a process estimated to take up to 60 years if no new water recharged the lake. Radiocarbon dates from marsh deposits and archaeological sites around the lake indicate from two to three major infillings over the last 1300 years, each lasting for several hundred years. There were also partial infillings and many fluctuations in lake levels. Up to the 1980s, this process was believed by archaeologists to have ended by A.D. 1540 and the first Spanish expeditions up the Colorado River (Wilke 1978). These would not have been possible if the river was still flowing into Lake Cahuilla. In fact, Gifford (1931:83) speculated that there may have been Lake Cahuilla infillings between Spanish visits to the Colorado River based on Kamia origin accounts that the El Centro area lay under the "Salton Sea" when they first entered Imperial Valley (Gifford 1931:4, 79, 82).

Now subsequent research at over a dozen sites located below sea level have proven Gifford correct. Over 30 radiocarbon dates from a dozen sites have conclusively demonstrated that there was at least a partial infilling as recently as A.D. 1600-1700, between Spanish visits to the river (Laylander 1995, 1997, Schaefer 1994a). A substantial beach berm was preserved at sea level at the southern end of the lake and on which a large fish camp was investigated (Schaefer 1986). This may indicate the level to which Lake Cahuilla rose in the protohistoric phase.

IMP-7750 is located at 47 m (155 ft.) below sea level in the lowest portions of the Salton Trough. It is located at the southern end of Salton City approximately 150 m south of Zenas Wash and 1.7 km north of the Salton Sea Test Base boundary. The site is located in close proximity to graded lots, houses, and partially developed areas in Salton City and it is a wonder that it remained undisturbed in such a populated area. Natural vegetation in the immediate area is sparse and is dominated by halophytes of the Alkali Sink habitat and the Saltbush vegetative community, including saltbush (*Atriplex* spp.), pickelweed (*Allenrolfia occidentalis*), and greasewood (*Sarcobatus vermiculatus*). Noticeably absent from the area are typical plants of the Creosote-White Bursage community, including creosote (*Larrea tridentata*), white bursage (*Ambrosia dumosa*), brittlebush (*Encelia farinosa*) and ocotillo (*Fouguieria splendens*). These plants become increasingly more common as one approaches sea level, approximately 4 km to the east.

The Native Americans who followed the receding Lake Cahuilla shoreline would have faced a much different and dynamic environment than is currently present. These conditions can be partially reconstructed from the observations of scientists who were assembled by the Carnegie Institution of Washington to investigate the ecology of the newly formed Salton Sea. This miniature mimic of Lake Cahuilla was created when poorly conceived headgates for an irrigation system from the Colorado River to Imperial Valley were washed away in a series of natural floods of the Colorado and Gila rivers. From the end of November, 1905 until February of 1907 the full flow of both rivers emptied into the Salton Trough, creating the present Salton Sea (Wells 1907; MacDougal 1914a; Frisby 1992).

D.T. MacDougal was among the people to see the headgate in operation in 1904, and then witness the 1905 summer flood that enlarged the channel into the Salton Basin. A botanist with the New York Botanical Garden, he was leading a collecting trip in the delta. He had conducted a brief trip to the Salton Trough in 1903 and continued research in the area the following year. MacDougal and his colleagues recognized the unprecedented opportunities to study the environmental dynamics of the flood and brought another team back in subsequent years to study the geology, soils, plant ecology, and water chemistry. They compiled an important data base on the changes in hydrology and vegetational succession following the end of the flood in 1907, its rapid recession, and eventual stabilization through 1912 (MacDougal 1914a,b). They also catalogued some 200 plant species in the Salton Sea area, including several habitats above the Alkaki Sink but still below sea level.

Before applying the Carnegie Institution study, there are significance differences between the Salton Sea and Lake Cahuilla that need to be appreciated. The Salton Sea covered less than a quarter of the area of Lake Cahuilla and rose to only -195 ft. compared to the much higher +40 ft. of the ancient lake. When MacDougal observed freshly exposed surfaces of the receding Salton Sea they had only been inundated for from one to three years, while the bottom of Lake Cahuilla had been flooded for possibly 50 years or more before exposure to sun and seed. In general, the Salton Sea phenomenon represented a shorter and more rapid inundation and recession sequence. Water salinity was probably also much higher by the time Lake Cahuilla receded to the project area since a greater volume of water had evaporated and more time had passed for salts to leach out. Yet the descriptions of the receding Salton Sea is a very plausible analogy to the last, and possibly partial stand of Lake Cahuilla. This vegetative reconstruction finds support in the macrofloral and pollen analyses from IMP-7750 as we shall see in the following chapters.

MacDougal et al. were able to make careful observations of areas that had been completely denuded of vegetation and were revisited once or twice annually over several years for botanical collection. These included emergent hilltops that reappeared as islands in the Salton Sea. Also surveyed were lower parts of bajadas and detrital slopes on the west shoreline. Most significant of the teams observations of plant species occupying the Salton Sink were the influence of increased humidity and soil moisture on plant species above the lake levels, the survival of vegetation in the marginal portions of the sea, and the patterns of plant colonization and succession on newly emergent and denuded stands and islands. Observations tend to be anecdotal, however, and were not based on systematic transect surveys as practiced by modern botanists. Still, their observations have validity and indicate the variety and general abundance of plant species present during the recession.

The initial Salton Sea recession was extremely rapid once the breach in the delta had been closed on February 10, 1907. During the five-year study period, water levels decreased vertically by 6.4 m (21.16 ft.), averaging 129 cm (50.8 in.) per year. Depending on the location, the horizontal recession could be very great. At Travertine Wash, the shoreline retreated 305 m during the first year and another 183 m the following year. Recession was greatest during the summer months from June through August due to evaporation; as much as 1.5 m daily (MacDougal 1914b:122). During December and January the recession slowed to a crawl, leaving a series of beach strands behind. Certain halophytic and xerophytic plants would take root and in front of the strands and some wetland species could temporarily gain a foothold. As the waters continued to recede, the strands would develop into erosional banks and the least drought-resistant species would die off as soil moisture was depleted. Several different patterns of colonial succession was thus observed that varied with local topographic conditions. For example, a greater variety of plants would colonize steeper gravelly slopes once the water receded. Fewer species would initially colonize the alkali flats due to higher water salinity and temperatures that tended to kill seeds in the water and soil. Once revegetation proceeded, it was limited to the most hardy halophytes. Revegetation was also most vigorous where older stream channels had filled with silts during the innundation.

The botanical studies suggest that Indian groups who followed the receding shoreline did not have long to wait before substantial opportunities arose to exploit important plant staples, as identified for the Cahuilla by Bean and Saubel (1972). Many of these plants had utilitarian and medicinal functions as well. Some of the earlier colonizers that generally withstood the eventual progress of soil dessication were *Atriplex canescens* (fourwing saltbush), *Atriplex lentiformis* (big saltbush), and *Suaeda torreyana* (seepweed). Seeds were gathered in great numbers, parched, ground, and made into cakes. *Suaeda* greens were cooked and eaten. These would be among the species to remain as dependable staples after the final dessication.

Shoots of several salt-tolerant wetland species would emerge along the strands as long as soil moisture remained high. Among the most abundant was *Pluchea sericia* (arrowweed). Roots of young plants were roasted and eaten. The straight stems were used to make arrow shafts, structural walls, roofs, and granaries. Arrowweed was found to be growing along strands for up to five years after the waters receded from them, but were found to be slowing dying with increased soil dessication. Under the same conditions, shoots of *Typha angustifolia* (cattail) and *Scirpus paludosus* (tule) also emerged. The roots of both were ground and cooked. *Typha* pollen was also a tasty and nourishing food item. Small amounts of *Juncus cooperi* were also recorded, an important basket-making material. These species only survived for a year after the recession. Also associated with this species were emergent *Salix nigra* (willow) and *Populus fremonii* var.

macdougalii (cottonwood) which remained for several years after the recession. Seeds of *Prosopis glandulosa* (mesquite) was found to be incapable of surviving submersion in the saline waters of the Salton Sea and as a result, were rarely encountered along emergent strands. *Prosopis pubescens* (screwbean mesquite) was found to be much hardier under saline soil and water conditions. They were actively colonizing strands on Obsidian Island and the Travertine Terraces. Mesquite beans were an important staple food collected in late Spring and stored for use throughout the year. Considerably more opportunities for plant exploitation were present during the final recession than we might have expected. Also winter season would have afforded greater shoreline stability from which to establish fish traps.

CULTURE HISTORY

The culture history of the sites under consideration here begins with the Late Prehistoric period. Approximately 1,200 years ago the people of the Colorado Desert region began to adopt the use of ceramics, a skill probably introduced from the flourishing Hohokam culture area to the east or Mesoamerica to the South. This marks the beginning of what Malcolm Rogers (1945) termed the "Yuman" period, which is the first archaeological period in the Salton Rift for which substantial information is available. Today it is more often referred to as the "Patayan Pattern." Agriculture was not introduced into the regions removed from the Colorado River until quite late, so that these groups were reliant upon the more abundant natural resources provided by the oasis surrounding the Colorado River, the desert springs, and the shores of Lake Cahuilla.

Late prehistoric peoples living in this region typically organized themselves into mobile bands that had flexible mobility and settlement strategies to deal with seasonal and other environmental dynamics. Their camps were simple, the primary structures being brush huts and ramadas. These same people maintained elaborate long-distance trail systems across much of the Colorado Desert. Their paths allowed relatively efficient and safe travel over the long and relatively featureless tracts of desert that separate sparse water sources and special resource exploitation areas. Pot drops, short-term camps, pictographs, petroglyphs, and trailside shrines attest to the long use of these trails by generations of people for trading expeditions, warfare, and relocation.

The Late Prehistoric period in the Colorado Desert is usually divided into three sub-phases based primarily upon changes in settlement patterns and pottery styles. The Patayan I phase dates to between about A.D. 500 and A.D. 1050, and appears to extend from western Arizona to the Colorado Desert. The eastern margins are characterized by a mixed horticultural and foraging economy, while the western desert could only support mobile foraging groups. By about 950 A.D. the distinctive cultural traits that characterized the Colorado River groups are reflected in Colorado and Mojave desert sites of the Patayan II phase. At least three substantial stands of Lake Cahuilla during this period attracted larger numbers of individuals to the shoreline environment. The foothills abutting the western shorelines of Lake Cahuilla were particularly well populated, since there were relatively well-watered routes between the lake and the nearby Peninsular Ranges that groups could follow, or when the lake became too saline (Wilke 1978; Schaefer 1993:14, 1994). The same was not true of the eastern margins, which were isolated from the Colorado River by wide expanses of dry desert. This resulted in a strikingly different settlement pattern on either side of the lake basin and no doubt affected both the movement of groups around the lake and the intensity of their exploitation of lacustrine resources (Wilke 1978; Gallegos 1980, 1986; von Werlhof and McNitt 1980).

Recent research within the area suggests that the typical band during the Patayan II phase (A.D. 1000-1500) moved through temporary camps in a seasonal round between the valleys of the Peninsular Ranges and the shores of Lake Cahuilla (Schaefer 1993:15, 1994; Sutton 1993; Weide 1976). Although many of the sites in the area appear to be directly associated with embayments and shallows along the shore of lake Cahuilla, there is evidence to suggest that intensive use of alkaline pan environments adjoining the lake during the rainy seasons was a common phenomena (Schaefer 1988). In any case, the general economic pattern during this period was heavily oriented toward exploitation of lacustrine and riparian environments at the Colorado River, along the shores of Lake Cahuilla, and along the drainages of the Peninsular Range. Several fish and migratory waterfowl species were particularly attractive. However, it is apparent that these people could and did exploit an amazingly wide range of desert resources including mesquite, saltbush, and many other alkali-resistant plant species.

During the Patayan III phase (A.D. 1500 to historic period), there was an adjustment to the final recession of Lake Cahuilla as a series of temporary camps were established along recessional shorelines. Lake Cahuilla was again partially filled to sea level sometime after A.D. 1600, but had receded yet again by A.D. 1700. This final infilling and recession mark another major change in the movement of local populations encompassing Native American cultures in the area until their disruption by European incursions. The camps of these proto-historic groups continued to line the receding lakeshores until finally the saline lake could no longer support life, probably somewhere around 180 ft below mean sea level (Laylander 1994, 1995, 1997; Schaefer 1994). One of the most unique adaptations of the Patayan II and III phases on the western side of Lake Cahuilla was the use of stone fish traps, to be discussed in greater detail later in this report. The subsistence orientation was more specialized and appeared to focus on a primary resource. Fish bone dominated the faunal assemblages at the Dunaway Road Fish Camp (IMP-5204) and the Salton Sea Test Base sites (Schaefer 1986; Apple et al. 1997). Waterfowl bone make up more than 95 percent of the bone at the Elmore site (IMP-6427) (Laylander 1994). The Dunaway and Elmore site populations supplemented their diets with some rabbit, ungulates, mesquite bean or flowers, and other vegetal foods. The sites at the lowest elevations (more than 110 ft below sea level) on the Salton Sea Test Base appear to be even more specialized. Few other activities were undertaken besides fish procurement and processing. These data suggest that the Lake Cahuilla shore line habitats were much less stable during recessional periods as water levels receded at an estimated rate of 5 ft. per year (Wilke 1976). While the temporary camps that were established along the 40 ft AMSL shoreline could probably be occupied for a longer period of time and be oriented to the exploitation of a variety of wetland and desert resources, the recessional shoreline camps were shore-lived, specialized, and opportunistic. Once the fish were processed, then the people returned to temporary camps or residential bases in more optimal habitats with reliable fresh water and vegetal staple foods.

The loss of lacustrine resources did not appear to result in a major disruption in the lives of the residents of the Salton Rift, but instead required them to rely exclusively on the desert and mountain resources they had traditionally exploited for much of the year. One apparent result of this economic trend was a regional shift and expansion of the seasonal rounds, taking groups across the desert margins and back into the Peninsular Ranges or Colorado River drainages over the cycle of their year. Major Yuman-speaking populations remained centered along the Colorado River where their agricultural villages were among the first to come into contact with western explorers. Inland desert, mountain, and coastal Yuman groups, the Kumeyaay, developed a sophisticated seasonal round that extended from the Pacific into the Colorado Desert. Over time, some bands of the Kumeyaay, such as the Kamia developed exclusively desert-oriented economies. Similarly, Desert Cahuilla groups developed seasonal rounds from the lower desert areas and the upper elevations of the Santa Rosa and San Jacinto Mountains.

ETHNOGRAPHIC OVERVIEW

Among the ethnohistorically documented tribes living in the project vicinity of the Western Colorado Desert, syntheses have been prepared for the Kamia or eastern Kumeyaay (Gifford 1931; Knack 1981; Spier 1923). Ethnographic and ethnohistoric studies of the Cahuilla have been documented by Barrows (1900), Bean (1972), Bean and Saubel (1972), Curtis (1926), Drucker (1937), Heizer (1974), Hooper (1920), Kroeber (1908), and Strong (1929). Bean (1978) has summarized much of the information on the Cahuilla. Although Apple et al. (1997) argue that the Salton Sea Test Base sites are Kumeyaay, counter-arguments are provided in the conclusions chapter for why the question remains open as to Kumeyaay or Cahuilla affiliation for RIV-7750. Therefore, ethnographic overviews are provided for both groups.

The Kumeyaay/Kamia

Major ethnographies for the Kumeyaay and the desert branch of the group, the Kamia, were researched and written in the 1920s and 1930s (Spier 1923; Gifford 1918, 1931), about 150 years after the establishment of the mission system. By this time many traditions were known only by memory or were practiced in modified form on the small reservations in the mountains (Cline 1989). The Kamia had been largely integrated into the Quechan tribe on the Colorado River. Kumeyaay social organization appears to have been loosely structured at the band level. Patrilineal, minimally territorial, exogamous lineages called "*ǎmul*," or gentes, have been described as the highest level of Southern Diegueño social organization (Spier 1923). Luomala (1963:285-286, 1978) suggested that residence was not strictly patrilocal, but bilocal, in that newly married couples resided with the woman's family as often as not. This type of flexibility may be a cultural response to environmental stresses such as drought (Shipek 1981:297), or a result of reduced population and territory after historic contact.

The Kumeyaay are depicted primarily as hunters and gatherers in ethnographic and ethnohistoric documents, but some groups practiced agriculture in areas of the Imperial Valley (Gifford 1931:21-22). Shipek (1989) has hypothesized that horticultural practices among the Kumeyaay were widespread and intensive, involving transplantation and cultivation of several native plant species. There is still much controversy regarding the degree of dependence these groups placed on "cultivated" crops versus "natural" crops. Review of the ethnographic and ethnohistoric record indicates that most groups moved to different areas on a seasonal basis to capitalize on particular wild crops such as acorns or agave, and were not wholly dependent on any one species.

Animal resources for the Kumeyaay consisted mostly of small game such as rabbits (*Sylvilagus* spp.), hares (*Lepus californicus*), woodrats (*Neotoma* spp.), lizards, some snakes, and grasshoppers (Spier 1923:335-336; Gifford 1931:14; Shipek 1991:32). Many birds probably were not eaten (Drucker 1937:8), although this restriction seems to apply mostly to shorebirds. Fish (in some springs and streams) were not ignored, although these probably contributed to the diet in much smaller proportion (Orcutt 1888a:2, 1888b:4). Larger game, mostly mule deer (*Odocoileus hemionus*) and possibly pronghorn (*Antilocapra americana*, now locally extinct) were also hunted.

Different Kumeyaay lineage groups followed varying seasonal routines, probably relying upon staple foods that were common to the lineage home area. Hicks (1963:214) assumed that the majority of aboriginal Kumeyaay lineage locations would have been in the mountains near oak groves, rather than in the desert or desert foothills where agave is more plentiful, but cited only Spier (1923) and not Gifford (1931). Archaeological surveys have helped illustrate that villages were commonly located near reliable water sources and at contact areas between biotic zones (May 1975; Shackley 1980).

One oasis-like environment at San Sebastian Marsh became a major occupation area after the final recession of Lake Cahuilla (Schaefer et al. 1987). A series of springs were produced by the exposure of the aquifer where San Felipe Creek, Fish Creek, and Carrico Creek converge. When the Anza Expeditions of 1774 and 1775 traveled through the area, they found the area to be heavily occupied in late Spring and Summer when the abundant mesquite trees provided a major staple food, but to be largely depopulated in Fall and Winter when most able-bodied individuals ascended the mountains to hunt, and to collect acorns and pinyon nuts. The ripening of agave in early Spring brought the population down to intermediate elevations before re-establishing their residential base at San Sebastian. Hundreds of sites are distributed among the sand dunes and along San Felipe Creek as a result of all this activity. They include evidence of ceremonialism, local resource utilization, and trade, extending over a large area.

The Desert Cahuilla

The Cahuilla are a Takic speaking group of people who occupied an area generally within what is now northwestern Imperial and Riverside Counties. Some dozen or more political groups or clans owned this territory. Each of these clans was an independent, politically autonomous land holding unit. Each of these territories ranged from the desert or valley floor to mountain areas within which several biotic zones existed. Clans included several or more lineages, each of which had an independent community area which it owned within the larger clan area.

In addition to residence areas of each lineage, and locations within a clan territory which it owned in common with other clan members, each lineage had ownership rights to various food collecting, hunting, and other areas. Individuals also owned specific areas or resources, e.g. plant foods, hunting areas, mineral collecting places, and sacred spots used only by shamans, healers, and ritual practitioners.

These clans varied in population size up to several thousand people. They were arranged so that each lineage or community was placed in an area near significant water and food resources. Within each community, generally several miles from each other, houses and structures were spatially placed at some distance from each other. Often a community would spread over a mile or two in distance with each nuclear and extended family having houses and associated structures for storage of food, and shaded work places for tool manufacture and food processing. Each community contained a house of the lineage or clan leader, the *net*.

In more recent times, a ceremonial house (*kishumnawat*) was placed within each community. Most major religious ceremonies of the clan were held there. In addition, house and ceremonial structures, storage granaries, sweat houses, and song houses (for recreational music) were present. Usually an area within one to three miles contained the bulk of materials needed for daily subsistence, although territories of a given clan might be larger, and longer distances were traveled to get precious or necessary resources, usually at higher altitudes.

While most daily secular and religious activities took place within the community, there were places at some distance from the community where people stayed for extended periods of time (e.g. acorn or pinyon groves). Throughout the area there were sacred places used primarily for rituals, intergroup or inter-clan meetings, caches for sacred materials, and locations for use by shamans. Generally hilly, rocky areas, cave sites, or walled cave sites were used for temporary camping, storage of foods, fasting by shamans, and as hunting blinds.

Wilke (1975) lists at least ten villages as being located in the southwest end of Coachella Valley in the 1850s. These include Agua Dulce near Travertine Point, Martinez, Toro, La Mesa, and Cabazones. Most of this information was compiled from U.S. government survey maps done at that time. At least ten walk-in, hand dug wells, were also noted.

The Cahuilla of the Torres-Martinez area became familiar with Europeans as early as 1797. Often their relatives in western Cahuilla areas were baptized and worked among the Spanish. In addition, runaway neophytes from the missions undoubtably sought refuge among the desert tribes. Certainly, by 1823 they were not only familiar with Hispanic ways but were comfortable in dealing with them, as evidenced by their reaction to the members of the Romero Expedition in 1823 (Bean and Mason 1962). At that time, the Mexicans were running cattle into the desert through the San Gorgonio Pass as far as present day Palm Springs. The Romero expedition reported that the Cahuilla at Toro were engaged in agricultural pursuits (growing corn and melons) and were already familiar with the use of horses and cattle.

Within three decades, the Cahuilla in the Torres-Martinez area were variously contacted by Spaniards, Mexicans, and Americans. Exploring expeditions came through the area. The people of the Torres-Martinez area were suddenly exposed to a new people, new ways, opportunities, and constraints. In 1851, the Toro leader Chungil, along with other Cahuilla and Luiseño leaders, signed a treaty with the United States government, although it was never ratified by congress.

Their leader, Chief Cabazon, was a figure of great significance in Southern California, as was his son.

In the 1860s, several epidemics devastated the Cahuilla population and the increasing contact with Europeans continued to have a major impact on their traditional ways. Survivors of decimated lineages and class joined villages that were able to maintain their ceremonial, cultural, and economic institutions.

The Southern Pacific Railroad was built in 1877, a task in which Indians from Torres-Martinez and Cabazon desert villages participated as laborers. Much of their traditional lands were taken away from them by the government and given to the railroad, with only a small portion provided as reservations. In 1891, they and other Indians were firmly settled on reservations. The present Torres-Martinez Reservation was established by executive order on May 4, 1876. Another act on February 11, 1903, added 640 acres of state lands to the reservation in exchange for lands to be set aside for the Torres Band under Act of January 12,1891. The present area under trust is approximately 14,000 acres. Tribal population in 1991 was listed as 192 living on the reservation and 57 members adjacent.

3. FIELD INVESTIGATIONS OF A PIT HOUSE AND MIDDEN AT IMP-7750:

METHODS

IMP-7750 was first recorded on June 26, 1998 by Drew Pallette and Collin O'Neill as part of the Imperial Irrigation District L-Line Pole Replacement Project cultural resources survey (Schaefer et al. 1998). After the site was determined eligible for the National Register and impacts from the pole replacement project were assessed, a treatment plan and research design was developed for data recovery (Schaefer 1998). Following consultation with the Torres-Martinez Desert Cahuilla Indians, an ARPA fieldwork authorization was issued by the Bureau of Land Management. A monitor was assigned by the Torres-Martinez Cahuilla during data recovery. Excavations lasted from August 2-4, and continued for an additional day on August 11, 1999. Fieldwork at the other sites was undertaken on August 2 and 5, 1999. The Field Director was Mr. Ken Victorino, M.A. Field crew included Mr. Josh Smallwood, Mr. Andrew Gilletti, and Mr. Matt Murray.

The house pit was found substantially buried by wind and water laid silts. Midden deposits were found eroding on the south side near what appeared to be the entrance (Figure 3) and on the north in an area that originally appeared to be an exterior stone feature (Figure 4).

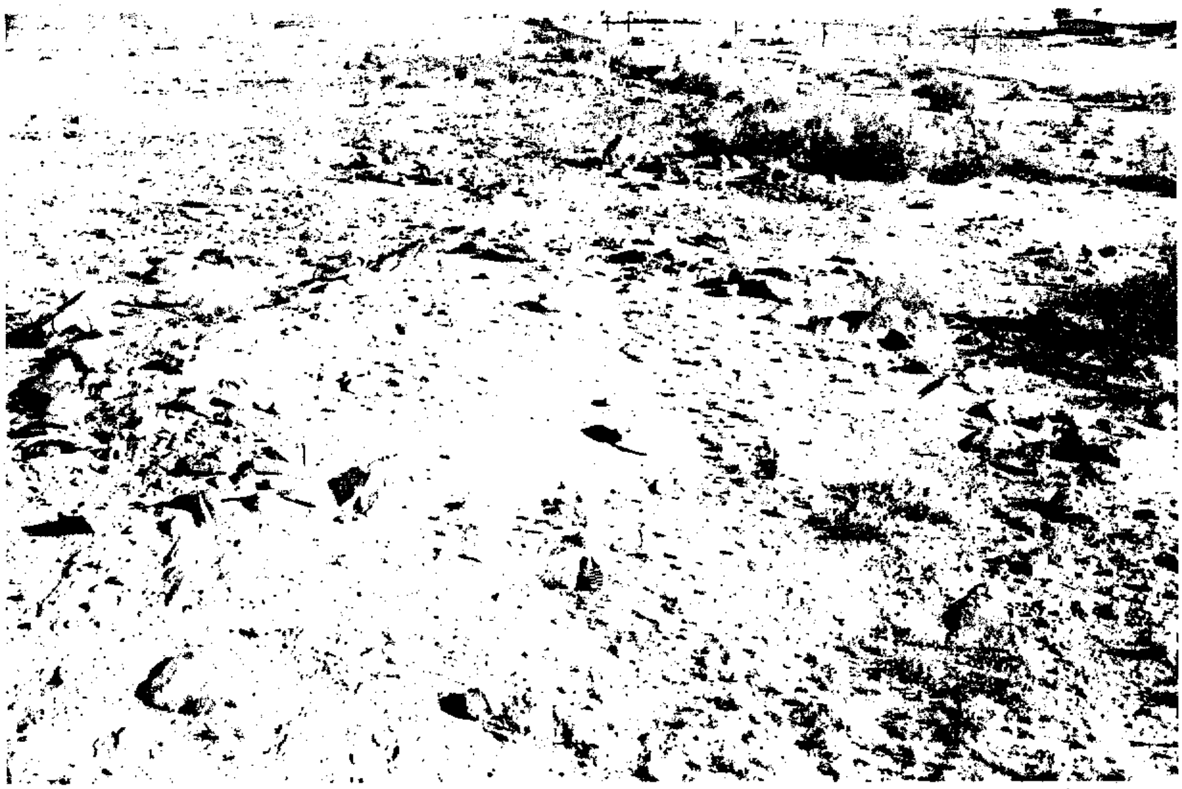


Figure 3. IMP-7750 before excavation. Midden area can be seen at bottom right, view north.

Figure 4. IMP-7750 before excavation with central datum line in place. Midden in Unit 1 at lower right, view south.

A datum line, oriented toward true North, was established through the center of the structure. The extent of surface remains and midden were then mapped in relation to a grid system set over the site (Figure 5). The purpose of the grid plan was to discriminate areas within and outside the structure in separate excavation units and to position them so profiles could be drawn through the pit house.

Four 2 x 2 m units were established at the north end of the structure for this purpose with the expectation that a large portion of each would be filled with architectural elements of the outer slab alignment. The remainder of the site was excavated in 1 x 2 m units with actual unit boundaries made to conform to the structure plan. The goal was to have no units contain material from both within and without the pit house as its form became better defined. Two 1 x 1 m units were also added to complete the definition of the exterior rock alignment. Only some midden deposits were excavated above the slabs and not the small amount of room fill in these units. All the rest of the interior floor deposit were fully excavated, as was the small northern midden area. On the south side, the vast majority of the midden was also recovered. Areas outside excavated units contained the thinnest eroding edges of midden deposit. We estimate that approximately 80 percent of all artifact-bearing deposits were recovered from the site. Several units were laid out but not excavated because deposits or architecture did not extend that far. Units 4-6 are virtually bedrock covered with some structural slabs and a thin layer of sand. Units 7-9 and 15-16 were also not excavated. Eight shovel test pits were also excavated in the area between the pit house and the L-Line access road to determine if any additional buried deposits existed in the APE. All were excavated to sandstone bedrock and proved negative Figure 5.

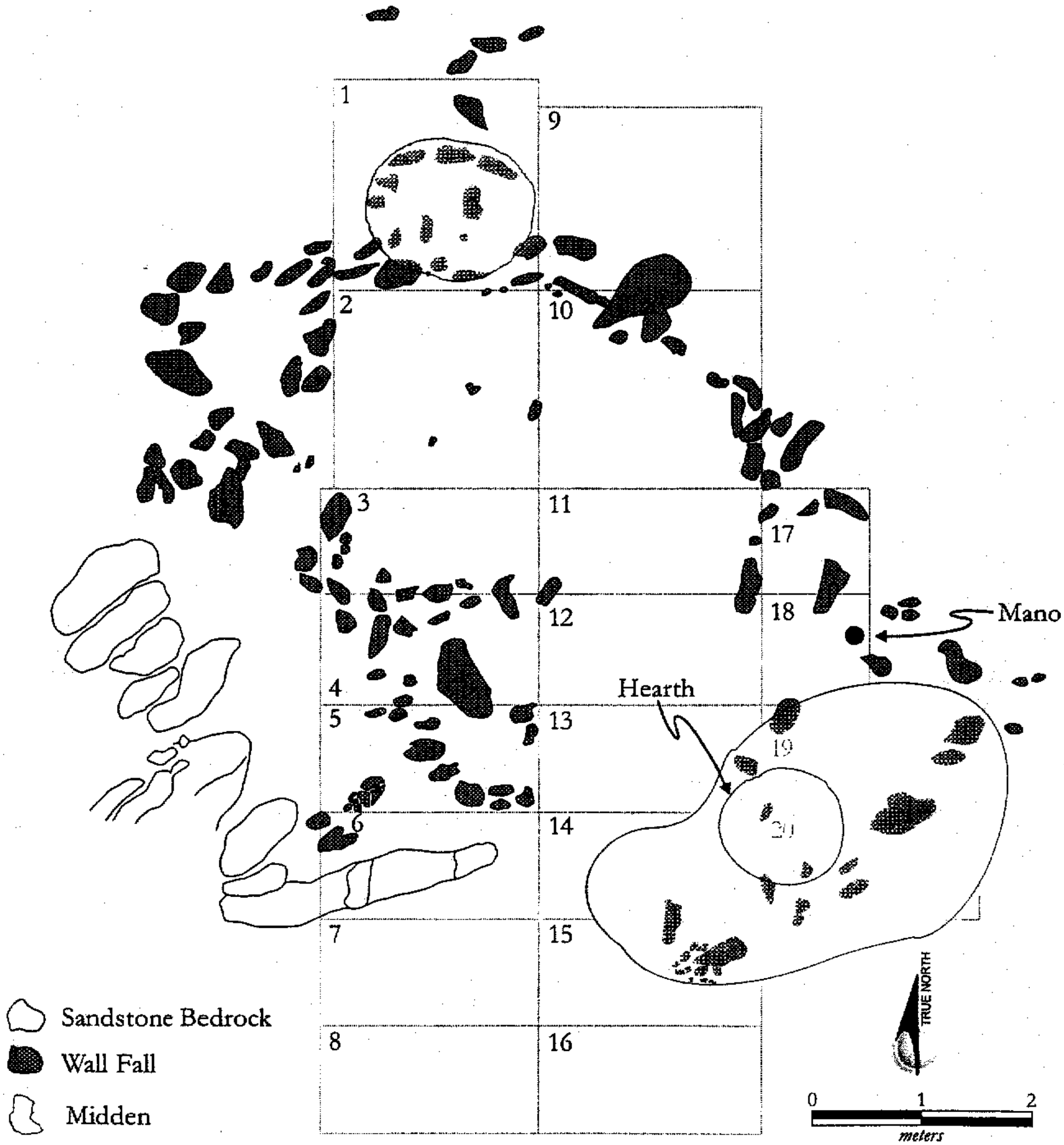


Figure 5. Top plan of IMP-7750 before excavation showing excavation units.

Interior deposits were excavated by 10 cm levels except when thick deposits of slab fall were encountered. These were first exposed to determine "wall fall" and structural details, then removed as a single layer, usually from 0-30/35 cm below the surface (Figure 6). These levels represent the structure collapse after abandonment and subsequent alluvial and aeolian fill. No artifacts derived from the screened upper level in unit 2 so it was decided that the remaining upper fill in the other interior units could be removed without screening. Stones were always left in place until wall fall patterns could be mapped and photographed. The wall fall usually rested on fine sandy floor deposits than contained charcoal, bone, and artifacts that had been trampled into the loose living surfaces. These were excavated in 10 cm levels until sandstone bedrock or sterile lacustrine silts were reached.

All floor deposits and midden were sifted through 1/8 in. mesh screen except those deposits that were entirely collected for floatation. That included 350 litres (88 gallons) of sediment from the floor levels and midden area, a substantial portion of the cultural deposits. Separate pollen samples were also taken from every level that underwent floatation sampling. When fish bone occurred in great abundance in areas that were screened, the entirety of the sifted fraction was kept for bone extraction in the lab. Bone counts were also exceptionally high because of the amount of bone that could be recovered from the heavy fraction of the floatation sample.

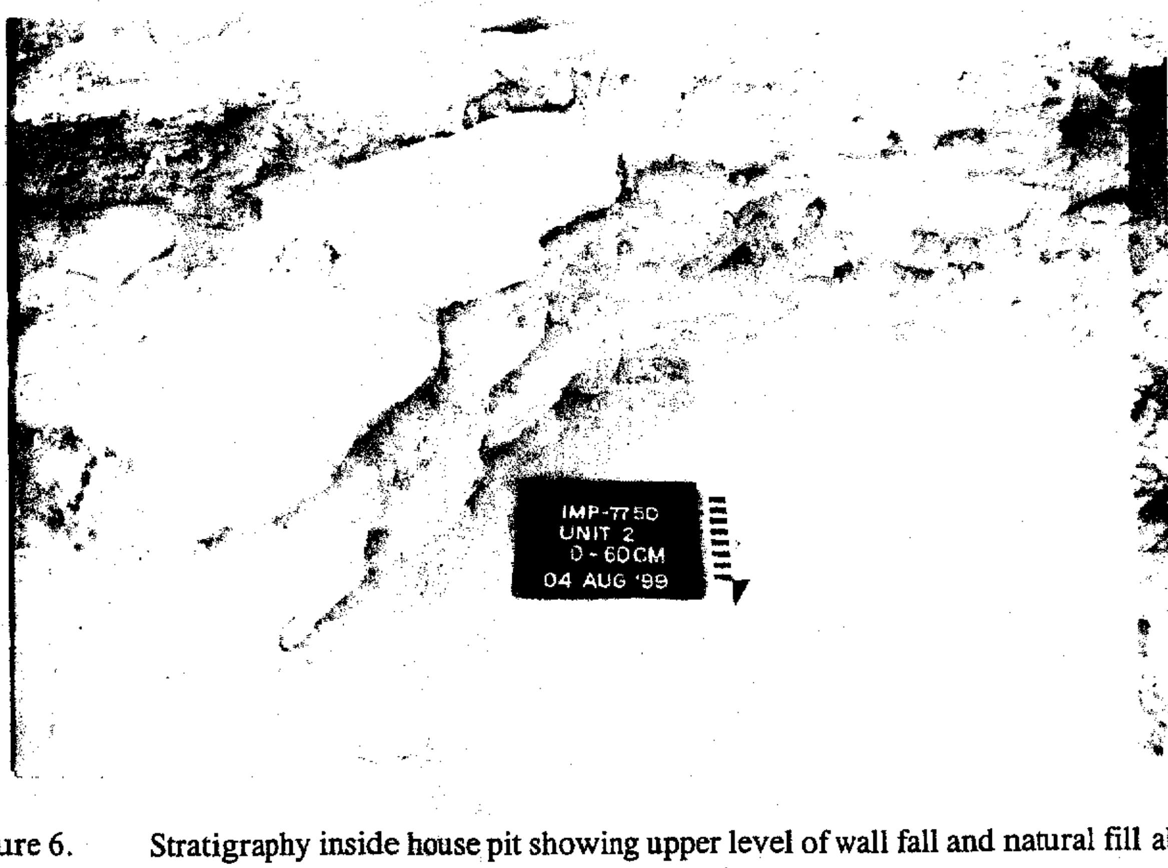


Figure 6. Stratigraphy inside house pit showing upper level of wall fall and natural fill above sandy floor level that was excavated to sterile.

The Structure

The dwelling was constructed by digging a pit approximately 4 meters in diameter and 40-50 cm deep (Figure 7). The pit opens to the south and it is outside the opening that the largest trash midden deposits were found (Figure 8, also see Figure 5). The floor consisted of fine loose sand within which carbonized material and a small number of flakes, ceramics, two projectile points and *Olivella* spp. beads were recovered. Much of this material was probably trampled into the floor level during occupation. A sign of good housekeeping, artifact and ecofact densities were decidedly lower within the structure than without.

Presumably a brush superstructure was build within the pit and sandstone slaps were set around the perimeter to anchor the brush, much like earth around a Chemehueve example photographed by Edward Curtis at the turn of the century (Figure 9). Unnaturally high quantities of creosote bush pollen were detected in the interior, midden, and especially in the entrance area of the structure, leading to the interpretation that creosote was used not only for fuel, but as the covering material of the structure. Much of the sandstone was found toppled into the pit house, probably when the brush was removed or disintegrated after abandonment (Figure 10). The pit eventually filled with aeolian sands and silts, leaving a definite bowl-shaped profile in section. (Figures 11-12).

THE MIDDENS

The small midden on the north side of the structure in unit 1 was made up entirely of fish bone. It was found under a file of sandstone slabs from the collapsed structure. The most extensive midden deposits were found outside the south entrance to the pit house (units 12-13) and extending to the southeastern side (units 14-15, 19-20). It consisted of tan-colored sandy deposits rich in fish bone and with moderate amounts of charcoal and high quantities of carbonized seeds. The southern midden extended from 0-20 cm below the surface. The majority of artifacts from the site derive from this area. They included large quantities of fish bone, bird and mammal bone, *Anodonta dejecta* shell, debitage, one projectile point midsection, ceramics, milling equipment, pumice, and *Olivell*a spp. beads. All of the milling equipment was found in this area and included a well shaped mano found on the surface of unit 18, a whole sandstone metate found nearby at unit 19, and a fragment of a diorite mano or pestle in unit 19. A small fragment of a sandstone metate also derives from the entrance area in unit 13. These appear to represent a single milling tool kit that was probably used just outside the structure. The only fire-affected rock (N=5) came from the entrance area of the structure in unit 13.

One hearth feature was also detected in the midden area. A circular area of brown-gray, burned and carbonaceous sand was found in Units 20 and 21 (Figure 13). The feature was just below the surface and less than 5 cm thick. It appeared more as a stain than a thick deposit and in the eastern portion, lay directly on decomposed sandstone. Some ceramics sherds and charcoal concentrations were in direct association. A focus of cooking and parching activities is suggested by the proximity to the only milling equipment at the site and unusually high recovery of carbonized seeds in these units, as well as adjacent unit 13 at the entrance to the structure. Fish processing is also apparent from the very high concentrations of bone.

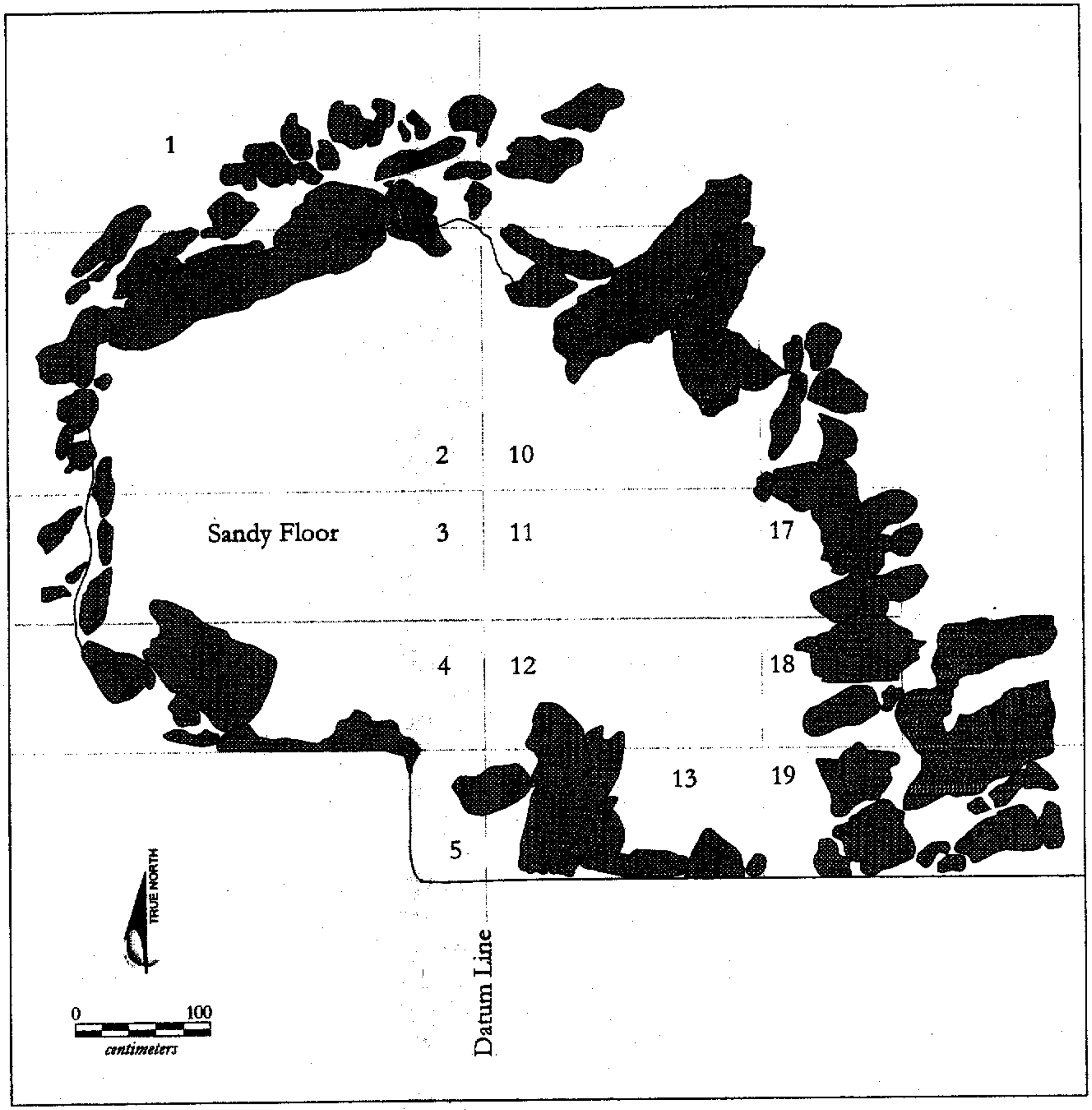


Figure 7. Top plan of structure after excavation.

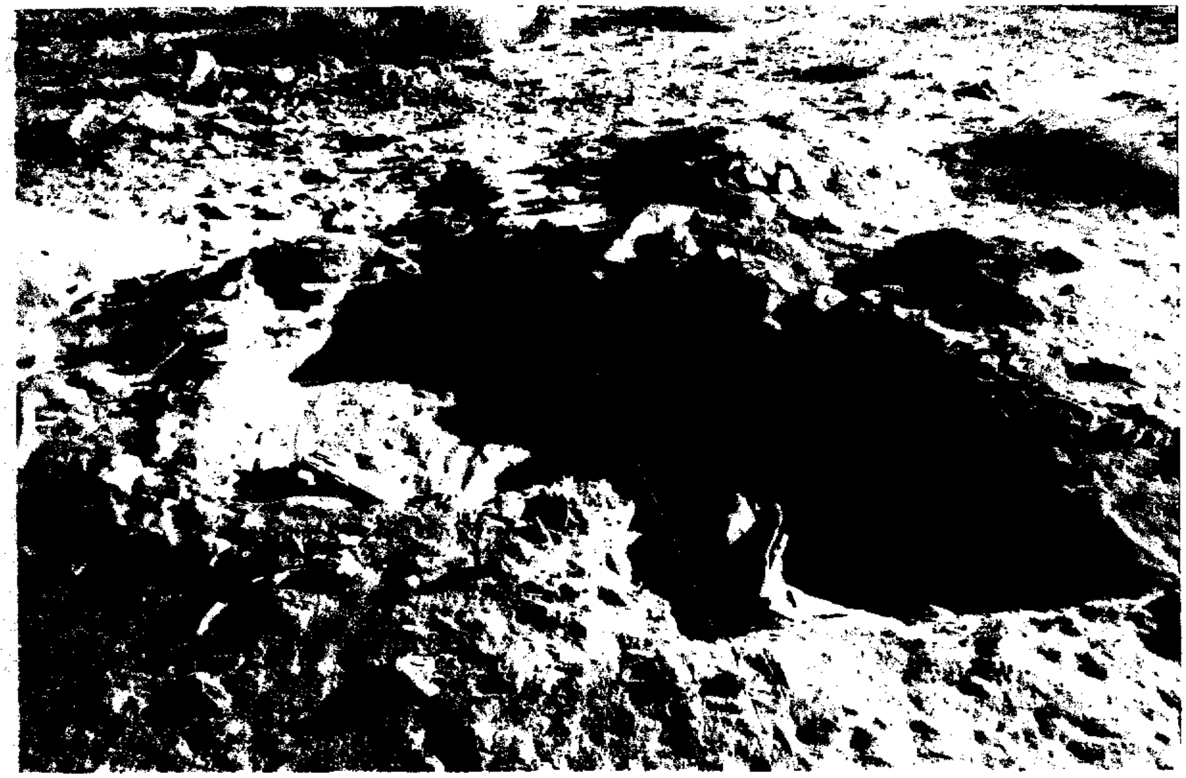


Figure 8. Structure after excavation, view north.

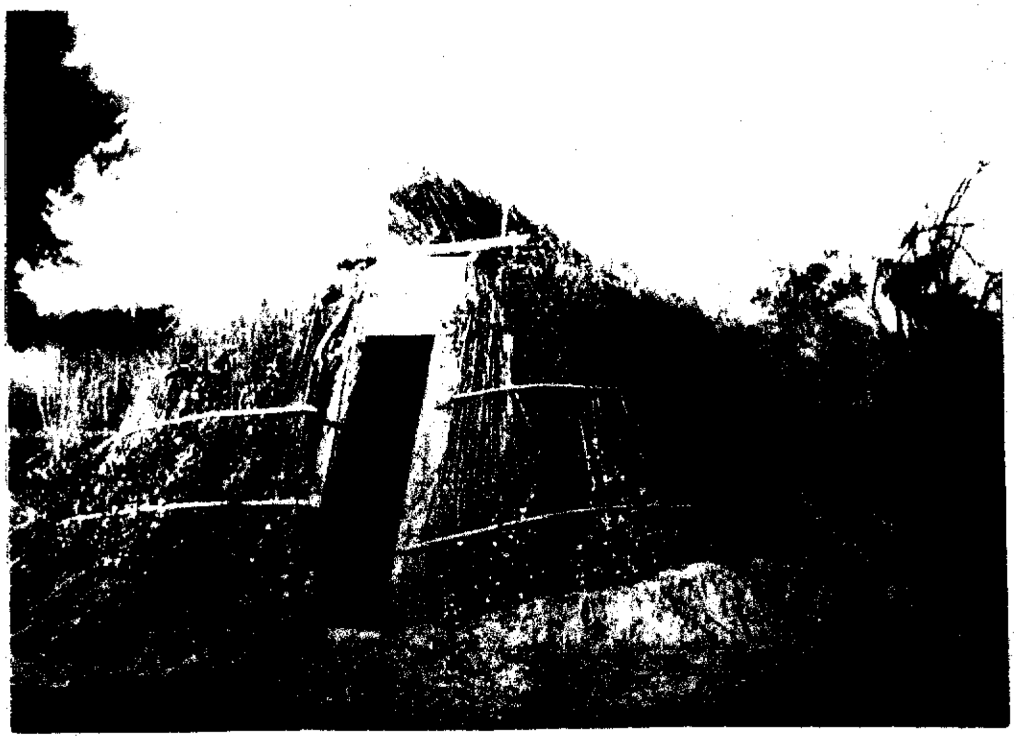


Figure 9. Chemehueve pit house showing method of anchoring structure with soil (Edward Curtis 1908).

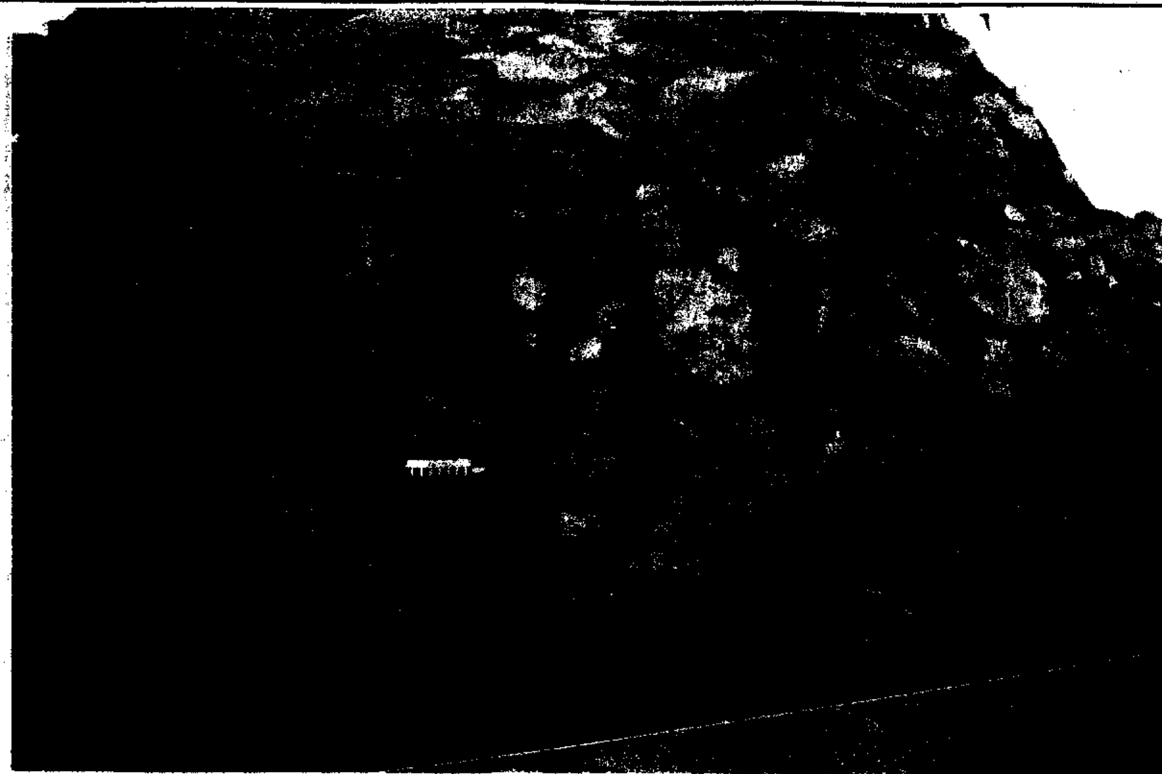


Figure 10. Exposed wall fall on floor in Unit 2, view west. Note intact slabs at far right marking pit house edge.

Figure 11. Portion of bowl-shaped interior stratigraphic profile, after excavation, showing natural fill above sand floor levels.

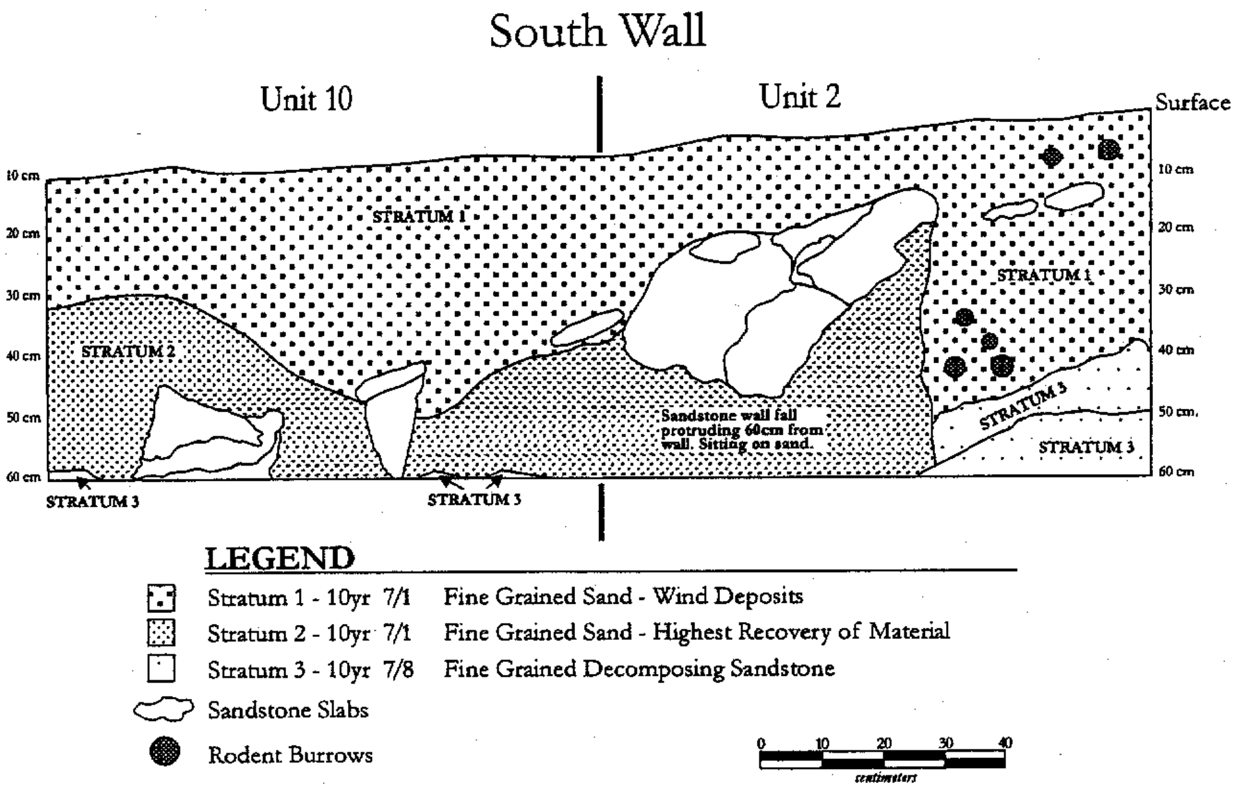


Figure 12. South wall profiles of units 2 and 10 showing sterile fill (Stratum 1) over floor deposits (Stratum 2).

Figure 13. Hearth area in Unit 20.

DATE

There were five intercepts of the radiocarbon date with the calibration curve (Appendix A). This is typical of late period sites because of secular variability in atmospheric carbon isotopes during the last 300 years , known as the DeVries effect (Taylor 1987). The earliest intercepts and the only one preceding the 19th century place the site firmly between A.D. 1680 and 1745 (with one sigma).

4. MATERIAL CULTURE OF A RECESSIONAL LAKE CAHUILLA CAMP: IMP-7750

INTRASITE SPATIAL PATTERNING *by Deborah Huntley*

Surface collection and excavation of two 1 x 1m units, three 2 x 2m units, and six 1 x 2m units at IMP-7750 produced a total of 226 artifacts and 435g of vertebrate faunal remains (Table 1, Appendix B). Two midden areas were identified during excavations at IMP-7750. The first of these, represented by unit 1, is located to the north of the stone structure. The second midden area is situated to the south and southeast of the stone structure and consists of units 12, 13, 19, 20, and upper portion of 17- 18 . Due to the small sample size for unit 1, these two midden areas have been combined for the purpose of this analysis. Four units, 2, 3, 10, and 11, are located within the stone structure

Artifact and ecofact density is much higher for the combined midden units compared to units placed within the structure (Table 2). Artifact densities were calculated by dividing artifact counts for each context (midden vs. structure) by the total excavated and screened sediment volume for each context. Overburden removed without screening was not included in estimates of excavated volume. Differences in artifact density between the structure and the midden are most evident for ceramics and flaked stone (debitage and tools), the two most common material classes present at the site. Differences in vertebrate faunal densities are also striking. It appears that the stone structure was relatively empty at the time it was abandoned and that most artifacts from the floor represent trash or items that had been trampled into the loose sandy floor deposit during its occupation.

While there are clear differences in artifact density between the midden and structure, there do not appear to be any strong intrasite patterns in the distribution of different material classes (Table 2). The single possible exception is ground stone, which was recovered only from the surface, and in the upper deposits in units 13 and 19 outside the stone structure. Two of the ground stone items were complete milling tools. This recovery pattern may suggest spatial restriction of milling activities near the hearth feature at IMP-7750.

It appears that most of the material deposited within the structure was situated on or near its floor which was located some 40 cm below the surface. Very few artifacts were observed in the natural fill which after the sifting of all material in unit 2, was removed without screening but was carefully examined for artifacts during excavation. In contrast, cultural deposits outside the structure appear to be shallow and at ground level. Most of the recovered material came from the uppermost excavated levels. It appears, therefore, that cultural deposits within the midden and the stone structure at IMP-7750 were the result of very different depositional conditions and occupational patterns.

Table 1. Artifact Recovery by Provenience at IMP-7750

Provenience		Material Class							
Unit	Depth (cm)	Flaked Stone (N)	Ceramics (N)	Ground Stone (N)	Modified Shell (N)	Other (N)	Artifact Total	Modern/ Historic	Vertebrate (g)
Surface									
Structure									
2[1]	0 - 10	-	-	-	-	-	-	-	2.8
	10 - 20	1	1	-	-	-	2	-	5.8
	20 - 30	-	1	-	-	-	1	-	28.2
	30 - 40	-	-	-	-	-	-	-	17.1
	40 - 50	-	-	-	-	-	-	-	12.6
	50 - 60	-	-	-	-	-	-	-	3.4
	Total	**1**	**2**	**-**	**-**	**-**	**3**	**-**	**69.9**
3[2]	35-60	-	-	-	-	-	-	-	4.3
	Total	-	-	-	-	-	-	-	4.3
10[1]	0 - 30	-	-	-	-	-	-	-	0.1
	30 - 50	4	6	-	1	-	11	2	39.4
	Total	**4**	**6**	**-**	**1**	**-**	**11**	**-**	**39.5**
11[2]	30 - 40	2	1	-	-	-	3	-	5.8
	40 - 50	3	1	-	1	-	5	-	22.3
	Total	**5**	**2**	**-**	**1**	**-**	**8**	**-**	**28.1**
Midden									
1[1]	0 - 10	-	-	-	-	-	-	-	19.7
	10 - 20	-	-	-	-	-	-	-	27.7
	20 - 30	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
	30 - 40	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
	40 - 50	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
	50 - 60	-	-	-	-	-	-	-	12.5
	Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**59.9**
12[3]	0 - 20	8	8	-	-	1	17	-	6.34
	20 - 30	6	12	-	-	-	18	-	14.2
	30 - 40	1	3	-	-	-	4	-	14.5
	Total	**15**	**23**	**-**	**-**	**1**	**39**	**-**	**35.0**
13[2]	0 - 10	17	5	1	-	-	23	-	20.1
	10 - 20	9	9	-	-	-	18	-	51.7
	Total	**26**	**14**	**1**	**-**	**-**	**41**	**-**	**71.8**
17[4]	0 - 10	1	6	-	-	-	7	2	17.5
	10 - 20	-	-	-	-	-	-	1	33.0
	Total	**1**	**6**	**-**	**-**	**-**	**7**	**3**	**50.5**
18[4]	0 - 10	-	7	-	-	-	7	1	7.0
	10 - 20	-	-	-	-	-	-	-	2.0
	Total	**-**	**7**	**-**	**-**	**-**	**7**	**1**	**9.0**
19[2]	0 - 10	13	31	2	1	-	47	-	15.1
	10 - 20	16	8	-	-	1	25	1	16.8
	Total	**29**	**39**	**2**	**1**	**1**	**72**	**1**	**31.9**

Provenience		Material Class							
Unit	Depth (cm)	Flaked Stone (N)	Ceramics (N)	Ground Stone (N)	Modified Shell (N)	Other (N)	Artifact Total	Modern/ Historic	Vertebrate (g)
Surface									
Structure									
20[2]	0 - 10	10	18	-	-	-	28	-	13.5
	10 - 20	1	1	-	-	-	2	-	21.8
	Total	**11**	**19**	-	-	-	**30**	-	**35.3**
Grand Total		**92**	**118**	**4**	**3**	**2**	**219**	**7**	**436**

* Levels 20-50 were rock fall and aeolian fill under which midden was found. Level 50-60 is a column sample.
[1] 2x2m unit
[2] 1x2m unit
[3] 0-30 level is 1x2m unit; 30-40 level is 1x1m
[4] 1x1m unit

Table 2. Artifact and Ecofact Density by Context at IMP-7750 (Units Combined)

Context	Flaked Stone (N/m³)	Ceramics (N/m³)	Ground Stone (N/m³)	Shell Artifacts (N/m³)	Other* (N/m³)	Total Artifacts (N/m³)	Vertebrates (g/m³)
Structure	2.2	2.2	-	0.4	0.4	5.3	31.3
Midden	26.5	34.8	1	0.3	2.6	65.2	94.5
Total Site	12.0	15.5	0.4	0.4	1.3	29.6	56.9

* Includes miscellaneous artifacts, historic and modern refuse. Excludes single surface item.

ARTIFACT AND ECOFACT ASSEMBLAGES *by Deborah Huntley*

A total of 226 artifacts and 435g of vertebrate faunal remains were recovered from the surface, two 1 x 1m units, three 2 x 2m units, and six 1 x 2m units at IMP-7750 (Table 3). Of the total number of recovered artifacts, the majority (n=118, 52.2 percent) are ceramics, 86 (38.1 percent) are flaked stone debitage, four (1.8 percent) are ground stone tools, three (1.3 percent) are cores, three (1.3 percent) are projectile points, three (1.3 percent) are shell artifacts, and two (0.9 percent) are miscellaneous artifacts. Seven pieces of historic or modern refuse were also recovered from subsurface deposits. Virtually the entire artifact assemblage was recovered from subsurface contexts. The majority of artifacts (n=201, 88.9 percent) were recovered from units placed within midden contexts, as were the majority of vertebrate remains (293g, 67.4 percent). The following sections discuss in more detail the artifact assemblage from IMP-7750. A general summary and interpretation of prehistoric activities represented at the site concludes this section.

Ceramics *by Deborah Huntley and Jerry Schaefer*

The majority of ceramics recovered from at IMP-7750 (n=68; 58 percent) were classified as Salton Brown (Table 4). Topoc Buff and Colorado Buff each comprise 20 percent of the total ceramic assemblage. Salton Brown and Topoc Buff were manufactured during the Patayan II and

III periods (ca. A.D. 1000 to post-A.D. 1600) while Colorado Buff is an exclusively Patayan III type (A.D. 1600-1930). A single Salton Buff and a single Tizon Brown Ware sherd were also recovered. Production of Tizon Brown spans the Patayan I-III periods, while Salton Buff was made during the Patayan II period. It is very likely the Salton Buff sherd represents an earlier recycled or an intrusive sherd.

Table 3. Artifact and Ecofact Assemblages from IMP-7750

	Surface		Midden Units		Structure Units		Total	
Artifact Class	**Ct. (n)**	**%**	**Ct. (n)**	**%**	**Ct. (n)**	**%**	**Ct. (n)**	**%**
Ceramics	-	-	108	47.8	10	4.4	118	52.2
Debitage	-	-	79	35.0	7	3.1	86	38.1
Milling Tools	1	0.4	3	1.3	-	-	4	1.8
Cores	-	-	2	0.9	1	0.4	3	1.3
Bifacial Retouch	-	-	1	0.4	2	0.9	3	1.3
Shell Artifacts	-	-	1	0.4	2	0.9	3	1.3
Misc. Artifacts	-	-	2	0.9	-	-	2	0.9
Historic/Modern	-	-	5	2.2	2	0.9	7	3.1
Total Artifacts	1	0.4	201	88.9	24	10.6	226	100
Ecofact Class	Wt. (g)	%	Wt. (g)	%	Wt. (g)	%	Wt. (g)	%
Vertebrates	-	-	293	67.4	142	32.6	435	100

Table 4. Ceramic Type Frequencies by Context

	Midden Units		Structure Units		Total	
Ceramic Type	**Ct. (n)**	**%**	**Ct. (n)**	**%**	**Ct. (n)**	**%**
Salton Brown	62	53.0	6	5.1	68	58.1
Topoc Buff	21	17.9	3	2.6	24	20.5
Colorado Buff	23	19.7	-	-	23	19.7
Tizon Brown	1	0.9	-	-	1	0.9
Salton Buff	1	0.9	-	-	1	0.9
Total	108	92.3	9	7.7	117	100

Definition of Ceramic Types

Ceramics were classified by type based on fabric color and texture, surface treatment, and type of inclusions present. For each sherd, a freshly broken surface was examined using a 10x hand lens or binocular microscope under low power. Type assignment was initially made by Deborah Huntley and then verified by Jerry Schaefer. A sample of the ceramic assemblage (seven sherds) was also submitted, along with a sample of raw clay, for Neutron Activation Analysis (NAA).

Types definitions are based on recent investigations of ceramics and clays of the Colorado Desert and Peninsular Range (Hildebrand et al., in press). NAA and petrographic analysis of ceramic thin sections were used to address the veracity of ceramic typologies developed by Malcomb Rogers (1936; May 1978) and Michael Waters (1982a,b), the latter work being a synthesis of Rogers' unpublished material on Lower Colorado Buff Ware. Among the most important results of these new ongoing studies is the recognition of Salton Brown as a distinct ware made from sedimentary clays of the Brawley formation and probably other sources. It is often mis-identified as Tizon Brown Ware because of its similar color, texture, and micaceous inclusions. Salton Brown can be best discriminated from Tizon Brown by the absence of amphibole (hornblend) and the predominance of quartz grains over feldspar and other minerals. Sometimes a microscope is necessary to detect the presence/absence of hornblend. Thin sections and chemical fingerprinting also provide a reliable method of establishing Salton Brown characteristic type sherds in a specific site assemblage. This discrimination is extremely important because Tizon Brown Ware is used to infer settlement mobility and trade between mountain and desert areas. If most desert brown ware is in fact Salton Brown, then conclusions drawn from pottery type distributions will need to be reconsidered.

Lower Colorado Buff Ware types share very similar chemical signatures because of their common origins in clays that have been homogenized by the Colorado River and Lake Cahuilla. Temper, inclusions, surface treatment, and rim form still remain important attributes for type discriminations.

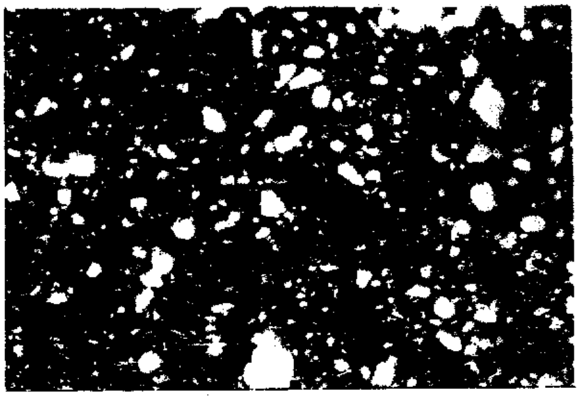
Formal descriptions of the types at IMP-7750 are provided below based on Hildebrand et al (in press) and recent ceramic analyses (Schaefer 1994b, 1995). Photomicroscopy of thin section was undertaken on selected sherds to illustrate the mineralogy of the most common types (Figure 14). Neutron Activation Analysis results will be presented in future studies of desert ceramics.

Salton Brown (Figure 14a-b)

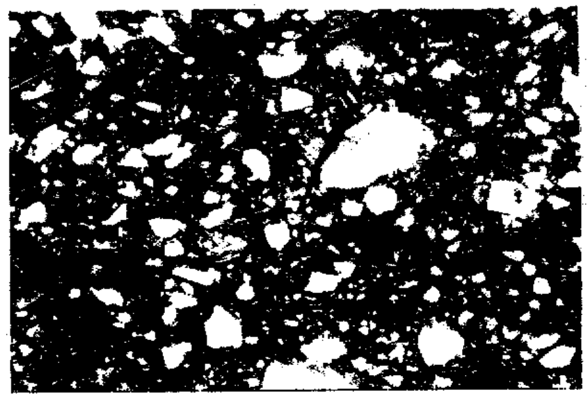
- Paste: Grainy sedimentary clay derived from alluvial deposits at the foot of the Peninsular Range.
- Inclusions: Moderately well sorted and abundant subangular to rounded quartz. From 0.1 to 1.0 percent plagioclase feldspar. Biotite mica is very obvious in section and on the surface. Some inclusions may actually be intentional tempering but clays are naturally rich in mineral inclusions.
- Color: Dark brown to gray.
- Fracture: Generally crumbly to hard.

Tizon Brown

1. Paste: Grainy residual clay.
2. Inclusions: Poorly sorted, abundant angular to subangular quartz, feldspar, hornblende (amphibole), muscovite and biotite mica, and other mineral grains.
3. Temper: presumably none but some sherds can have crushed sherds.
4. Color: Dark red, brown, or black.
5. Fracture: Generally crumbly to medium hard.



a)



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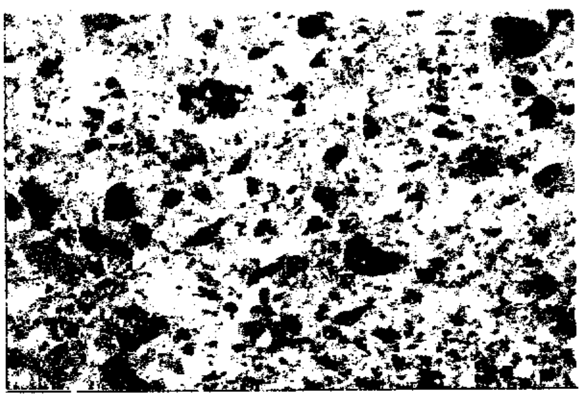

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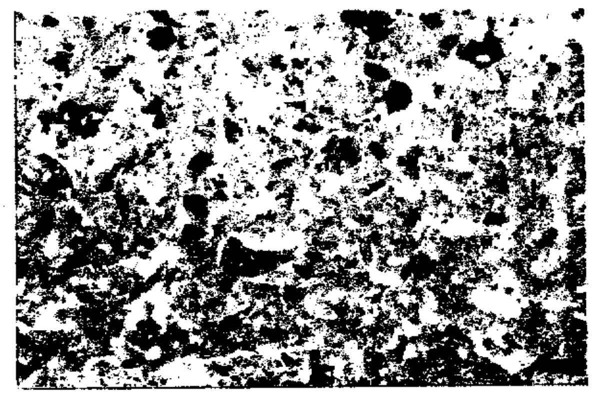

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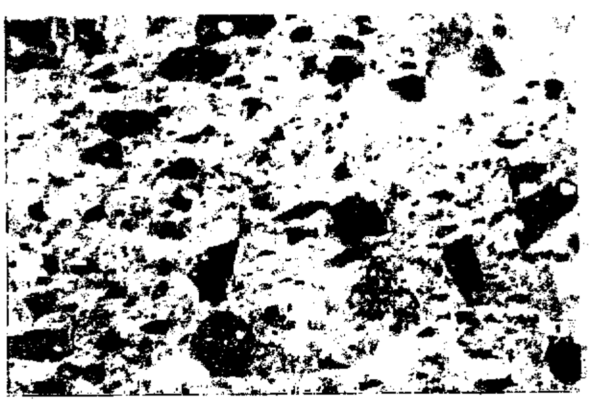
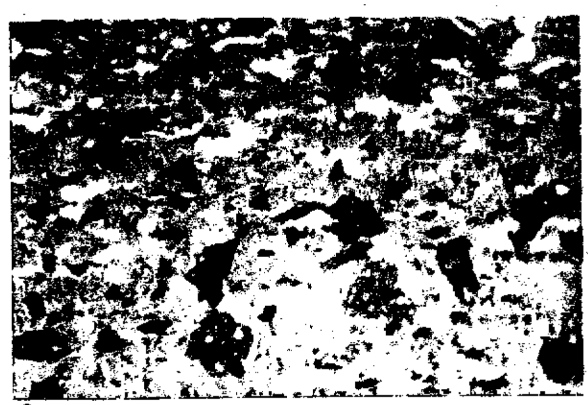


e)



f)

Figure 14. Ceramic thin section photomicroscopy under polarized light.

Topoc Buff

- Paste: Grainy
- Temper/Inclusions: Moderately sorted rounded to subangular quartz, hornblend, and other grains with specs of muscovite mica.
- Color: Buff to pink.
- Surface: Moderately well wet smoothed with wipe marks visible. Mica and other grains shows through surface
- Fracture: Medium to crumbly.

Colorado Buff (Figure 14c-d)

- Paste: Very fine.
- Temper/Inclusions: Darker clay particles seen in thin section but not under hand lens. May indicate multiple clay sources or crushed sherds. Occasional rounded quartz, plagioclase feldspar, or mica grains.
- Color: Buff to pink.
- Surface: Well smoothed with thin, even, walls.
- Fracture: Hard.

Salton Buff (Figure 14e-f)

- Paste: A fairly dense paste that is not grainy. The more classic Salton Buff has a denser paste.
- Temper: Well sorted grains tend to be rounded to subrounded, with quartz predominating. Some sherds are exclusively quartz while other contain up to five percent amphibole (hornblende) and traces of biotite mica.
- Color: Most of the ceramic is buff to red in color.
- Surface: Moderately well smoothed with temper much of temper showing through surface.
- Fracture: Sherds range from hard to crumbly. Many are heavily eroded.

Ceramic Shapes

Seven of the 117 sherds recovered from IMP-7750 are rim sherds. Two of these are large, refitted Topoc Buff rim sherds from structure floor levels in unit 10 and unit 11 (Figure 15a). They are probably from a large (ca. 33cm diameter) parching tray or shallow plate with a slightly recurved lipped rim, fire clouds, and light sooting. Another large rim sherd was recovered from the upper 10cm of unit 19, located in the midden area to the southeast of the structure. This is also a fragment of a large Colorado Buff parching tray with a slightly recurved lipped rim (Figure 15b). The rim diameter is estimated at 38cm. Parching trays would be reasonable finds in association with milling equipment and the abundant carbonized seeds discussed below. The other four rim sherds are too small for rim diameter measurements or accurte drawings. Three are Salton Brown rims. One is a direct rim, possibly from a jar, which has been thoroughly burned. One is slightly recurved with a flattened lip and is probably also a jar. The third appears to have a rounded lip, but is too small to classify further. A final rim was classified as Topoc Buff. It is very small and friable and may be from a pinch pot or scoop.

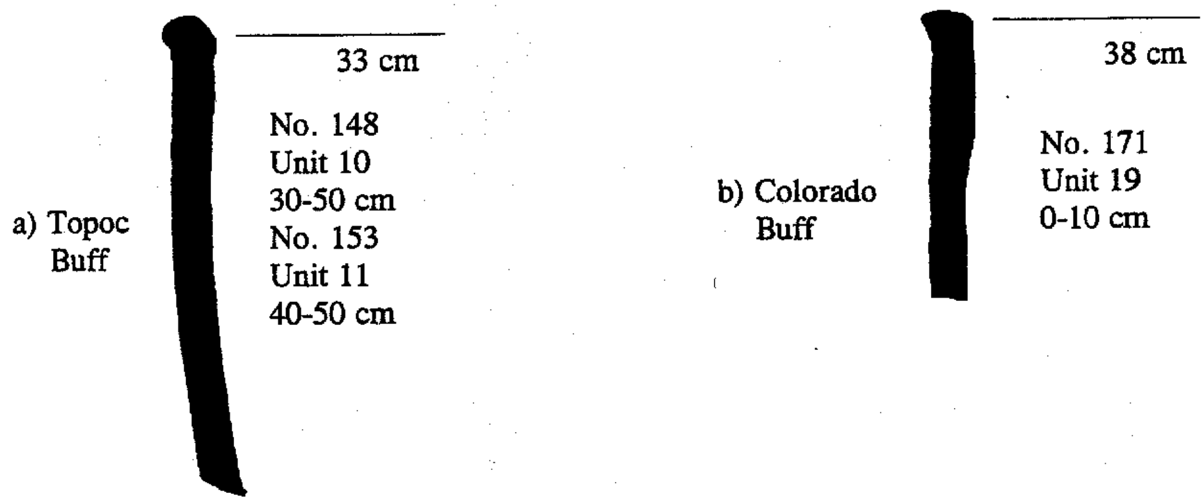


Figure 15. Ceramics from IMP-7750.

Two samples of raw clay were also recovered from IMP-7750. The first is a large sample (13.4g) found in the upper 10cm of unit 17. A portion of this clay sample was submitted for NAA analysis and will be the subject of later studies. The second clay sample consisted of a small chunk weighing less than 1g recovered from the 10-20cm level of unit 2 (within the stone structure).

Ceramics are much more common in midden excavation units than in structure units (Table 5). While they were recovered from every excavated unit, units 12, 13, 19 and 20 in the midden area southeast of the stone structure contained the majority of ceramics. Unit 19 in particular contains one third of all recovered ceramics. As discussed below, this unit also contains relatively high frequencies of debitage and a milling tool kit, among other artifacts . There are also differences between the midden and stone structure in terms of ceramic types. The small number of ceramics recovered from the structure are either Salton Brown or Topoc Buff. These are the most common ceramic types present at IMP-7750, and they also comprise the majority of the midden ceramic assemblage. Three additional types, Colorado Buff, Tizon Brown, and Salton Buff, are represented in smaller amounts in the midden assemblage but are completely absent from the structure assemblage. The Salton Buff sherd is probably not contemporary with the rest of the assemblage and may have been curated from a Patayan II site. Differences in sample size between the structure and midden may also explain the greater number of types outside the structure.

Table 5. Debitage Reduction Stage by Material Type

	Primary		Secondary		Interior		Shatter		Total	
Material Type	**Ct.**	**%**	**Ct.**	**%**	**Ct.**	**%**	**Ct.**	**%**	**Ct.**	**%**
Quartzite	7	8.1	12	14.0	25	29.1	3	3.5	47	54.7
Metavolcanic	5	5.8	3	3.5	16	18.6	1	1.3	25	29.1
Wonderstone	4	4.7	6	7.0	1	1.2	-	-	11	12.8
Other/unknown	-	-	-	-	2	2.3	-	-	2	2.3
Basalt	-	-	-	-	1	1.2	-	-	1	1.2
Total	16	18.6	21	24.5	45	52.4	4	4.8	86	100.00

Flaked Stone Assemblage

Subsurface excavations produced 92 pieces of flaked stone (ca. 40 percent of the total artifact assemblage), including 86 flakes and pieces of angular shatter, three cores, and three bifacially retouched tools (see Table 1). Flaked stone density for the midden units is eight times that of the structure units when total excavated volume is taken into account (see Table 3). Each flaked stone subclass is discussed in further detail below.

Debitage

A total of 86 pieces of debitage (38.1 percent of the total artifact assemblage) were recovered from subsurface deposits at IMP-7750 (Table 3). Debitage was found in all excavated units (see also Table 1), but was most common in unit 19, located in the midden area southeast of the stone structure (n=28, 33 percent of total debitage). Unit 13, located just west of unit 19 at the southern end of the structure, also contained relatively high frequencies of debitage (n=25, 29 percent of total debitage). Unit 18 contained no debitage, and units 2, 10, 11, and 17 contained very low debitage frequencies. This suggests that most stone tool production or rejuvenation took place outside the structure or debitage was removed from the structure to the midden area during housekeeping.

Five different raw material types are represented in the assemblage (Table 5). Quartzite is the most common material class, representing just over half of the entire debitage assemblage. Metavolcanics and Wonderstone comprise 29 percent and 13 percent, respectively, of the total assemblage. Wonderstone is a hydrothermally altered silicified rock containing distinctive bands of color caused by iron and manganese inclusions (Pigñiolo 1995). Wonderstone occurs in two major sources in southern California. The first of these is Rainbow Rock Quarry, located on the western side of the Salton Trough at the southeastern end of the Santa Rosa Mountains. This would have been the nearest source of Wonderstone for the inhabitants of IMP-7750. A second source, Cerro Colorado, is located just south of the U.S. border and west of Mount Signal in Baja California Norte. In addition to the more common raw material types represented in the debitage assemblage, a small amount of basalt and other material, probably diorite, was also present. Both probable diorite flakes are small non-cortical flakes that may have resulted from milling tool use or manufacture.

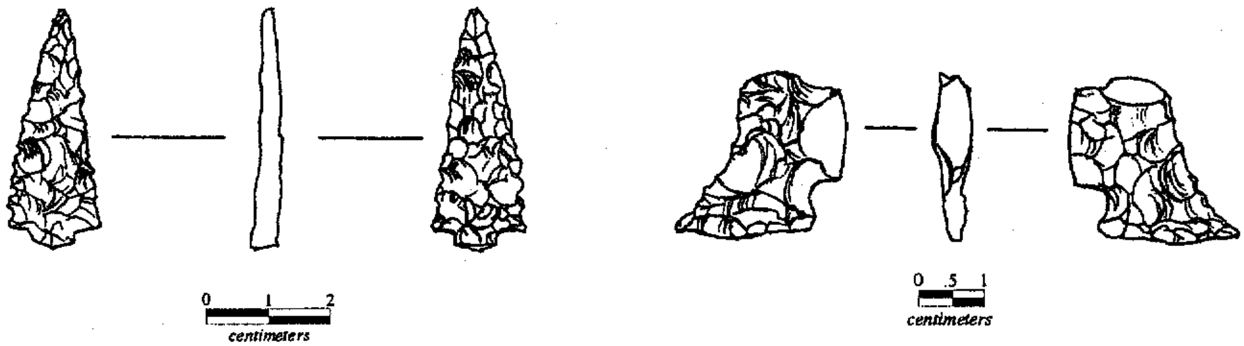
All stages of debitage reduction are present, from primary flakes to shatter. Both cortical (primary and secondary) and non-cortical (interior) flakes are common. No obvious pressure flakes or bifacial thinning flakes were noted in the assemblage, although several bifaces were recovered from the site. This may suggest that biface manufacture and rejuvenation occurred away from the site. The low frequency of mammal bone in the faunal assemblage also suggests that hunting was not a primary activity. Small sample size is also a factor.

Cores

A total of three cores, (1.3 percent of the total IMP-7750 artifact assemblage) were recovered from the site (Table 3). One of these came from a unit within the stone structure; the other two were recovered from the midden area. The first is a unidirectional quartzite core fragment from the 30-40cm level of unit 10. This core appears to have initially been used as a percussing tool, as its cortical surface is heavily battered. It weighs 68.3g. The second core is a large (476.1g) quartzite block from the 10-20cm level of unit 13. It has been bifacially flaked and contains extensive step fracturing and platform preparation. This core may also have been used as a percussing tool, as several of the non-flaked margins exhibit impact scars. The third core is a fragment of a variegated, fine-grained metavolcanic block from the 10-20cm level of unit 19. A single flake has been removed from this fragment, possibly to test the material for workability. It weighs 89g.

Bifacially Retouched Stone

Three bifacially retouched items, all projectile points, were recovered from IMP-7750. They may have been used for hunting, fishing, or defense. Two of these were recovered from the stone structure; one was found in the midden. The first projectile point is a nearly complete Desert Side-notched point made of fine-grained gray metavolcanic stone (Figure 16a). The base of the point has snapped off. This point is 2.9cm long by 1.1cm wide by 0.3cm thick and was recovered from the 30-40cm level of unit 10, located within the stone structure. The second projectile point is approximately one lateral half of the base, including the notch, of an obsidian Desert Side-notched point (Figure 16b). At least one of the breaks on this point appears fresh, and it may have been broken through post-depositional processes. The obsidian bears all the characteristics (i.e. phenocrysts) of the Obsidian Butte source. This point fragment was also recovered from the interior of the stone structure in the 40-50cm level of unit 11. A final projectile point, a mid-section fragment of what appears to be a Cottonwood Triangular point, was found in the upper 10cm of unit 20 (not shown). This thin quartz point has been extensively retouched on one face and less completely retouched on the opposite face. It appears to have snapped during manufacture.



a) b)

Figure 16. Projectile points from IMP-7760.

Milling Equipment

A total of 4 milling tools were collected (1.8 percent of the total artifact assemblage). All of the milling tools were made of locally available materials, including sandstone from the nearby Brawley Formation, and granites and diorites, which occur in alluvial fans and stream beds originating from the Peninsular Ranges to the west of the site. One of these is a complete unifacial granite mano collected from the surface of the site (see Figure 5). The non-grinding surface appears to have been shaped and somewhat smoothed, but it does not exhibit the grinding striations or polished facets present on the grinding surface (Figure 17). This mano measures 12.7cm by 8.9cm by 5.5cm. A fragment of a second mano or pestle was recovered from the upper 10cm of unit 19. This fragment is heavily battered along its distal margin and may have been recycled for use as a percussing tool. It is made of diorite and weighs 238g.

A complete rectangular sandstone slab metate was recovered from the upper 10cm of unit 19 (Figure 17). This slab metate is 30cm long, 29cm wide, and 2.9cm thick. The grinding surface measures approximately 21cm by 17cm. A final milling tool, a small fragment of a sandstone metate, was found in the 0-10cm level of unit 13. Weighing only 95g, it is too small to classify further. This fragment is extremely weathered and friable and appears to have been fire-affected.

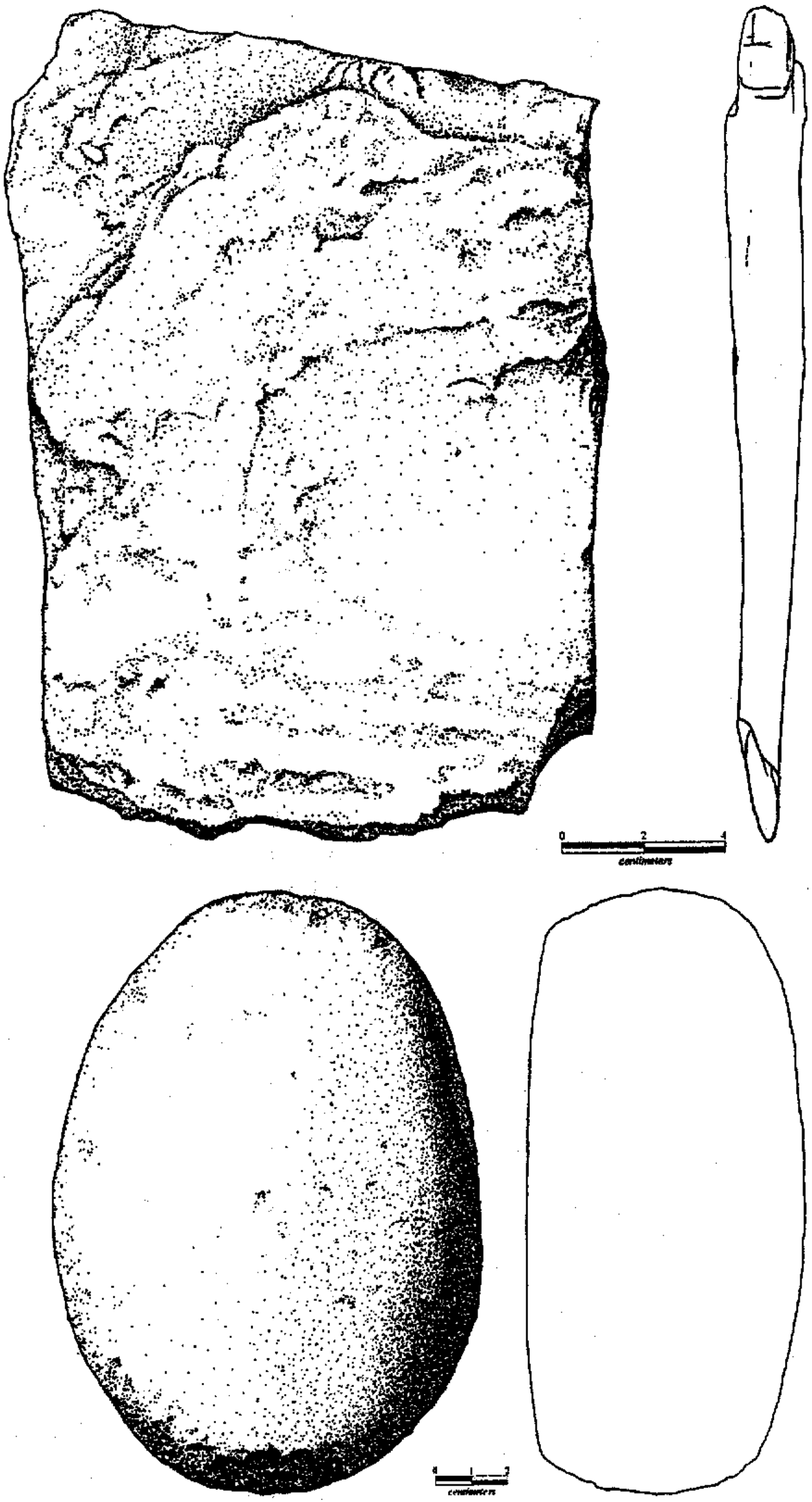


Figure 17. Complete milling tools from IMP-7750.

Modified Shell

Three modified shell artifacts were recovered (1.3 percent of the total artifact assemblage) (Table 1). Two of these artifacts are very similar *Olivella dama* beads recovered from units 10 and 11 within the stone structure. They appear to be spire-lopped, but the spires on both beads have been broken and not ground, making further classification as to bead type difficult (Figure 18a). Both beads are 1.1cm in length. The first bead, which was found in the 30-40cm level of unit 10, measures 0.5cm in diameter. The second bead, recovered from the 40-50cm level of unit 11 (immediately south of unit 10), measures 0.6cm in diameter (Figure 18b). *O.dama* was procured from the Gulf of California and spire-lopped beads commonly occur at recessional sites (Rosen 1994).

A final modified shell artifact is a probable Lucina *Lucina* spp.) that has been ground and perforated through its apex, possibly for use as a pendant (Figure 18c). Members of this genus occur along the Pacific Coast from Alaska to Baja, California (Morris 1966). The edges of the shell have been broken, but its current dimensions are 1.5cm by 1.4cm. The diameter of the perforation is 0.3cm. This artifact was found in the upper 10cm of unit 19 in the midden area southeast of the stone structure.

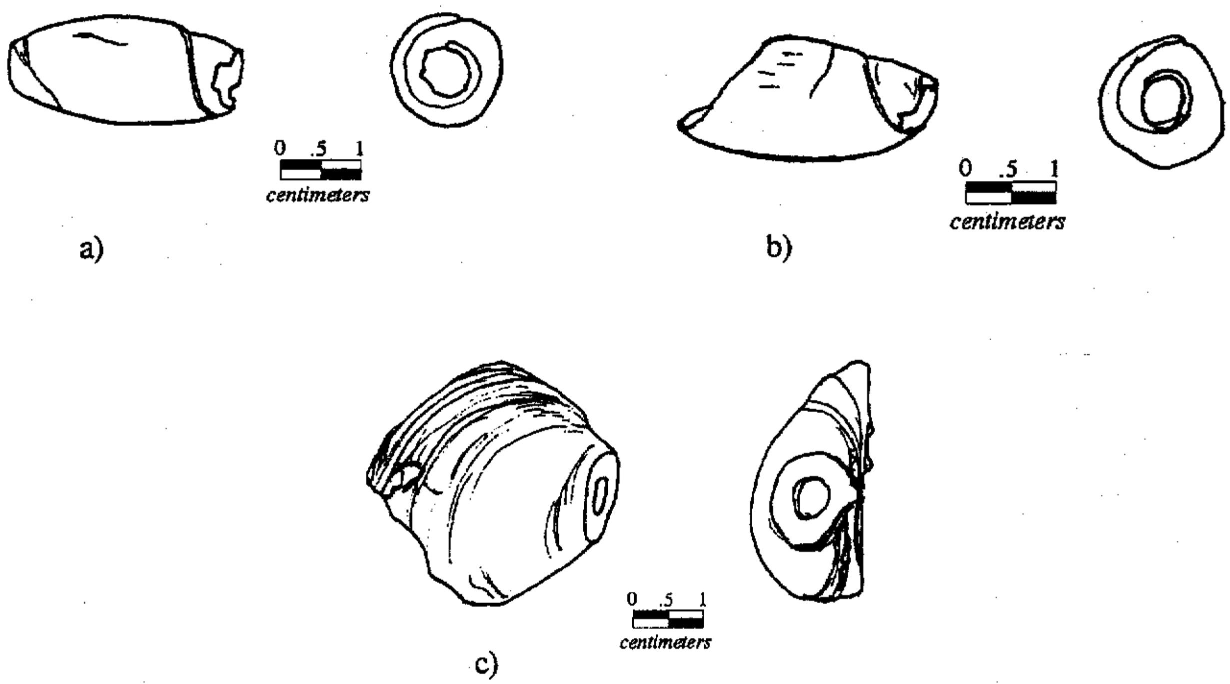
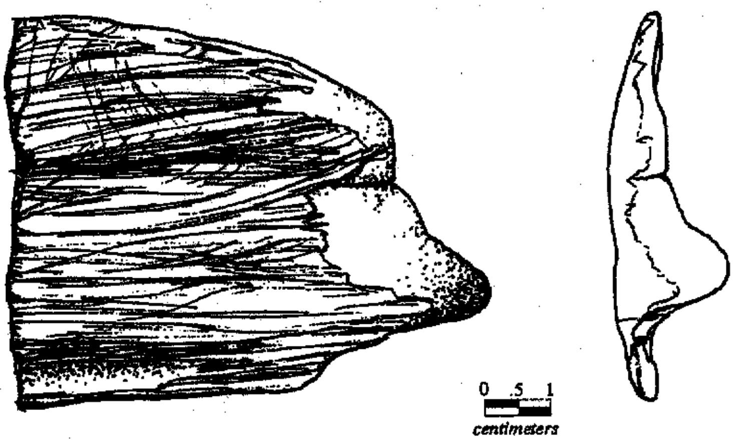


Figure 18. Modified shell beads and pendant from IMP-7750.

Miscellaneous Artifacts

Two indeterminate artifacts (1.3 percent of the total artifact assemblage) were recovered from units 12 and 19. Both of these are unusually shaped stone items that may or may not have been culturally modified. The first item appears to be part of a flat piece of a reddish-brown siltstone or Wonderstone with fine striations on one surface (Figure 19 top). It was found in the 10-20 cm level of unit 19. This item measures 2.6cm by 2.2cm and the striations run parallel to its long axis. The second item was recovered from the 0-20cm level of unit 12 (not shown). It is part of a rectangular piece of chalky tan siltstone measuring 1.8cm by 1.3cm. This item does not appear to have been modified, but is an unusual shape and may be a manuport. Finally, a number of small fragments of what may be fiber cordage was recovered from several contexts at IMP-7750. These fragments are not included in the total artifact count for the site. They were found in the upper 10-20 cm of units 1, 17, and 19 and total less than 1g. The fragment from unit 19 may appear to have been twisted, but no clearly diagnostic twist and spin pattern can be identified. It seems more likely that these fragments originate from naturally occurring vegetation growing in the vicinity of the site.



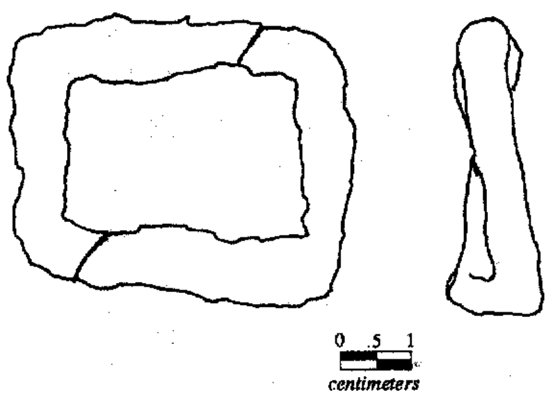


Figure 19. Miscellaneous artifacts fom IMP-7750.

Possible European Trade Item

Two fragments of extremely rusted metal, from a single buckle of some sort, were found in the 30-40cm level of unit 10 (Figure 19 bottom; Figure 20). These fragments appear to be quite old and may be historic and contemporary with the occupation. The item is quite small and was found inside the structure at floor level, and in an area where there was no evidence whatsoever of disturbance, intrusion, or rodent activity. Although a few modern items were found in the uppermost levels outside the structure, no other modern material culture was found elsewhere on the site, particularly in the structure floor levels that were well sealed below sandstone slab wall fall and aeolian/alluvial sediments.

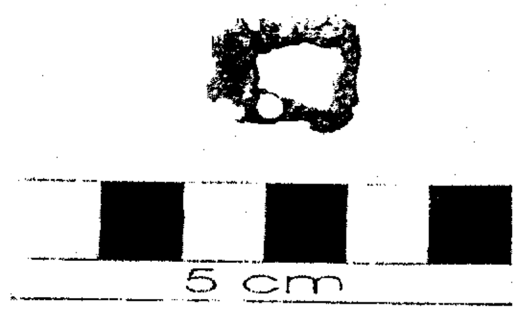


Figure 20. Possible historic iron buckle from the floor level of Unit 10 within the Structure.

There are historical records of Spanish expeditions to the Colorado River in 1540, 1604, and 1700. Spanish missionary activity was very active as early as 1620 in northern Sinaloa and by 1678 in northern Sonora , particularly with Father Eusebio Kino's activities in the 1680s and 1690s (Forbes 1965). Spanish exploration of Baja California had also begun by the 1680s (Crosby 1994). These and probably other unrecorded contacts provided ample opportunity for European goods, especially small "trade" items, to be distributed along Native trade networks before the establishment of the first Spanish missions in Alta California. The occurrence of this item is therefore compatible with the c. A.D. 1700 date of occupation. If so, it does represent one of the oldest historic items to be documented in the western Colorado Desert, well before more substantive influences of European colonization.

Modern Material

A number of modern items were recovered from IMP-7750. The modern items are few in number and probably represent deposition from wind, rain, or rodent activity. Animal burrowing at the site was not apparent in the excavations, except for what appears to be intrusive faunal elements of a kit fox. Currently occupied Salton City homes are near the site so that some modern items are not unexpected. Most of these items came from units located in midden areas surrounding the stone structure. A plastic button and a fragment of blue plastic (possibly a vinyl tarp) were collected from the 0-10cm level of unit 17. The 10-20cm level in this unit also contained a very small fragment of clear modern glass. A small piece of modern plastic was recovered from the upper 10cm of unit 18. Finally, a small piece of thin, flat, clear glass came from the 10-20cm level of unit 19. This fragment appears to be a piece of old chimney glass and was classified as historic.

MAMMAL AND BIRD REMAINS *by Patricia Mitchell*

Introduction

The bird and mammal bone collected from site IMP-7750 consists of 504 fragments weighing 49.9 grams (Appendix C). Of the 504 fragments, 21 (0.8 grams) were determined to be intrusive to the prehistoric site. These 20 bone fragments exhibited signs such as oily texture or fragile, whole elements. The oily texture suggests the presence of collagen in the bone and, therefore, the bones are most likely the result of a recent, natural death. The remaining 483 bone fragments (49.1 grams) were recovered from the 0 to 60 cm levels of 11 excavation units. All bone fragments were identified to class, order, family, or when possible to genus and species. Three animal species were identified and included *Fulica americana* (American coot), *Lepus californicus* (black-tailed jackrabbit), and *Vulpes macrotis* (kit fox). The remaining bone fragments lacked the morphological features that would have allowed them to be identified to a taxonomic category greater than their class. Other categories used to identify these fragments included small mammal, medium mammal, and bird. Evidence of burning was present on a portion of the collection and has allowed for some interpretation of the preparation of the meat diet at site IMP-7750.

Methods

Each bone was examined to determine:

- element
- right or left side
- highest taxonomic category
- evidence of burning, and if so, what degree of oxidation
- evidence of butchering, and if so, what method of butchering

Comparative skeletal collections used in the identification process included those from the San Diego Natural History Museum as well as from private collections. Bone atlases (Gilbert et al. 1985; Olsen 1979, 1985) supplemented the analysis.

Categories used in this analysis include:

Burned: Bone elements or fragments that show color change from exposure to heat or fire (oxidation):

- brown = exposure to heat, but little or no exposure to open flames.
- black = direct exposure to open flames (i.e., roasting or discard in a fire).
- blue/white (calcined) = direct exposure to a fire hotter than 800° Celsius
- (Ubelaker 1978:34). This may represent bone that was severely burned during preparation, in which case, if flesh was present on the bone during exposure to the fire the bone would exhibit signs of warping and shrinking (Ubelaker 1978:34). Calcined bone may also be the result of having been discarded in a fire hearth (Wing and Brown 1979:109).

Unburned: No evidence of burning or oxidation.

Butchered: Bone with evidence of processing by slicing or chopping actions.

Bird: Bones that have thin walls in cross-section, are hollow and light in weight. These are often distinguishable from mammal bone because they contain large cavities and, which in life, are filled with air.

Small Mammal: All non-diagnostic vertebrate fragments, whose sizes are between a mouse and a jackrabbit.

Medium Mammal: All non-diagnostic vertebrate fragments, whose sizes are larger than a jackrabbit, but smaller than a deer.

Snake: Vertebrae with ball and socket features with a domed-shaped ventral foramen.

The quantification of faunal material can be studied with several methods. The methods used in individual studies are usually determined by the sample size and type of site being investigated. Two methods were used in this study: the number of identified specimens per taxon (NISP) which represents the total number of specimens within a category; and the minimum number of individuals (MNI) which represents the minimum number of individuals within a genus and species category.

Results

The animal remains recovered from 11 excavation units consisted of 483 bone elements (49.1 grams) from the 0 to 60 cm levels of the site (Tables 6 and 7). Three animal species were identified from 15 of the 483 bones. One of the species identified was a small-sized terrestrial mammal, *Lepus californicus* (black-tailed jackrabbit). The other species identified included a medium-sized mammal, *Vulpes macrotis* (kit fox), and a bird, *Fulica americana* (American coot). The remaining 468 bones lacked the morphological features that would have allowed them to be identified to the genus and species level and were therefore identified as bird, small mammal, or medium mammal.

Table 6. IMP-7750 NISP of Vertebrate Remains by Provenience

Specimen	Unit 1	Unit 2	Unit 3	Unit 10	Unit 11	Unit 12	Unit 13	Unit 17	Unit 18	Unit 19	Unit 20	Total	Percent
Fulica americana	0	0	0	0	0	3	2	0	0	1	3	9	2.0%
Lepus californicus	0	1	2	0	0	1	0	0	0	0	0	4	0.9%
Vulpes macrotis	0	2	0	0	0	0	0	0	0	0	0	12	0.2%
Medium Mammal	0	14	0	0	0	0	0	0	0	0	0	14	3.1%
Small Mammal	4	4	3	1	5	13	27	0	0	26	36	119	25.1%
Bird	0	6	0	6	30	12	92	10	7	55	115	333	68.8%
Snake	0	0	0	0	0	0	2	0	0	0	0	2	0.4
Total	4	27	5	7	35	29	123	10	7	82	154	485	100.0%
Percent	0.9%	5.1%	1.1%	1.5%	4.4%	6.4%	26.4%	2.2%	1.5%	16.7%	33.8%	100.0%	

Table 7. IMP-7750 NISP of Vertebrate Remains by Depth

Specimen	0-10 cm	0-20 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm	35-60 cm	Total	Percent
Fulica americana	4	0	2	2	1	0	0	9	1.9%
Lepus californicus	0	0	1	1	0	0	2	4	0.8%
Vulpes macrotis	0	0	0	1	0	0	0	2	0.4%
Medium Mammal	13	0	0	1	0	0	0	14	2.9%
Small Mammal	16	0	80	8	8	4	3	119	24.6%
Bird	121	12	152	11	11	26	0	333	68.0%
Snake	0	0	2	0	0	0	0	2	0.4
Total	149	12	233	21	20	15	5	455	100.0%
Percent	32.7%	2.6%	51.2%	4.6%	4.4%	3.3%	1.1%	100.0%	

Horizontal distribution of NISP counts presented in Table 6 shows the majority of bones were recovered from Unit 20 (31.1 percent), then units 13 (25.5 percent), 19 (17 percent), 11 (7.2 percent), 12 (6.0 percent) and 2 (5.6 percent). The remaining six units contributed less than 5 percent each.

Table 7 presents the results of the vertical distribution of NISP counts of the 11 units. There is a steady increase of vertebrate remains recovered from the surface to the 20 cm levels (NISP=154 to NISP=237). The NISP counts then begin to decline from the 20 cm level to the 60 cm level (NISP=237 to NISP=5). The majority of bones (83.4 percent combined) were recovered from the 0 to 20 cm levels.

Table 8 presents the total NISP and MNI (when possible) for each genus and species identified. A minimum total of 4 animals were represented in the collection. *Fulica americana* had a MNI of two, and the remaining species, *Lepus californicus* and *Vulpes macrotis*, each had a MNI of one.

Table 8. IMP-7750 MNI of Vertebrate Remains

Specimen	NISP	MNI	Element Used
Fulica americana	9	2	Right distal tibiotarsus
Lepus californicus	4	1	Right mandible
Vulpes macrotis	2	1	Right mandible
Medium Mammal	14	-	
Small Mammal	119	-	
Bird	333	-	
Snake	2	-	
Total	483	4	

Throughout the site the greatest resource was identified as avian and included *Fulica americana*, and undifferentiated bird (70.8 percent combined). The remaining animal resources contributed less to the meat diet at the site: small mammal resources were 25.5 percent and include *Lepus californica* and undifferentiated small mammal; medium mammal resources were 3.3 percent and included *Vulpes macrotis* and undifferentiated medium mammal; reptilian resources, contributed the least with 0.4 percent and consisted of undifferentiated snake remains.

As seen in Table 9, evidence of burning was present on a portion of the collection (39.1 percent). Of the 186 bones burned, 45.5 percent (n=84) were burned brown in color, which indicated exposure to heat but not to a direct flame. This suggest that these animals were cooked in some type of container (e.g., pottery, stone, basketry). Animal species or categories burned brown in color included *Fulica americana,* bird, and small mammal.

The bones that were burned black in color represent 47.1 percent (n=89) of the burned specimens. The coloring suggests that these bones were burned during roasting or they were discarded in a fire hearth. Wing and Brown (1979:109) suggested that this type of charring is usually confined to the exposed ends of bone. This type of charring was not identified on any of the bones burned black in color. It is likely that the specimens charred black were the result of being discarded in a fire hearth. Animal species or categories charred black in color included bird and small mammal.

Table 9. IMP-7750 Summary of Burned Vertebrate Remains

Specimen	Burned Brown	Burned Black	Calcined	Total Burned	% Burned	Overall Total
Fulica americana	1	0	0	1	11.1%	9
Lepus californica	0	0	0	0	0.0%	4
Vulpes macrotis	0	0	0	0	0.0%	2
Medium Mammal	0	0	0	0	0.0%	14
Small Mammal	37	25	13	75	63.0%	119
Bird	48	64	1	113	33.9%	333
Snake	0	0	0	0	0	2
Total	86	89	14	189	39.1%	483
Percent	45.5%	47.1%	7.4%	100.0%		

The specimens that were calcined (7.4 percent/n=14 of the burned elements) were exposed to a direct flame at extremely high temperatures (greater than 800° Celsius). Of the 14 calcined bones, none exhibited signs of shrinking or warping. These are attributes that indicate the presence of soft tissue on the bone at the time the bones were exposed to an open flame. It is likely that the calcined specimens were the result of being discarded in a fire hearth. Animal species or categories calcined included small mammal.

Comparison With Previous Excavations In The Area

Vertebrate analysis from excavations at contemporaneous sites such as the Elmore site (IMP-6427) reinforces the importance of avian resources as a part of the meat diet at IMP-7750. Nineteen avian species were identified at the Elmore site (Laylander 1997:90), while only one species was identified at IMP-7750.

Natural History

Terrestrial

One species of Leporidae is represented in the vertebrate collection: *Lepus californicus* (black-tailed jackrabbit). Jackrabbit is found only in open or partially open areas (Bond 1977:234), and is most active in the morning and early evening. They feed on green vegetation, shrubs, and cacti (Russo and Oldhausen 1987:20). According to Christenson (1986), jackrabbit is best hunted with nets.

Vulpes macrotis (kit fox) is found in sandy, level desert areas (Bond 1977:242), ranging from Canada to Mexico. Kit foxes hunt primarily at night, preferring to spend most of the daytime hours underground in their dens. An adult fox weighs approximately five pounds and feeds on small rodents (The Kit Fox:internet source).

Avian

One bird species was identified in the collection, *Fulica americana* (American coot). The duck-like bird is a rare winter migrant (October to March) to the desert (Unitt 1984:69). They were obviously much more common when Lake Cahuilla was present, based on finds from the Elmore site. They are common throughout the coastal slopes in San Diego County in the summer, and abundant in the winter (Unitt 1984:69).

FISH REMAINS FROM ARCHAEOLOGICAL SITE IMP-7750 *by Kenneth W. Gobalet and Kalie Hardin, Department of Biology, California State University, Bakersfield*

Introduction

Previous studies of the fish material recovered from archaeological sites in the Salton Basin have evaluated in excess of 17,000 remains of bonytail (*Gila elegans*) and razorback sucker (*Xyrauchen texanus*) (Gobalet 1992, 1994, Gobalet and Wake "in press"). These account for over 98 percent of the total fish remains. Small numbers of remains of the Colorado pike minnow (*Ptychocheilus lucius*), machete (*Elops affinis*), and striped mullet (*Mugil cephalus*) contribute to this depauperate fauna. The current study is on the fish material (N=2593) recovered during the excavation of archaeological site IMP-7750.

Methods and Materials

Since only two species dominate the fish fauna of ancient Lake Cahuilla, discriminating between the diagnostic elements reduces to differences between a sucker (family Catostomidae), the razorback sucker, and a minnow (family Cyprinidae), the bonytail. Skeletons of razorback sucker (ASU# 13760) and bonytail (ASU# 16387) were borrowed from the Department of Zoology, of Arizona State University to assist in discrimination. Since these skeletons arrived late in the identification work, many of the identifications were based on differences between a minnow, the tui chub (*Siphateles bicolor),* lake sucker (*Chasmistes cujus*), which is in the sister genus of the razorback sucker (Miller and Smith 1981, Smith 1992), and Sacramento sucker (*Catostomus occidentalis*). Skeletons of the machete, striped mullet, Sacramento pike minnow (*Ptychocheilus grandis*), and northern pike minnow (*Ptychocheilus oregonensis*) in the collection of the first author at the Department of Biology, California State University, Bakersfield were also used. The latter two are congeners of the Colorado pike minnow. Pike minnow remains are distinctively different from those of either bonytail or razorback sucker and are not likely to be confused with any other fishes in this basin. The lumping of all minnow material as bonytail and all sucker material as razorback sucker clearly fails to follow the recommendation of Driver (1992) that every bone fragment should be identified on its own merits. According to Driver, all these remains should be recorded as Cyprinidae or Catostomidae. Driver is correct that such conservatism is normally warranted. In this case, however, where unsuccessful searches have been undertaken for remains of roundtail chub (*Gila robusta*), humpback chub (*G. cypha*), and flannelmouth sucker (*Catostomus latipinnis*), other species that possibly occupied Lake Cahuilla (Gobalet 1994), I am confident that these identifications are accurate. Preliminary identifications were made by Kalie Hardin or to a lesser extent by Alex Brown. Ken Gobalet confirmed all the identifications. Taxononic and common names of the fishes follow Robins et al. (1991).

The precaudal vertebrae of minnows (Cyprinidae) can be distinguished from those of suckers (Catostomidae) by the presence of a narrow strut interconnecting the socket of the parapophysis on the ventral portion of the lateral surface of the centrum with the neural spine. The caudal vertebrae of minnows have a ventrally projecting spine on the posteroventral portion of the centrum that is lacking in suckers (Gobalet 1994). Considering the considerable energy that has been expended to classify the members of the *Gila robusta* complex in the Colorado River and its tributaries (see references in Gobalet 1992, Holden and Stalnaker 1970, Minckley and DeMarais 2000), I doubt that bonytail, roundtail chub and humpback chub can be discriminated on the basis of individual fragmentary elements.

Average estimated lengths were determined for the bonytail and razorback suckers from each sample. The proportional method of Casteel (1976) was used to determine the standard lengths of individual fish based on the lengths of complete precaudal vertebral centra. Bonytail specimens of known standard length were borrowed from the California Academy of Sciences (CAS) and used as the standards. Bonytail specimen CAS #25860 had a standard length (S. L.) of 195 mm and the average length of its precaudal vertebrae was 2.71 mm. For CAS #66038, the S.L. was 321 mm and the average precaudal vertebral length was 4.44 mm.

The length-weight equation of Vanicek and Kramer (1969) was used to obtain the weights of the bonytail; $\log W = -4.7899 + 2.860 \log L$ (W= weight in grams; L= total length in mm). Since the lengths used by Vanicek and Kramer (1969) were total and not standard lengths, the relationship between standard and total length was determined for ASU 16387 and used to adjust for the disparity. The factor used was 112.5 percent standard length to total length.

The standard length of a razorback sucker used to determine the lengths of the specimens represented was estimated by laying out the axial skeleton of ASU 13760 and measuring the standard length (365 mm). Because McAda and Wydoski (1980) used total lengths in their two length – weight equations ($\log W = 3.16 \log L - 5.36$; $\log W = 2.31 \log L - 3.12$), standard lengths were multiplied by a factor of 120 percent to estimate total lengths. Values generated from both of McAda and Wydoski's equations are reported in Table 2. The minimum number of individuals (MNI) was estimated on the basis of the size of the remains and on the frequency of the same element in the sample.

Results and Discussion

Of the numerous remains recovered (2,593 identifiable elements were analyzed), three of the species previously identified from sites in the Salton Basin have been found at IMP-7750: bonytail, razorback sucker, and machete (Table 10 and Appendix D). Remarkably, the percentage of remains of bonytail and razorback sucker in these samples are virtually the same as were previously found in the 44 sites excavated on the Salton Sea Test Base (Gobalet and Wake "in press"). Approximately 67 percent of the identified remains at IMP-7750 are from razorback sucker and the remainder are from bonytail (33 percent). Only two machete vertebrae were recovered. At 44 sites on the Salton Sea Test Base, the percentages were approximately 68 percent and 32 percent for over 3800 elements (Gobalet and Wake "in press"). The only other specimen was from a striped mullet. This is an unexplained local phenomenon because the collective totals from 97 sites in the Salton Basin (IMP-7750 and Gobalet and Wake "in press") have nearly 20,000 remains with 58 percent being from bonytail and 41 percent from razorback sucker. Why there seem to be more razorback sucker appearing in the middens in the area southeast of Salton City is illusive.

Table 10. Number of Fish Remains Recovered from the Excavation of Archaeological Site IMP-7750

Taxon	Common Name	Number of Elements
Elops affinis	machete	2
Cyprinidae	carps and minnows	11
Gila elegans	bonytail	821
Xyrauchen texanus	razorback sucker	1772

Table 11 contains data on the average total length of bonytail and razorback sucker in individual samples, the estimated weight of the average specimen, and the minimum number of individuals. Weights are based on data provided by Vanicek and Kramer (1969) for bonytail and McAda and Wydoski (1980) for razorback sucker. The range of weights indicated for razorback sucker reflects the two equations of McAda and Wydoski (1980). These data can be used to estimate the edible weight in each sample. Deitz et al. (1988:358) reported that approximately 75 percent of a fish is edible meat. This figure seems optimistic, but does provide a figure to work with. These data are used by Schaefer in the concluding chapter to estimate potential nutritional yield and carrying capacity of the fish catch during the occupation of IMP-7750.

Table 11. Estimated average total length, weight, and minimum number of individuals (MNI) for samples of fish remains from IMP-7750

Unit	Catalog Number	Species	Ave. Total length (mm)	Weight (g)	MNI
1	24	bonytail	374	370	7
		razorback sucker	354	495-586	8
1	25	bonytail	312	220	3
		razorback sucker	346	461-556	4
1	177	bonytail	419	512	4
		razorback sucker	288	258-364	4
1	180	bonytail	345	294	3
		razorback sucker	341	440-538	3
2	26	bonytail	362	337	2
		razorback sucker	221	111-197	3
2	32	bonytail	345	294	3
		razorback sucker	275	223-327	4
2	35	bonytail	380	388	2
		razorback sucker	324	374-478	7
2	36	bonytail	276	155	4
		razorback sucker	379	614-687	4
2	181	bonytail	430	552	2
		razorback sucker	402	740-787	3
2	38	bonytail	281	163	2
		razorback sucker	282	241-347	3
2	40	bonytail	258	128	2
		razorback sucker	267	203-306	3
3	42	bonytail	281	163	1
		razorback sucker	388	662-725	3
10	44	razorback sucker	332	404-506	2
10	49	bonytail	303	203	6
		razorback sucker	278	231-336	8
10	183	bonytail	383	396	3
		razorback sucker	320	360-464	3
11	53	bonytail	334	268	2
		razorback sucker	379	614-687	4
11	57	bonytail	431	556	3
		razorback sucker	280	236-341	4
11	185	bonytail	554	1139	3

Unit	Catalog Number	Species	Ave. Total length (mm)	Weight (g)	MNI
		razorback sucker	396	706-760	4
12	60	bonytail	342	287	2
		razorback sucker	282	241-347	4
12	65	bonytail	415	499	3
		razorback sucker	389	667-729	3
12	68	bonytail	334	268	3
		razorback sucker	263	194-295	4
12	188	bonytail	334	268	3
		razorback sucker	394	695-751	3
13	72	bonytail	342	287	4
		razorback sucker	350	478-571	6
13	76	bonytail	383	396	6
		razorback sucker	344	452-549	7
13	191	bonytail	261	132	4
		razorback sucker	326	382-485	9
17	81	bonytail	365	345	7
		razorback sucker	278	231-336	4
17	83	bonytail	381	390	6
		razorback sucker	381	625-695	7
18	86	bonytail	294	186	3
		razorback sucker	382	630-699	5
18	88	bonytail	298	193	2
		razorback sucker	360	522-610	3
19	93	bonytail	261	132	3
		razorback sucker	379	614-687	5
19	99	bonytail	390	417	3
		razorback sucker	371	574-654	3
19	193	bonytail	285	170	3
		razorback sucker	329	393-495	4
20	103	bonytail	390	417	4
		razorback sucker	323	371-475	5
20	106	bonytail	293	184	3
		razorback sucker	309	322-428	4
20	200	bonytail	342	287	3
		razorback sucker	372	579-658	3

Fish Traps, Capture Methods, and Fish Sizes

Numerous sites in the Salton Basin contain rock features that Treganza (1945) concluded were former house sites or antelope blinds. These are more likely weirs or fish traps. These may have been used to help capture the fishes by the Native Americans. There are hundreds of "V" and "U"-shaped rock alignments found along successively descending ancient Lake Cahuilla shorelines. W. L. Minckley (Arizona State University, pers. comm.) proposed that the weirs formed a barrier between the shallow gravely shoreline and deeper water. The weir was blocked at its offshore narrow end with a net or equivalent structure. Because razorback suckers spawn near shore and retreat quickly to deeper water when startled (Minckley, 1973, 1983; Marsh, 1985, 1987; Papoulias and Minckley, 1990), they could have easily been herded into nets at the point of the "V" by startling spawning fishes within the confines of the weir.

There was a striking uniformity in the size of vertebrae recovered within a species at IMP-7750 that is consistent with weir fishing. Captured bonytail were typically around 320 mm in standard length. Small individuals could hide in crevices between rocks constituting the weir or swim through large mesh nets to escape capture. Though bonytail seemed to be generally uniform in size, the method of their capture is more problematic because they spawn over gravel in slightly deeper water and do not always choose shorelines (LaRivers, 1962; Minckley, 1973; Moyle, 1976). However, wave action along the shore may have provided unsilted gravel beds appropriate for bonytail spawning, which could explain the uniform size of the many bonytail remains if they too were captured using weirs.

PLANTS REMAINS AND HOUSE PITS: PALEOETHNOBOTANY AT IMP-7750 *by Seetha N. Reddy*

This chapter presents the paleoethnobotanical study of samples from IMP-7750. The principle aim of the study was to elucidate any potential plant usage at IMP-7750. Very little is known about the *prehistoric* use of plants based directly on archaeobotanical materials in this specific region. Hypotheses of plant usage proposed for the area are based primarily on information gleaned from ethnohistorical accounts, and are thus highly biased and have not been tested on archaeological materials.

In this study of carbonized plant remains, the basic premise of archaeobotanical data recovery necessary for archaeological investigations will be established, and the relationship between rock features and plant utilization will be explored. In doing so, the importance and contribution potential of paleoethnobotanical studies to prehistoric archaeology will be illustrated. After a brief discussion of the theoretical basis of paleoethnobotanical investigations and the archaeobotanical methodology and sampling strategies employed in this particular project, the archaeobotanical results are presented and discussed, concluding with a summary discussion of functional and intra-site variations.

Applying Paleoethnobotany

The study of economic and subsistence systems remains a major focus of archaeological research mainly because food acquisition and production systems have long been considered the most recoverable of all cultural phenomena (Hastorf and Popper 1988). Additionally, subsistence has historically been viewed as a central, if not driving, variable of culture change. This correlation between subsistence and culture change has been implicit within much of archaeological theoretical discussion.

Reconstruction of prehistoric diet is a very common theme of subsistence studies, since understanding human diet is key to comprehending a series of issues related to success and failure of adaptive strategies and subsistence systems, change in subsistence behavior and so on. The most common and widespread approach to elucidating paleodiet is through the study of floral and faunal remains from archaeological sites, with paleoethnobotanical and archaeofaunal studies being distinct yet complementing avenues of investigation. This study focuses on the study of archaeological plant remains specifically tailored to reconstruct prehistoric plant usage. The goals and approaches of all subsistence studies are similar in that they seek to ascertain how the ancient cultures made a living in terms of obtaining food, consumption and related activities. Common research questions that are addressed include; which plants and animals were eaten regularly, which were preferred, and which were the major components of the diet? Was there any social/gender/age differentiation in food consumption and acquisition? How was food procured? Moreover, subsistence studies, specifically archaeofaunal studies and archaeobotany, require knowledge of the effect that formation processes, particularly taphonomy, have on the archaeological record (Schiffer 1983). The issue of context, specifically the predepositional and depositional processes related to botanical remains, is a major concern of all paleoethnobotanical investigations.

Archaeological plant remains provide crucial data for economic studies, specifically the subsistence practices of past cultures. Plant remains provide direct evidence of the association between humans and specific economic activities. Ethnographic studies confirm that plant remains recovered from archaeological sites are indicators of specific human behavior and/or accidental inclusions from the local habitat (Ford 1979, 1985). Since ancient plant remains are only partially indicative of human activity, their study falls into two disciplines: archaeobotany and paleoethnobotany. The recovery, identification and study of plant remains from archaeological contexts is archaeobotany (Ford 1979:229). The study of plant remains from archaeological contexts which were cultivated or utilized by humans in ancient times has been defined as paleoethnobotany by Renfrew (1973) and Helbaek (1959). There are many shades of meaning for these two terms, but for the purpose of this study, paleoethnobotany is referred to as the analysis and interpretation of archaeobotanical remains to provide information about the interpretation of the interaction between human populations and plants (Hastorf and Popper 1988:2). By necessity, the first stage of such research is the recovery and identification of archaeobotanical remains. This is usually followed by interpretations which are typically dependent on the questions posed by the researcher.

Since Helbaek (1959) coined the term 'paleoethnobotany', it has become an integral component of anthropological archaeology. Even though it is a part of ethnobiology, paleoethnobotany uses ecological and archaeological approaches (Pearsall 1988). Interpretations elucidate the nature of human-plant relationships as relevant to the archaeological context. The relationships and interactions between humans and plants may take a number of forms, including differential use of plants as fuel, food, fodder, medicines, in rituals, seasonality of availability, human-plant interdependency, and so on. In general the problems addressed by the paleoethnobotanist are often dependent on the overall objectives of the excavations/ research project. The focus of the paleoethnobotanical study varies; for example, a key element of American paleoethnobotany is ecology (Bohrer 1986; Ford 1979), with the interpretation of data focusing on what can be learned about the impact of humans on certain plants and the landscape. European paleoethnobotany however has moved beyond traditional focus on morphology and taxonomy, to cultural interpretation (Ford 1985). Excellent examples of such progress in paleoethnobotany are the research by Hillman (1984) and Jones (1984). This study attempts to address cultural interpretation of macrobotanical remains.

Paleoethnobotanical data includes a variety of plant remains which can be broadly classified as micro-remains (such as pollen grains, spores and phytoliths) and macro-remains (such as seeds, nuts, fibers and wood). This report focuses on the macro-remains, particularly seeds related to human consumption. The deposition and preservation of archaeological seeds is a complex process. All seeds recovered from archaeological contexts need not necessarily be cultural, since seeds could have entered the archaeological record through processes unrelated to human activities. Therefore, the context and nature (carbonized or fresh) of the seeds are critical for any paleoethnobotanical investigation. Green (1979) has forcefully argued that the most common means of seed preservation in archaeological contexts is through charring or mineralization, and in most situations uncharred seeds are considered to be recent contaminants. There are several ways by which seeds which are not prehistoric may end up in archaeological context. As articulated by Keepax (1977:225), there are four distinct sources of contamination: poor excavation techniques, sample collection, and flotation; wind blown contamination of exposed samples; contamination through the flotation apparatus; and in situ contamination through sediment disturbance by natural formation processes. To reconstruct the relationship between plants and humans and to elucidate associated human behavior, it is important to determine the processes by which seeds became carbonized prehistorically. Discounting natural fires, there are several ways in which carbonization would occur, of which intentional burning (as fuel) or chance or accidental burning during processing (of food grains) are most common. The decipherment of these processes is key to understanding the subsistence processes in play prehistorically.

It is important to note, particularly for this study, that the deposition and preservation of archaeological seeds is a complex process, and all seeds recovered from archaeological contexts need not necessarily be cultural since seeds could have entered the archaeological record through natural processes unrelated to human activities. Therefore, the context and nature of the seeds (carbonized or fresh) are two extremely critical variables for any paleoethnobotanical study. Paleoethnobotanists consider carbonization of plant seeds to be the most reliable field indication of antiquity. However, it is important to note that seeds can be carbonized through natural fires. Therefore, in this study, only charred seeds are included in the analysis and interpretation, and none of the fresh uncarbonized seeds are addressed. The processes by which seeds, retrieved from archaeological sediments, are carbonized needs to be determined to reconstruct the relationship between plants and humans, and elucidate the associated human behavior.

Macrobotanical Recovery and Analysis

Sampling

The archaeobotanical methodology endorsed by this investigator emphasizes the importance of intensive sampling and the use of an efficient plant recovery system to help provide a richer understanding of past subsistence economies (see Reddy 1994, 1996).The potential contribution of both intensive and systematic sampling strategy for paleoethnobotanical interpretations has been clearly demonstrated for southern California (Reddy 1996). In this study, a primary concern was to establish and adopt a consistent and rigorous sampling strategy, however there were severe constraints on pursuing such investigations because the sampling strategy employed in the field lacked consistency in the sampling of the different features. Given this, the analysis and interpretations are limited and have to remain cautious.

The type of sampling employed in this project was bulk sampling. Bulk samples are best described as samples collected from very small areas and are best suited to address spatial patterns linked to specific activities (for example, hearth related activities, discard areas and so on). Scatter samples (also called grab or pinch samples) involve collection of small subsamples from a larger area which are then combined and thus provide information that is an average of the area rather than a specific activity area or concentration. Lennstrom and Hastorf (1992) have discussed the research ramifications of these two types of sampling, and in general they argue that scatter samples are more diverse than bulk samples, but there is less variability between different samples. This is because the scatter samples include sediment from a larger non-discreet area versus bulk samples which are more discreet collections. There is considerable debate among paleoethnobotanists regarding the relevancy of each type of sampling, but it is argued here that sample types are directly dependent on the research questions addressed. For example, bulk samples are more relevant if the research issues are related to elucidation of food procurement and consumption areas within the site(s) or whether specific features are associated with human food preparation and consumption. However, scatter samples are more relevant if the research issues are focused on reconstructing the environment (i.e. plant communities). This research project is primarily concerned with elucidation of human and plant interaction in terms of subsistence activities, depositional processes, and post depositional transformations, and therefore bulk sampling was more appropriate.

A total of 350.9 liters were processed for archaeobotanical materials from nine samples. The sample contexts all include feature fills from the rock feature. The nine samples were collected at varying levels from eight units, and only one unit (Unit 1) had two samples from the 10-20 cm and 50-60 cm levels. The remaining seven samples were collected from seven units, and as such do not allow for analyses of distribution of plant remains by depth at the site, in this case being irrelevant since carbonized remains only occur in specific midden deposits and occupational surfaces. Nonetheless, the sampling provides good context for discussion of intra-site distribution of plant remains both within and outside the rock feature.

Recovery

The water flotation system used for plant recovery is a modified SMAP-type machine (called Piyush One) (Watson 1976). The modifications were primarily aimed at increasing efficiency. The basis of the flotation system was a custom designed square aluminum tank which was fitted with custom parts. For the heavy fraction screen, sheets of 1 mm plastic window mesh were used as separate inserts for each sample. The heavy fraction inserts were attached to the flotation machine with the use of clothes pins. A metal box constructed to catch the light fraction have open tops and a bottom covered with wire mesh. The light fraction sieve was a polyester mesh with .25 mm openings. These pieces of cloth were attached to the top of the light fraction box by plastic and wooden clothes pins. It was imperative to test the recovery rates, and a recovery test was run with charred cultivated poppy seeds, and 91percent of floating seeds were successfully recovered in the light fractions.

The system was run for 15 minutes every morning before any samples were processed to wash out the tank and avoid contamination both from previous samples processed and exterior elements. The heavy fraction insert was also washed out thoroughly after every sample, to ensure minimal contamination. The tank bottom, where the washed sediment settles, was cleaned out when the water started getting turbid. On the average, about 30 liters of sediment were processed before the tank had to be cleaned out. The water supply was maintained continuously. The sediments were described whenever appropriate. In general, all sediments were ashy and had a relatively high charcoal content.

For each flotation sample processed, the context was noted and volume measured before it was deposited into the heavy fraction insert with the window mesh in the flotation tank. The out flowing light fraction was caught continuously in the boxes, while the sediment was agitated gently by hand to help break lumps and heavier sediment. Once the sample was processed, the heavy fraction insert was lifted and the window mesh which contained the heavy fraction removed, labeled and laid to dry in the sun. The light fraction bags were tagged and hung on a clothesline to dry. The heavy fraction insert, the measuring bucket and the walls of the tank were washed out thoroughly before the next sample was processed. Careful attention was given to keeping contamination to a minimum at every step. When they were well dried, the light fractions were emptied out of the cheese cloths and stored in plastic bags for analysis at a later date.

Identification and Analysis

The first step in the analysis was to scan the light fraction samples individually for seeds using a binocular dissecting microscope. Seed identification was based on comparative materials and standard seed keys such as Martin and Barkley (1973) and Musil (1963). Taxonomic nomenclature follows Munz (1974) and ethnographic uses and seasonal data were abstracted from Munz (1974) and Ebeling (1986).

During the sorting process, charcoal and carbonized seeds were separated from the light fraction samples by scanning under a light binocular dissecting microscope at 20 X and 40 X. The volumes of the light fractions and charcoal were measured and recorded. Observations on the presence of fresh organic materials and possible signs of disturbance such as insects were recorded. Both carbonized and uncarbonized seeds were recovered, however in this study a conservative approach is adopted and only carbonized seeds are addressed in the analysis and discussion. Since organic preservation is poor at the sites, the uncarbonized seeds are interpreted as later intrusives and not of prehistoric context, and their exclusion increases the reliability of the analysis. The only way to ascertain the age of these uncarbonized seeds would be through accelerator dating. The condition of the carbonized seeds varies from very good preservation to badly charred distortion. Working drawings were made of the primary seed types to facilitate accurate identification.

In this report discernment of patterns in the archaeobotanical data was done through two tools: density and percentage, and relative taxonomic richness. Densities are indicative of the intensity of activities involving particular plant(s) and fire, and thus are useful in elucidating the intensity of plant use at each site (and indirectly the length of occupation). In other words, the higher the density, the more intense the activities involving the particular plant and fire (Pearsall 1983: 129). Percentages indicate the relative abundance of specific taxon in an assemblage, the magnitude of past accidents and importance of specific taxa. Paleoethnobotanists use this as an indicator of floral importance, or to compare different preservation contexts, or to detect replacement of one category by another (Miller 1988), or as a magnitude of past accidents (Minnis 1978). Taxonomic richness is considered to be more qualitative than quantitative in this report, and is used to refer to the number of taxa represented in an assemblage. In other words, high frequencies of a select few taxa is indicative of low plant diversity or specialized assemblages, while lower frequencies of a greater number of taxa is indicative of high diversity or generalized assemblages. Generalized and specialized assemblages are indicative of distinct plant exploitation strategies and would be significant in understanding prehistoric plant usage when used in conjunction with seed density data.

Results and Interpretations

A total of 8,285 carbonized seeds were retrieved from eight different units within IMP-7750 (Table 12). The contexts for sampling were chosen by the project archaeologist, and submitted for macrobotanical analysis. The macrobotanical assemblages from the 8 units are distinct in terms of seed densities, charcoal densities, and plant genera diversity to a lesser degree. It is noted that although uncarbonized seeds are not included in the analyses, they were recovered in relatively high densities from all the samples, and could be indicative of post depositional inclusion and disturbance.

Table 12. Macrobotanical Remains from IMP-7750

Context	Unit	Depth (m)	Sediment Floated (L)	Charcoal (g)	Charcoal Density (g/L)	Sediment Analyzed (L)	Carbonized Seeds (N)	Carbonized Seed Density (N/L)
Inside House Pit	2	30-40	42.5	7.14	0.12	42.5	462	10.87
	10	30-40	39.8	3.98	0.10	20	735	36.75
	11	40-50	40	4.84	0.12	8	1051	131.38
	Total		122.30	15.96	0.13	70.50	2248	31.89
Outside House Pit	1	10-20	40.3	6.57	0.20	40.3	397	9.85
	1	50-60	13.3	5.88	0.44	13.3	10	0.75
	12	30-40	65.1	3.54	0.05	6.51	1169	179.57
	13	10-20	40	4.55	0.11	4	2094	523.5
	19	10-20	34.4	4.62	0.13	3.44	1042	302.91
	20	10-20	35.5	6.23	0.18	3.55	1325	373.24
	Total		228.60	31.39	0.14	71.10	6037	84.91
Total			350.9	47.35	0.13	141.6	8285	58.51

Table 12 summarizes the macrobotanical remains from the different units. The units can be categorized as those from within the house pit (Units 2, 10, and 11) and those outside the house pit (Units 1, 12, 13, 19 and 20). The sediments outside the house pit were richer in organic residue and appear to be midden deposits, while sediments inside the house were less midden like. Although more sediment was floated from outside the house pit, the analyses involved equal quantities to assure comparability between the two spatial and functional portions of the site. Given this functional and spatial distinction at the site, the macrobotanical analyses will be discussed as relevant to inside and outside the house pit.

Charcoal was recovered in similar and low densities from inside and outside the house pit (Figure 21). The low charcoal density at IMP-7750 suggests low incidents of burning at the site. The similarity in charcoal densities in the house pit and outside the house pit reflects similar preservation levels in both areas; therefore, any differences in densities of plant remains in the two areas is suggestive of depositional (and post depositional processes). Density of carbonized seeds is significantly higher outside the house pit as compared to inside the house pit (see Figure 21). This is not surprising since the house pit appeared to have been cleaned out regularly, and all plant foods processed for food and accidentally spilled inside the house pit were included in this cleaning (see description of "The Structure" and "Intrasite Spatial Patterning" above). Overall, it is argued that the macrobotanical remains outside the house reflect an amalgam of activities related to cleanings from inside the house pit and ambient seed rain from the immediate area. Additional interpretations of these distributions are provided in the concluding chapter with regard to the possibility of plant processing in the vicinity of the midden.

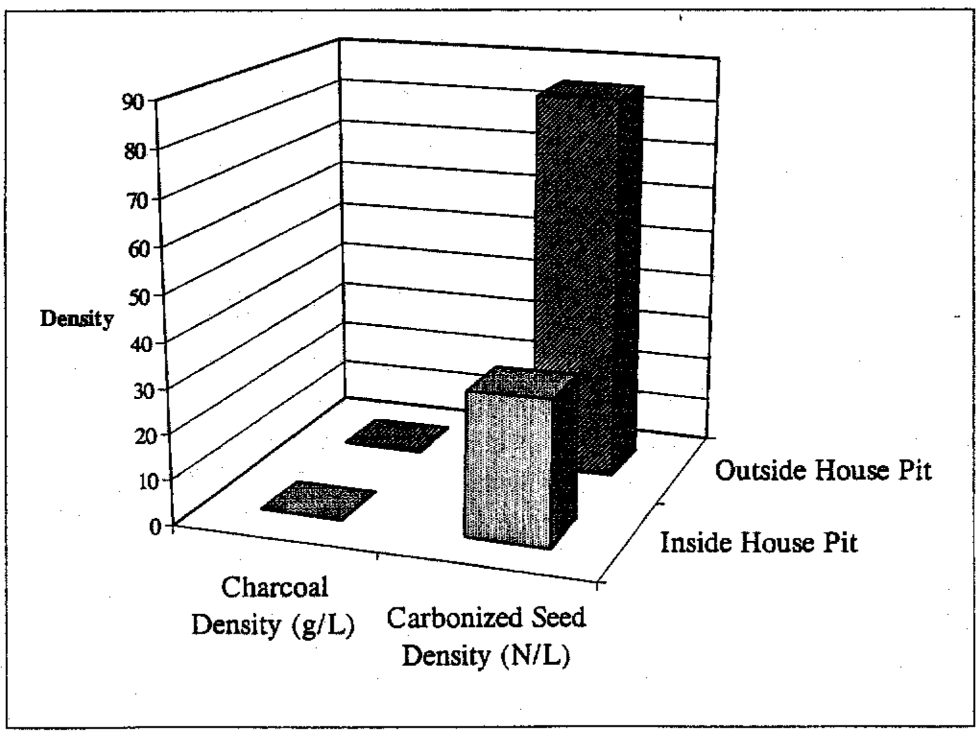


Figure 21. Charcoal and carbonized seed densities at CA-IMP-7750.

Plant genera recovered from the site are limited, and include *Atriplex* sp., *Chenopodium* sp.,and *Suaeda* sp. (Table 13). *Suaeda* sp. accounts for 75.2 percent of the macrobotanical assemblage, while *Atriplex* sp. accounts for 21.5 percent and *Chenopodium* sp. accounts for 0.40 percent. Following discussions of plant distributions and economic use are derived from Balls (1962), Bean and Saubel (1972), Ebeling (1986), Munz (1974) and Strike (1994).

Table 13. Plant Genera Recovered from IMP-7750

Plant Genera	Count	Origin	Seasonal Availability	Economic Use	Integrity of Macroremains
Atriplex sp.	1779	Native	Summer - Late fall	food, soap, medicinal	Uncertain
Chenopodium sp.	33	Introduced	Summer - Late fall	food, soap	Uncertain
Suaeda sp.	6229	Native	Summer - Late Fall	food, soap, medicinal	Uncertain

Suaeda sp. is the most ubiquitous and dominant species recovered from IMP-7750. *Suaeda* are annual or perennial herbs or shrubs. The most likely species represented at the site could be *Suaeda torreyana*, a perennial which thrives in alkaline soils. *Suaeda* leaves were boiled and eaten by Cahuilla and Luiseño. *Suaeda* was one of the many plants whose seeds were used in pinole by Native American in California. Pinole was made using small seeds which were parched by tossing in a basket with glowing coals or hot pebbles. Seeds were then pulverized and eaten. Sometimes, the pulverized seeds were pressed into cakes. Often seeds of different plant species were mixed together to enhance the flavor of the pinole. Non-food uses of *Suaeda* include steeping the plant in water to produce a rich and durable black dye. In addition, soap was made from the ashes of large quantities of burned or crushed *Suaeda*.

Atriplex sp., the second most ubiquitous plant at IMP-7750, is indigenous to the area. This plant is a herb or shrub, and the most likely species represented could be *Atriplex canescens*, which is a shrub common in the desert areas from the southern Mohave Desert to the Salton Sea. Balls (1962) presents ethnohistoric evidence for the use of *Atriplex californica* for food and as soap. The fleshy roots were used as soap by Native American and early settlers. The seeds were used to make mush or bread either by cleaning the seeds and tossing them with hot coals in baskets, or grinding without parching, and made into a mush by mixing with water. According to Bean and Saubel (1972:45), two species of this genus, *Atriplex lentiformis* (an indigenous plant) and *Atriplex semibaccata* (an introduced species) were used by the Cahuilla. The Cahuilla also ate the fresh leaves of *Atriplex canescens* as greens or boiled the leaves with other foods to add flavor. Often large quantities of cicadas were found on *Atriplex* bushes, and the cicadas were gathered, roasted and eaten. Leaves of *Atriplex lentiformis* were used as soap, while the seeds were used to make mush. Flowers, stem, and leaves of *Atriplex lentiformis* had medicinal uses. *Atriplex* branches were used to make arrow foreshafts approximately five inches long. The introduced species *Atriplex semibaccata* produced sweet and salty berries that were collected and eaten fresh. The *Atriplex* sp. seed recovered from IMP-7750 could be indicative of use as food and/or medicine by the site inhabitants.

Chenopodium sp. was a commonly used plant by the Cahuilla according to Bean and Saubel (2972: 52-53). Several species of this genus were present in the Cahuilla territory, and included

Chenopodium californicum, *Chenopodium humile*, *Chenopodium fremontii*, and *Chenopodium murale*. Seeds of *Chenopodium fremontii* and *Chenopodium californicum* were parched and ground into flour, and consumed as mush or cakes, while leaves and tender shoots were boiled and eaten as greens. The root of the plant was used to make soap. Legumes account for 1 percent of the macrobotanical assemblage at IMP-7750. They were too fragmentary to be identified. One possible legume common in this area is *Medicago* sp., an introduced legume. One species of this genus occurred in the Cahuilla territory according to Bean and Saubel (1972:88) - *M. hispida* or bur-clover. The seeds of this legume were harvested in spring and summer months, and consumed after they were parches, ground and made into a mush meal.

The plant genera represented at IMP-7750 are primarily economic plants. The seasons represented are spring through late fall, and integrity of the macrobotanical remains is uncertain because of the high quantities of uncarbonized seeds of the same species recovered from the samples. The high frequencies of *Suaeda* sp. and *Atriplex* sp. lends to conclude that it is highly likely these plants were utilized as economic resources.

Macrobotanical Remains From Inside House Pit

Three units from within the house pit were sampled for macrobotanical remains, Units 2, 10 and 11. A total of 70.50 liters of sediment was analyzed for carbonized seeds from three samples taken from two different depths of the three units. The samples included carbonized and uncarbonized seeds. A total of 2,248 carbonized seeds were recovered which included seeds belonging to five families, three genera and amorphous seed fragments (Table 14). The five families represented include Asteraceae (sunflower family), Chenopodiaceae (goosefoot family), Fabaceae (bean family- legumes), Lamiaceae (mint family), and Poaceae (grass family). Of the five families, seeds belonging to Chenopodiaceae dominate the assemblage accounting for 96 percent of all carbonized seeds. Chenopodiaceae is represented by *Atriplex* sp.(N=530; 23.6 percent), *Chenopodium* sp. (N=17; 0.76 percent), and *Suaeda* sp. (N=1669; 74 percent).

There is some variation in the distribution of carbonized remains between the three units within the house pit. Unit 11 has the highest seed density (131.38 seeds per liter) while Unit 2 has the lowest with 10.87 seeds per liter of sediment and Unit 10 has 36.75 seeds per liter. The variation in seed density between the three units, despite their proximity is intriguing. Since charcoal density is analogous between the three units, this distinction could be the result of depositional processes. Unit 11 is at the interface of the inside and outside of the housepit, and as such could have been an interface area where the domestic cleanings were deposited during site occupation. The lower densities in Unit 2 compared to adjacent Unit 10 could be an indication of lower plant usage in that portion of the house pit. It is noted that Unit 10 is also more protected by the rock lined pit compared to Unit 2, and as such there might have been more dispersal of sediments post-depositionally. Analyses of the vertical distribution of plant remains is limited because of small sample sizes. Two of the three samples from within inside the house pit were from the 30-40 cm levels while one (Unit 11) was from the 40-50 cm level, however all represent floor levels under rock fall or post-occupational fill.

Table 14. Plant Genera frequencies and densities, IMP-7750

Context	Unit	Depth (cm)	Asteraceae	Chenopodiaceae *Atriplex* sp.	*Chenopodium* sp.	*Suaeda* sp.	Fabaceae	Lamiaceae	Poaceae	Amorphous	Total
Inside House Pit	2	30-40	2	252	-	206	-	-	1	1	462
	10	30-40	-	71	13	635	4	-	-	12	735
	11	40-50	-	207	4	828	-	4	-	8	1051
	Total		2	530	17	1669	4	4	1	21	2248
Outside House Pit	1	10-20	-	178	-	218	-	-	-	1	397
	1	50-60	-	10	-	-	-	-	-	-	10
	12	30-40	-	91	16	1026	14	-	-	22	1169
	13	10-20	-	181	-	1778	57	-	-	78	2094
	19	10-20	-	364	-	663	-	-	-	15	1042
	20	10-20	-	425	-	875	8	-	-	17	1325
	Total		-	1249	16	4560	79	-	-	133	6037
Total			2	1779	33	6229	83	4	1	153	8285

Densities (N per liter) of macrobotanical remains recovered from IMP-7750

Context	Unit	Depth (cm)	Asteraceae	Chenopodiaceae *Atriplex* sp.	*Chenopodium* sp.	*Suaeda* sp.	Fabaceae	Lamiaceae	Poaceae	Amorphous	Total
Inside House Pit	2	30-40	0.05	5.93	-	4.85	-	-	0.02	0.02	10.87
	10	30-40	-	3.55	0.65	31.75	0.20	-	-	0.60	36.75
	11	40-50	-	25.88	0.50	103.5	-	0.50	-	1.00	131.38
	Total		0.03	7.52	0.24	23.67	0.06	0.06	0.01	0.30	31.89
Outside House Pit	1	10-20	-	4.42	-	5.41	-	-	-	0.02	9.85
	1	50-60	-	0.75	-	-	-	-	-	-	0.75
	12	30-40	-	13.97	2.46	157.60	2.15	-	-	0.31	179.57
	13	10-20	-	45.25	-	444.50	14.25	-	-	19.50	523.50
	19	10-20	-	105.81	-	192.73	-	-	-	4.36	302.91
	20	10-20	-	119.72	-	246.48	2.25	-	-	4.79	373.24
	Total		-	17.57	0.23	64.14	1.11	-	-	1.87	84.91
Total			0.01	12.56	0.23	43.99	0.59	0.03	0.007	1.08	58.51

Macrobotanical Remains from Outside House Pit

Five units from outside the house pit were sampled for macrobotanical remains, Units 1, 12, 13, 19, and 20. A total of 71.10 liters of sediment was analyzed for carbonized seeds from six samples taken from different depths of the five units. The samples included carbonized and uncarbonized seeds. A total of 6,037 carbonized seeds were recovered which included seeds belonging to two families, three genera and amorphous seed fragments (Table 14). The five families represented include Chenopodiaceae (goosefoot family) and Fabaceae (bean family-legumes). Of the five families, seeds belonging to Chenopodiaceae dominate the assemblage accounting for 96.5 percent of all carbonized seeds. Chenopodiaceae is represented by *Atriplex* sp.(N=1249; 21 percent), *Chenopodium* sp. (N=16; 0.26 percent), and *Suaeda* sp. (N=4560; 75.5 percent).

There is significant variation in the distribution of carbonized seeds in the units outside the house pit. Unit 13 has the highest seed density with 523.50 seeds per liter, while Units 19 and 20 have lower but similar densities at 302.91 and 373.24 seeds per liter respectively. Unit 12 has 179.57 seeds per liter while Unit 1 has the lowest density with 7.6 seeds per liter. Unit 1 is located on the north side of the house pit and it appears that there was the least amount of domestic cleanings incorporated into this spatial area, composed mostly of fish bone deposits. Vertical distribution of carbonized materials does not show strong testable patterning, primarily because the sampling was only from the midden layer. Nonetheless, the highest densities of carbonized seeds are from the 10-20 cm levels outside the house pit (which contrasts with the samples from inside the house pit where the higher seed density was from the 40-50 cm level at the floor level). Spatially, it can be inferred that domestic cleanings were deposited in the area represented by Units 13, 19 and 20 which have the significantly higher seed densities. Units11 and 12 are interface areas, while Unit 1, with the lowest seed density at the site, had relatively little domestic cleanings deposited.

Intra-site Spatial Distribution

The interpretation of archaeobotanical remains is often a difficult task because of the interaction of many formation processes both depositional and post-depositional. An issue of great concern to paleoethnobotanists is how plant remains are incorporated into archaeological sediments, in other words the depositional processes, and their original source. There are several distinct ways by which macrobotanical plant remains (in this case seeds) get into the site sediments and these include: seed rain from plant life near site, selective collection, type of processing method, and refuse disposal. Most importantly, only a very small fraction of the plants that were utilized at the site get carbonized and discarded into contexts that are archaeologically discoverable. In addition, differential preservation of various plant remains is an important factor that effects the interpretation of an archaeobotanical assemblage. Therefore, it is important to note that differences in seed densities need not necessarily imply differences in the intensity of plant usage. Instead, it could be an indication of inadequate preservation of plant materials in the particular context, or the sample collection midden area may not have been an area of plant disposal. This problem can only be overcome by sampling as many contexts as possible at a given site.

In the context of intra-site distribution and the implications of variation in the distributions of carbonized plant remains at IMP-7750, it is important to discuss the source of the macrobotanical remains in regards to being cultural or natural in the two spatially distinct areas at the site (inside and outside the house pit). All samples from IMP-7750 had a high number of uncarbonized seeds, and the higher densities of the two dominant genera (*Atriplex* sp. and *Suaeda* sp.) were represented by both carbonized and uncarbonized seeds (although only carbonized seeds were considered in the analyses). So, the question of cultural association of the carbonized *Atriplex* sp. and *Suaeda* sp. is inevitable. To address this issue, off-site control samples of non-cultural sediment were processed and sorted for seeds. The four immediate off-site controls included samples collected from two depths (0-15 cm and 15-30 cm) and two different proveniences. The samples were dominated by uncarbonized *Atriplex* sp. and *Suaeda* sp. seeds, and reflect that ambient seed rain as an important source of seeds in sediments. Both samples were dominated by *Suaeda* sp. (21 to 13 seeds per liter of sediment) with *Atriplex* sp. occurring in significantly lower densities (8 to 4 seeds per liter of sediment). In both sets of samples, not surprisingly, the densities of seeds per liter for both genera decreased with depth, suggesting that ambient seed rain was a long-term process. Given the shallow deposits at IMP-7750 and the presence of high quantities of uncarbonized seeds in all the samples, the integrity of carbonized seeds is questionable. However, if all or a high portion of the carbonized seeds from the site were indicative of ambient seed rain, one would not expect to see strong spatial variations between units (and sometimes between adjacent units) at the site that were noted. Furthermore, the significantly higher seed densities in the archaeological samples (compared to the control samples) are the results of both natural (ambient seed rain) and cultural processes (intentional collection). This is reinforced by the fact that the percentage of carbonized seeds in the control sample was low and is not analogous to the cultural samples. Therefore, it is argued here that ambient seed rain could be a very high contributory factor but there also appears to be a certain level of cultural patterning of the plant remains. Thus, most of the carbonized seeds could be cultural in origin; in other words, they were intentionally brought to the site (as food, fuel and other economical uses) and incorporated into the sediments subsequently.

The macrobotanical assemblage from IMP-7750 is characterized by the dominance of two plant genera. Of the three genera represented at the site, all are native to the area. Seasonality information indicates that collection during summer to late fall months is most prevalent. Comparison of the carbonized seed assemblages from within the house pit and outside the house pit reveals a certain degree of patterning in the seed densities and taxonomic richness (Figure 22). Sediments outside the house pit have significantly higher seed densities, but lower taxonomic richness with only two families and three genera represented. Sediments inside the house have lower seed densities but higher taxonomic richness with five families and three genera represented in the assemblage. Thus, the assemblage of carbonized seeds from outside the house pit has high frequencies of a select few taxa and is indicative of low plant diversity or specialized assemblages. In contrast, the assemblage from inside the house pit has lower frequencies of a greater number of taxa and is indicative of high diversity or generalized assemblages.

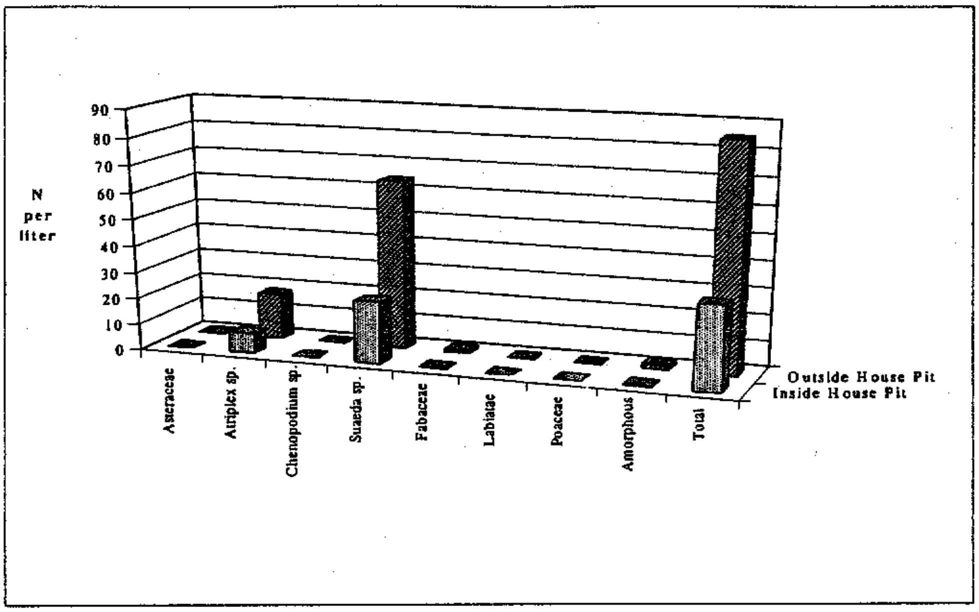


Figure 22. Distribution of plant genera within and outside house it, IMP-7750.

Overall, the macrobotanical assemblage at IMP-7750 is substantially dominated by *Suaeda* sp. and *Atriplex* sp., with the former occurring in higher densities. Since both plants are food resources, and also have other economical uses, it is worthwhile to explore whether the singular dominance of *Suaeda* sp. indicates cultural preference or environmental constraint. In the Salton sink, *Suaeda* sp. establishes well in sediments that are too alkaline for *Atriplex* sp. *Suaeda* sp. occur as subordinates in the *Atriplex* associations and are dominant only in areas which are too alkaline for *Atriplex* sp.(MacDougal 1914:93). This is of interest for prehistoric use if there is a preference of one genus over the other. For example, at IMP-7750, if we do not consider ambient seed rain as contributing to the high densities of *Suaeda* sp. and *Atriplex* sp., it is clear that the occupants favored *Suaeda* sp. over *Atriplex* sp., and were most likely focusing their plant resource exploitation to more alkaline areas within the daily foraging range of the site. If such areas are not within the daily foraging range then it is argued that *Suaeda* seeds were stored and utilized as needed. (Note however that the immediate off-site control samples yielded higher densities of *Suaeda* sp. as compared to *Atriplex* sp.). Such a finding would lend strong evidence for intensification of hunter gatherers adaptations particularly in terms of seasonal planning, storage and logistical movements. Future research at house pits in the Salton Sea region should focus on elucidating such processes through paleoethnobotanical and environmental studies.

Regardless of whether interpretations and hypotheses presented in this study are validated by subsequent research or not, such investigation will contribute to our understanding of prehistoric subsistence systems in southern California specially related house pits and spatial distinctions within small areas. Paleoethnobotanical investigations broaden our data base, provide new avenues of investigation, and generate additional insights of prehistoric behavior.

POLLEN AND PHYTOLITH ANALYSIS *by Linda Scott Cummings, Paleo Research Laboratories (With Assistance from Thomas E. Moutoux)*

Introduction

Five sediments samples were selected from Site IMP-7750 for pollen and phytolith analysis. Two samples were collected from the floor or immediately above the floor in a house structure. Two additional samples represent midden outside the house. The fifth sample was collected as a control sample beneath the midden. Pollen and phytolith samples were examined to provide evidence concerning subsistence activities at this site.

Methods

Pollen

A chemical extraction technique based on flotation is the standard preparation technique used in this laboratory for the removal of the pollen from the large volume of sand, silt, and clay with which they are mixed. This particular process was developed for extraction of pollen from soils where preservation has been less than ideal and pollen density is low.

Hydrochloric acid (10 percent) was used to remove calcium carbonates present in the soil, after which the samples were screened through 150 micron mesh. The samples were rinsed until neutral by adding water, letting the samples stand for 2 hours, then pouring off the supernatant. A small quantity of sodium hexametaphosphate was added to each sample once it reached neutrality, then the beaker was again filled with water and allowed to stand for 2 hours. The samples were again rinsed until neutral, filling the beakers only with water. This step was added to remove clay prior to heavy liquid separation. At this time the samples are dried then pulverized. Sodium polytungstate (density 2.1) was used for the flotation process. The samples were mixed with sodium polytungstate and centrifuged at 2000 rpm for 5 minutes to separate organic from inorganic remains. The supernatant containing pollen and organic remains is decanted. Sodium polytungstate is again added to the inorganic fraction to repeat the separation process. The supernatant is decanted into the same tube as the supernatant from the first separation. This supernatant is then centrifuged at 2000 rpm for 5 minutes to allow any silica remaining to be separated from the organics. Following this, the supernatant is decanted into a 50 ml conical tube and diluted with distilled water. These samples are centrifuged at 3000 rpm to concentrate the organic fraction in the bottom of the tube. After rinsing the pollen-rich organic fraction obtained by this separation, all samples received a short (10-15 minute) treatment in hot hydrofluoric acid to remove any remaining inorganic particles. The samples were then acetolated for 3 minutes to remove any extraneous organic matter.

A light microscope was used to count the pollen to a total of 101 to 301 pollen grains at a magnification of 400-600x. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University and the University of Colorado Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen, and may be interpreted to represent pollen dispersal over short distances, or the introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagram. A plus (+) on the pollen diagram indicates that the pollen type was observed outside the regular count while scanning the remainder of the microscope slide. Pollen diagrams are produced using Tilia, which was developed by Dr. Eric Grimm of the Illinois State Museum. Pollen concentrations are calculated in Tilia using the quantity of sample processed, the quantity of exotics (spores) added to the sample, the quantity of exotics counted, and the total pollen counted.

Indeterminate pollen includes pollen grains that are folded, mutilated, and otherwise distorted beyond recognition. These grains are included in the total pollen count, as they are part of the pollen record.

Phytoliths

Extraction of phytoliths from these sediments also was based on heavy liquid floatation. Sodium hypochlorite (bleach) was first used to destroy the organic fraction from 50 ml of sediment. Once this reaction was complete, calgon was added to the mixture to suspend the clays. The sample was rinsed thoroughly with distilled water to remove the clays, allowing the samples to settle by gravity. Once most of the clays were removed, the silt and sand size fraction was dried. The dried silts and sands were then mixed with sodium polytungstate (density 2.3) and centrifuged to separate the phytoliths, which will float, from the other silica, which will not. Phytoliths, in the broader sense, may include opal phytoliths and calcium oxalate crystals. Calcium oxalate crystals are formed by Opuntia (prickly pear cactus) and other plants including Yucca, and are separated, rather than destroyed, using this extraction technique, if these forms have survived in the sediments. Any remaining clay is floated with the phytoliths, and is further removed by mixing with calgon and distilled water. The samples are then rinsed with distilled water, then alcohols to remove the water. After several alcohol rinses, the samples are mounted in cinnamaldehyde for counting with a light microscope at a magnification of 500x. Phytolith diagrams are produced using Tilia, which was developed by Dr. Eric Grimm of the Illinois State Museum for diagramming pollen.

Phytolith Review

Phytoliths are silica bodies produced by plants when soluble silica in the ground water is absorbed by the roots and carried up the plant via the vascular system. Evaporation and metabolism of this water result in precipitation of the silica in and around the cellular walls. The general term phytoliths, while strictly applied to opal phytoliths, may also be used to refer to calcium oxylate crystals produced by a variety of plants, including cottonwood and willow. Opal phytoliths, which are distinct and decay-resistant plant remains, are deposited in the soil as the plant or plant parts die and break down. They are, however, subject to mechanical breakage and erosion and deterioration in high pH soils. Phytoliths are usually introduced directly into the soils in which the plants decay. Transportation of phytoliths occurs primarily by animal consumption, man's gathering of plants, or by erosion or transportation of the soil by wind, water, or ice.

The major divisions of grass short-cell phytoliths recovered include festucoid, chloridoid, and panicoid. Smooth elongate phytoliths are currently of no aid in interpreting either paleoenvironmental conditions or the subsistence record because they are produced by a large number of grasses. Phytoliths tabulated to represent "total phytoliths" include all silica forms representing plants. Frequencies for all other bodies recovered are calculated by dividing the number of each type recovered by the "total phytoliths".

The festucoid class of phytoliths is ascribed primarily to the subfamily Pooideae and occur most abundantly in cool, moist climates. However, Brown (1984) notes that festucoid phytoliths are produced in small quantity by nearly all grasses. Therefore, while they are typical phytoliths produced by the subfamily Pooideae, they are not exclusive to this subfamily. Chloridoid phytoliths are found primarily in the subfamily Chloridoideae, a warm-season grass that grows in arid to semi-arid areas and require less available soil moisture. Chloridoid grasses are the most abundant in the American Southwest (Gould and Shaw 1983:120). Panicoid phytoliths occur in warm-season or tall grasses that frequently thrive in humid conditions. Twiss (1987:181) also notes that some subfamily Chloridoideae members produce both bilobate (panicoid) and festucoid phytoliths. According to Gould and Shaw (1983, p. 110) "more than 97 percent of the native US grass species (1,026 or 1,053) are divided equally among three subfamilies Pooideae, Chloridoideae, and Panicoideae" (Twiss 1987:181).

Buliform phytoliths are produced by grasses in response to wet conditions (Irwin Rovner, personal communication, January 1991), and are to be expected in wet habitats of floodplains and other places. Trichomes represent epidermal hairs on grasses and/or sedges. Epidermal forms represent epidermal grass cells.

Discussion

Pollen and phytolith samples were examined from a structure, an associated midden, and a control collected beneath the midden (Table 15). The pollen record indicates abundant pollen in the samples associated with the midden and house, but a very low concentration in the control sample collected beneath the midden. Apparently pollen preservation is very good in these cultural sediments. In general Cheno-am pollen (Figure 23, Table 16) dominates the record from the control and most of the archaeological samples. It usually varies between 60 and 90 percent of the total pollen. This is consistent with reports of local vegetation that include large quantities of saltbush. The exception to this dominance is sample 6, collected from the house entrance. This pollen sample is dominated by Larrea pollen reflecting creosote bush. Recovery of over 50 percent Larrea pollen from this single sample collected from the floor of the entryway probably represents use of creosote bush as part of the building materials for the house. If this is true, the house was constructed while creosote bush was flowering. Sample 4, collected from sediments above the floor inside the structure does not exhibit this large quantity of Larrea pollen, perhaps because the house had already been constructed and the floor fill accumulated after pollen had dropped from the building materials. This sample also exhibited the only evidence of Quercus and Croton pollen, which were noted in small quantities.

The two midden samples contain the largest quantities of Cheno-am pollen observed in this suite of samples. The midden contains dense, carbonized household refuse. This might reflect discard of processed foods and parallels macrobotanical results discussed by Dr. Seetha Reddy above. It can also reflect growth of Chenopodium on these sediments as a colonizer of disturbed sediments. Depending on the alkalinity of these deposits, Suaeda also might be among the colonizers of the midden.

Other elements of the pollen record include High-spine Asteraceae, which includes Encelia, a common element of the local vegetation. It is interesting to note that quantities of High-spine Asteraceae pollen are depressed in the midden samples, further strengthening the interpretation that the elevated Cheno-am pollen in these samples probably reflects plants either growing in the midden or discarded there.

Table 15. Provenience Data for Samples from Site IMP-7750

Sample No.	Unit No.	Depth (cmbs)	Provenience/Description	Analysis
1	19	40	Control from sand below cultural deposit (midden)	Pollen Phytolith
4	2	30-40	Fill above floor in concentration of fish bone from inside of rock wall (house structure)	Pollen Phytolith
6	12	30-40	Floor, entrance to house	Pollen Phytolith
8	19	10	Fill from brown stain (midden), which included carbonized household refuse	Pollen Phytolith
11	20	10	Fill from area with dark ash and charcoal concentration (midden)	Pollen Phytolith

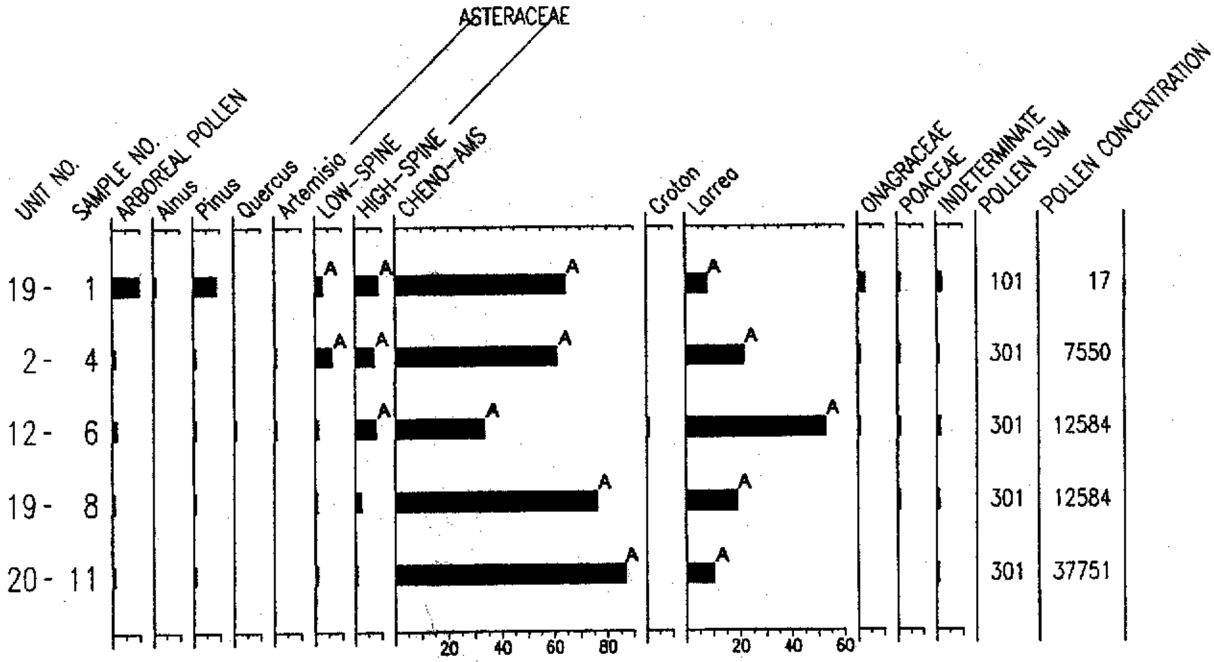


Figure 23. Pollen diagram for Site IMP-7750.

Table 16. Pollen Types Observed in Samples from Site IMP-7750

Scientific Name	Common Name
ARBOREAL POLLEN:	
Alnus	Alder
Pinus	Pine
Quercus	Oak
NON-ARBOREAL POLLEN:	
Asteraceae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Cheno-am	Includes amaranth and pigweed family
Croton	Croton
Larrea	Creosote
Onagraceae	Evening primrose family
Poaceae	Grass family
Indeterminate	Too badly deteriorated to identify

Sample 1, collected beneath the midden, reflects the local plant communities before occupation. Pinus pollen is noted in a larger quantity and Alnus pollen is present. Probably these pollen represent wind transport from other locations. Pollen concentration is much reduced in this sample, when compared with the occupation samples. This strengthens an interpretation that much of the pollen signal from the house and midden represents human activity.

The phytolith record is nearly the opposite of the pollen record with respect to preservation. The control sample contained sufficient phytoliths to obtain a count of 300 forms representing plants. Festucoid grass short cells (Figure 24) were the most abundant form recovered, indicating that grasses that grew during the cooler portion of the year probably dominated. Some chloridoid grass short cells were present, indicating the presence of short grasses that thrive in xeric, hot conditions. A few panicoid forms were observed that might represent either the presence of tall grasses or the manufacture of these forms by either cool season or short grasses. Elongate forms probably represent grasses. A single probable Agave serrated quadrilateral form was recovered in sample 11, representing the midden. This form was pitted, indicating that it was partially dissolved. It might represent transport of Agave from higher elevations where it grows. Agave fibers might have been discarded in the midden.

Phytolith samples examined from the structure and midden contain very few phytoliths. Apparently the chemical content of these anthropogenically modified sediments was enough different from the acultural sediments to result in nearly total dissolution of biogenic silica. Both samples examined from the structure yielded very few phytoliths. A few grass short cells and long cells were recovered exhibiting evidence of dissolution. The control sample was collected at a depth of 40 cm below the surface, while samples from cultural deposits were collected at depths of 30-40 and 1 cm below the surface. This correlation between phytolith dissolution in the upper samples and preservation in the lowest sample might reflect either a difference in chemical signature of the cultural deposits or more regular wetting of the upper deposits by occasional rain.

Volcanic ash fragments were noted in abundance. Volcanic ash fragments are present in a wide variety of sediments and often reflect atmospheric transport of these fragments. Their recovery and observation in these samples probably is the result of dissolution of biogenic silica and destruction of the phytolith record. Diatom and sponge spicule fragments were observed in small quantities, possibly reflecting wind transport of these remains with sediment or perhaps reflecting an elevated water table at some time. One of the midden samples contained more phytoliths than the other archaeological samples. Sample 11 yielded a total of 13 phytoliths and 15 unidentified biogenic silica fragments. These unidentified biogenic silica fragments often were square-ish with rounded corners and very ragged margins on three sides. The fourth side was invariably broken. These remains have been excluded from the phytolith total since they cannot be associated positively with plants. Round diatom fragments were quite abundant in this sample, as well, marking it as probably having a different moisture signature or perhaps indicating that fish remains were very abundant in this area.

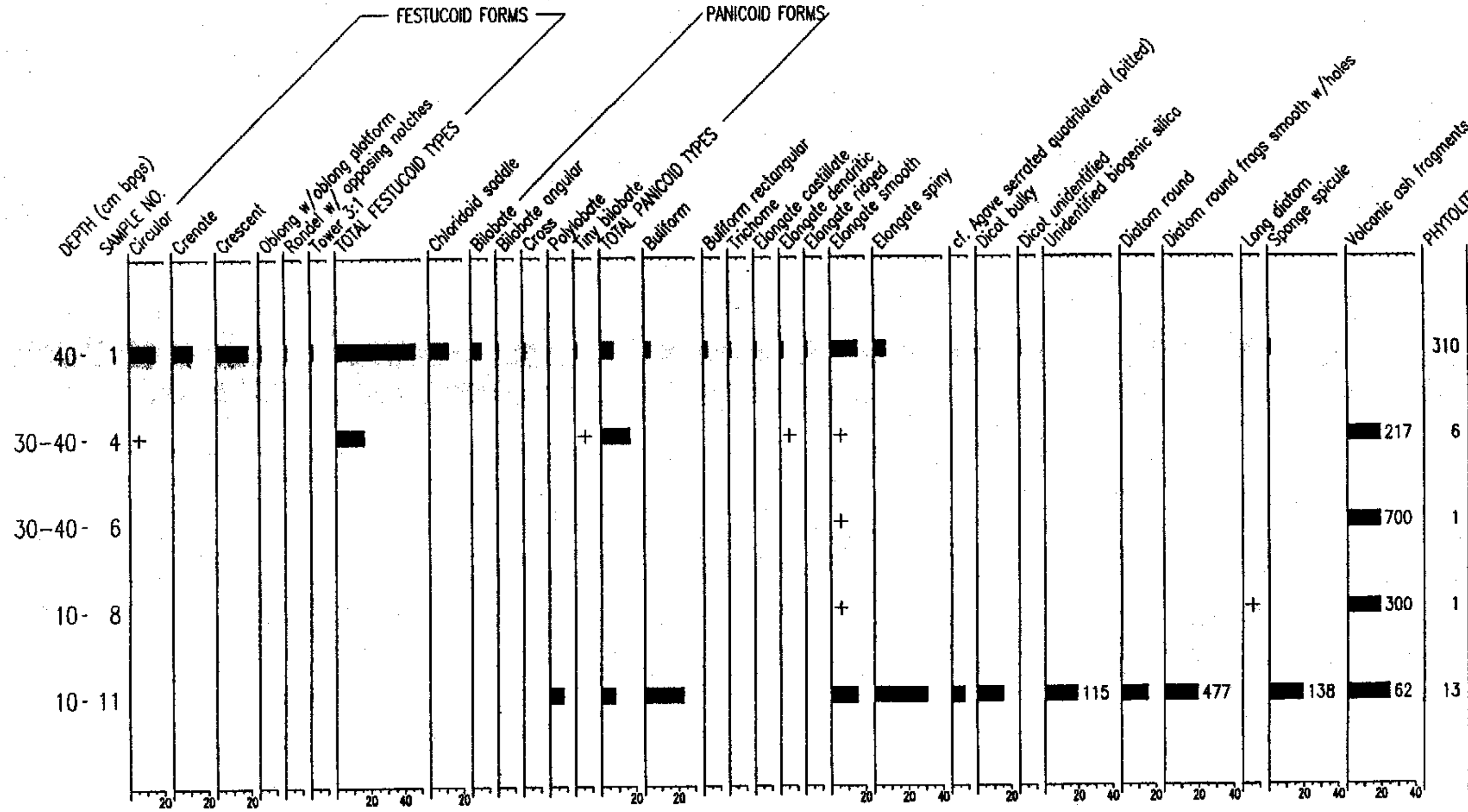


Figure 24. Phytolith diagram for Site IMP-7750.

Summary and Conclusions

Pollen analysis of samples from the structure and midden at Site IMP-7750 point to the probable use of creosote bush as a building material, based on the recovery of an extremely large amount of Larrea pollen in the sample from the entryway floor. This also points to the probable construction of the structure while Larrea was in bloom, providing the only evidence of seasonality in this record. Recovery of increased quantities of Cheno-am pollen from the two midden samples suggests that Chenopodium and/or Suaeda were among the colonizing plants growing on the midden and/or that remains of these plants, including their pollen, were discarded in the midden. A single, probable Agave serrated quadrilateral form was recovered from the entryway floor of the structure, suggesting occupants of this structure transported agave from higher elevations back to this site. The phytolith record suffered extreme dissolution only in samples collected from human habitation locations including the structure floor and floor fill, as well as the midden. Recovery of a good phytolith record from the control sample below the midden reflects generally good preservation conditions for biogenic silica in the acultural sediments. Differences in chemical signature between the acultural control and cultural sediments should be explored to more fully understand phytolith preservation in sites similar to this.

5. OTHER INVESTIGATED SITES

Four other sites underwent testing or data recovery as part of the L-Line research design (Schaefer 1998). Only one of the sites, IMP-7743, proved to be significant in producing a surface scatter of 110 ceramic and lithic artifacts from what appears to be an earlier Lake Cahuilla phase recessional camp. The results of the data analysis from that site is presented below. The remaining sites, IMP-4470, -7547, and -7749, proved negative by producing no archaeological remains or only recent historical materials. Site IMP-4470 contained three sandstone surface clusters, each about 1 m in diameter. Shovel scrapes under the slabs and four shovel test pits were all negative for charcoal, fire-stained soils, or artifacts. It was therefore impossible to determine if they were deflated hearth features or any other cultural feature. Site IMP-7547, had produced a small surface collection from a previous survey. Excavation of 10 shovel test pits through the area all proved negative. Site IMP-7749 appeared to be another rock lined pit just north of IMP-7750. Excavation proved it to be a recent historic feature lined with tar paper and burlap, and containing cigarette paper, nails, and plastic. The one site that produced prehistoric artifacts is discussed below.

IMP-7743: AN EARLY LAKE CAHUILLA RECESSIONAL TEMPORARY CAMP

Site Description and Field Methods

This 25 by 20 m site consists of a ceramic and lithic scatter situated on and around several small low-lying hummocks on lake bed sediments. It is located 7 m below sea level. Some fire affected sandstone is present that may be the remnants of a hearth.

Surface artifact collection and subsurface testing was undertaken with reference to a 5 x 5 m grid that was placed over the site (Figure 25). All surface artifacts (N=97) were collected by grid (A-M) and discriminated by these spatial units during analysis. Most of the artifacts were found within a limited 15 m^2 area of the site. Six shovel test pits were placed at the intersection of grid units and in the area of highest surface artifact density. All were dug to a maximum depth of 40 cm and proved to be negative. Three 1 x 1 m shovel scrapes units (units 1-3) were excavated within unit J to a depth of 5 cm where surface artifact densities were greatest around one of the sandy hummocks. All the scrapes proved to be positive, producing from one to nine artifacts (N=13). The site can therefore be interpreted as a small surface scatter of limited artifact variability, and representing a temporary camp, probably associated with a recessional phase of Lake Cahuilla. Analysis of ceramics, below, indicate a date prior to the final recession, and probably related to one of the maximal stands.

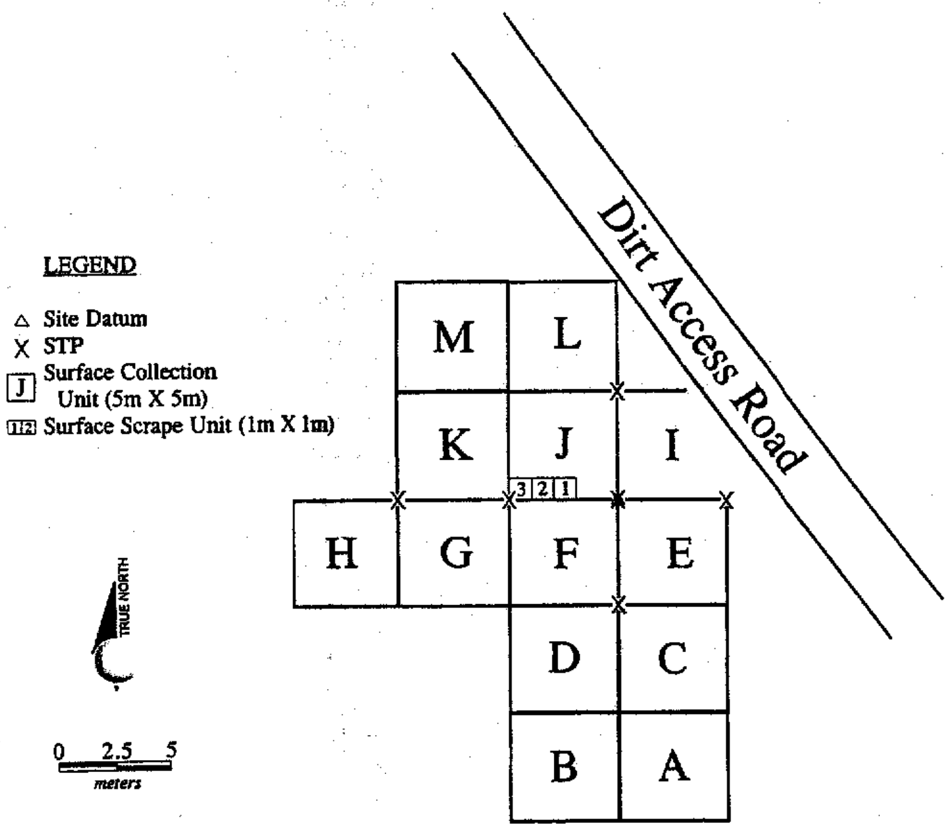


Figure 25. Top plan of IMP-774

Intrasite Spatial Patterning *by Deborah Huntley*

Nine 5 x 5m surface collection units and three 1 x 1m surface scrape units at IMP-7743 produced a total of 110 artifacts (Table 17). While there are no strong intrasite patterns of artifact distribution at IMP-7743, some trends are evident. Three adjacent surface collection units, I, J, and L, contain most of the material recovered from the site (n=76, 69 percent). All three units are located in the northeastern portion of the site near a dirt access road, suggesting that this area comprises the "core" of the site. Unit I contains the highest frequency of both ceramics and flaked stone of any surface collection unit (n=43, 39 percent).

No significant differences in flaked stone versus ceramic distribution could be discerned within the site, although it is clear that ceramics are far more common than debitage in general. In three cases, ceramics were recovered from units that contained no flaked stone artifacts. The converse is true in only one case (unit F), which contained a core and no other artifacts. Unfortunately, the small sample size and relative homogeneity of the assemblage from IMP-7743 precludes any further discussion of intrasite spatial patterning.

Table 17. Artifact Recovery by Provenience at IMP-7743

Provenience	Material Class					
	Flaked Stone		Ceramics		Total Artifacts	
Surface Unit	Ct. (n)	%	Ct. (n)	%	Ct. (n)	%
E (5x5)	3	2.7	4	3.6	7	6.4
F (5x5)	1	0.9	-	-	1	0.9
G (5x5)	-	-	7	6.4	7	6.4
H (5x5)	1	0.9	-	-	1	0.9
I (5x5)	21	19	22	20	43	39
J (5x5)	7	6.4	11	10	18	16.4
K (5x5)	-	-	4	3.6	4	3.6
L (5x5)	5	4.6	10	9.1	15	13.6
M (5x5)	-	-	1	0.9	1	0.9
Total	**38**	**34.5**	**59**	**13.6**	**97**	**88.2**
1 (1x1)	1	0.9	2	1.8	3	2.7
2 (1x1)	1	0.9	8	7.3	9	8.2
3 (1x1)	-	-	1	0.9	1	0.9
Total	**2**	**1.8**	**11**	**10**	**13**	**11.8**
Grand Total	**40**	**36.4**	**70**	**63.6**	**110**	**100.00**

Artifacts *by Deborah Huntley*

A total of 110 artifacts were recovered from nine 5 x 5m surface collections and three 1 x 1m surface scrapes (Table 18, Appendix B). Of the total number of recovered prehistoric artifacts, the majority (n=70, 63.6 percent) are ceramics, 36 (32.7 percent) are flaked stone debitage, two (2.7 percent) are cores, and one (0.9 percent) is a unifacially retouched item. The majority of material (n=97, 88.2 percent) was recovered from the surface collection units. The following two sections discuss in more detail the ceramic and flaked stone assemblages from IMP-7743. A general summary and interpretation of prehistoric activities represented by the IMP-7743 artifact assemblage concludes this section.

Table 18. Artifact and Ecofact Assemblages from IMP-7743

	Surface Unit		Surface Scrape		Total	
Artifact Class	**Ct. (n)**	**%**	**Ct. (n)**	**%**	**Ct. (n)**	**%**
Ceramics	59	53.6	11	10.0	70	63.6
Debitage	35	31.8	1	0.9	36	32.7
Core	3	2.7	-	-	3	2.7
Unifacial Retouch	-	-	1	0.9	1	0.9
Total	**97**	**88.2**	**13**	**11.8**	**110**	**100**

Ceramics

Ceramics are the most common artifact class, comprising nearly 64 percent of the entire artifact assemblage (Table 18). Detailed ware and type descriptions for ceramics as well as analytical methods are provided in Chapter 4 above.

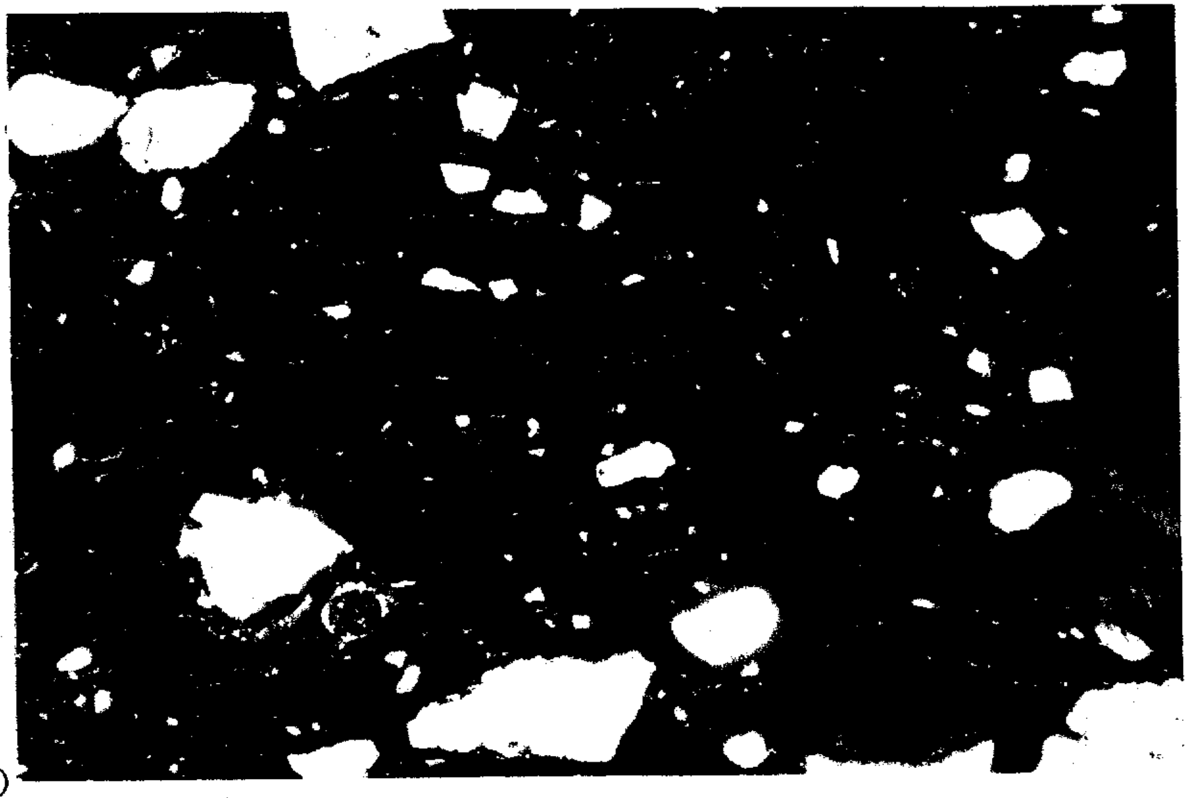
The vast majority of ceramics found at IMP-7743 (n=55; 79 percent) are Salton Buff, while the remainder (n=15) are classified as one of the two indeterminate types (Table 19). Three specimens of the Salton Buff were examined. The first one (SIC-235) has a darker brown paste and poorly sorted large rounded-to-angular- quartz grains. Plagioclase felspar constitutes less than 1 percent of the temper (Figure 26a). The second example (SIC-236) has pieces of paste in another color that may indicate crushed sherd temper or use of more than one clay source. Low amounts of rounded-to-angular quartz grains are present, as are occasional biotite mica flakes (not shown). This Salton Buff sherd thus bears some similarity to Tumco Buff if it were not for the relatively common quartz grains. The third specimen (SIC-237) is a light brown fabric with abundant, moderately well sorted, quartz grains. No mica or other minerals are present (Figure 26b). Only two of the 70 total sherds are rim sherds; both are Salton Buff. One of the rims (from surface collection unit I) is direct with a rounded lip, while the other (from surface collection unit J) is direct with a flattened, overhanging lip. The direct rim form is argued to be characteristic of Patayan I period (A.D. 500-1000) ceramics (Waters 1982a). Both rims are probably jar fragments but are too small to estimate vessel orifice diameter.

A number of sherds could not be definitively classified as one of the above types, resulting in the creation of two categories of "other" ceramics. The first of these, identified as type X1, consists of sherds with dark gray, fine-grained paste with small amounts of well-sorted, rounded sand, smoky quartz, and small amounts of mica. Type X2 is essentially the same as type X1 with the addition of abundant small, black subangular inclusions, possibly igneous rock. These two types may actually represent variants of one or more of the traditionally defined types.

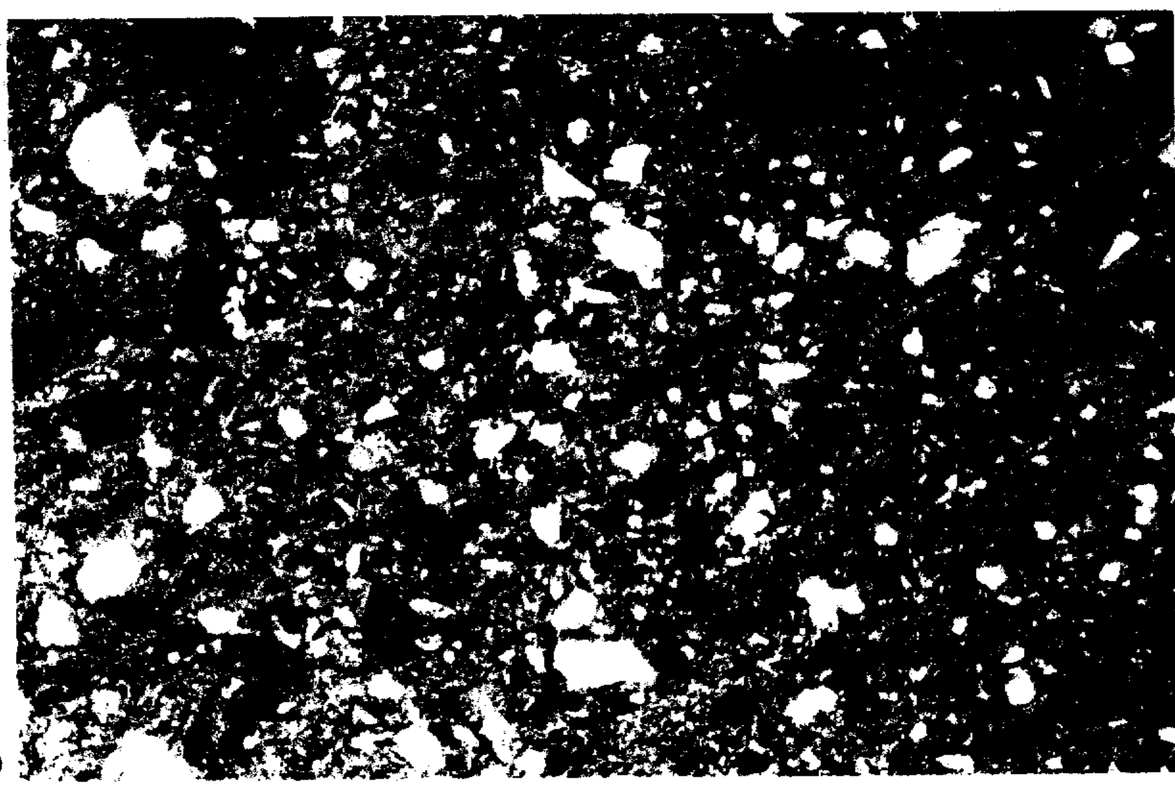
Table 19. Ceramic Type Frequencies

Ceramic Type	Ct. (total n/rim n)	%
Salton Buff	55/2	78.6
Other		
Type X1	6/0	8.6
Type X2	9/0	12.8
Total	70/2	100.0

Ceramics are not strongly patterned across the surface of IMP-7743, and nearly every surface collection unit and all three 1 x 1m surface scrapes contained at least one sherd. Surface collection unit I, located in the eastern portion of the site near a dirt access road, produced nearly one-third of all recovered ceramics. Unit J, located just east of unit I, also contained relatively large amounts of sherds (n=11; 15 percent of total ceramic assemblage).



a)



b)

Figure 26. Salton Buff sherd thin sections from IMP-7743 photographed under a polarizing microscope.

Flaked Stone Assemblage

Surface collections at IMP-7743 produced 40 pieces of flaked stone (36.3 percent of the total artifact assemblage), including 36 flakes and pieces of angular shatter, three cores, and one unifacially retouched item (see Table 18). The majority of these materials (95 percent) are from 5 x 5 m surface collection units. Each flaked stone subclass is discussed in further detail below.

Debitage

A total of 36 pieces of debitage (32.7 percent of the total artifact assemblage) were recovered from surface collection units and surface scrapes at IMP-7743 (Table 20). As discussed above, debitage is not strongly patterned within the site, although surface collection unit I contained over half of all debitage recovered. Four surface collection units (F, G, K, and M) contained no debitage at all, nor did surface scrapes 1 and 2.

Table 20. Debitage Reduction Stage by Material Type

	Primary		Secondary		Interior		Shatter		Total	
Material Type	Ct	%	Ct	%	Ct	%	Ct	%	Ct	%
Metavolcanic	5	13.9	3	8.3	-	-	2	5.6	10	27.8
Quartzite	1	2.8	3	8.3	7	19.4	1	2.8	12	33.3
Basalt	3	8.3	6	16.7	3	8.3	2	5.6	14	38.9
Total	9	25.0	12	33.3	10	27.7	5	14.0	36	100

Three different raw material types are represented in the assemblage from IMP-7743 (Table 20). These include fine and course-grained metavolcanics, basalt, and quartzite. These material types occur in fairly equal numbers within the debitage assemblage. The term metavolcanic is used in this analysis to describe a class of fine-grained, porphyritic material ranging from gray to green in color. Dark purplish-black, course-grained, aphanitic materials, often with small vesicles present on remaining cortical surfaces, were classified as basalt. Quartzite ranges from light gray to gray-brown in color and was distinguished from metavolcanics based on its uniform, granular appearance. All of these materials are associated with Quaternary alluvial terraces located along the base of the Peninsular Range to the west of the Salton Sea. They would have been locally available as cobbles in alluvial fans and major washes extending down into lower elevations.

All stages of debitage reduction, from primary flakes to shatter, are present at IMP-7743 (Table 20). Cortical (primary and secondary) flakes are twice as common than non-cortical (interior) flakes, suggesting that early stage reduction of cobbles or chunks of raw material was the predominant activity at this site. Although the sample size is very small, there are more non-cortical flakes of quartzite than basalt, and no interior metavolcanic flakes were recovered. No obvious pressure flakes or bifacial thinning flakes were observed in the assemblage, and there are no indications of formal tool manufacture at the site.

Cores

A total of 3 cores, (2.7 percent of the total IMP-7743 artifact assemblage) were recovered from the surface of the site (see Table 18). Two of the cores were found in unit I, which also produced the highest frequency of debitage, and one was found in unit F. Both cores from unit I are classified as multidirectional. Flakes have been removed from more than one platform. The first core from unit I is a dark gray, porphyritic metavolcanic with ca. 40 percent remaining cortex. The 75 g core exhibits a slight amount of platform preparation and several step fractures. The second 135 g core from unit I is a fragment of a quartzite cobble. It exhibits more extensive platform preparation than the first core. The third 73 g core from surface collection unit F is a small chuck of black metavolcanic porphyry several flakes removed from two platforms. Roughly 75 percent of the original cortex is present. Of note is the fact that no basalt cores were recovered from the site despite the presence of basalt flakes in the assemblage, possibly suggesting initial reduction of this material type elsewhere, curation of a finished core tool, or complete expenditure of the core. Unfortunately, the small number of cores recovered from IMP-7743 precludes further discussion of intrasite patterning or general flaked stone reduction strategies.

Unifacially Retouched Stone

A single unifacially retouched item was recovered from surface scrape 1 at IMP-7743. This item is a wedge-shaped fragment of a volcanic cobble weighing 55g. Based on pronounced pecking scars on its pointed end, it appears to have been originally used as a hammerstone. Three flakes have been removed from the lateral margin opposite the pecked surface. This item is not a formal tool, and no macroscopic evidence of use-wear was observed.

Summary and Interpretations ***by Jerry Schaefer and Deborah Huntley***

The artifact assemblage recovered from IMP-7743 is fairly small and not very diverse. Only two artifact classes are present: ceramics and debitage. Ceramics are much more common than debitage but the variability of ceramic types is also very low and suggests a very short-term occupation. There are no indications of formal tool manufacture or milling at the site, and no features that would suggest long-term habitation. Lithic debitage and retouched items suggest expedient use of local stone tool sources, including primary cobble reduction.

Although no organic material was recovered for radiocarbon dating, some assessment of the period of occupation can be made from the ceramic assemblage. Almost 79 percent of the ceramics are Salton Buff. This type dates to the Patayan II phase during the major stands of Lake Cahuilla prior to A.D. 1540 (Waters 1982a, Schaefer 1994b). Salton Buff is absent from sites post-dating that period, particularly sites dating to the final recession between A.D. 1600 and 1700. For example, only one sherd from IMP-7750 was Salton Buff, the majority of sherds being Colorado Buff and Topoc Buff. Similarly low frequencies were recorded at the Salton Sea Test Base complex (Apple et al. 1997) and at IMP-5204 (Schaefer 1986) which all date after A.D. 1600.

An early date would suggest the site represents a recessional camp from the last major infilling between A.D. 1450-1520, or possibly even an earlier phase. The site could also date to one of the earlier interlacustral phases. In any case, it must have been inundated during the last short infilling between A.D. 1600-1700. This may explain the lack of organics or charcoal that would have washed away during the innundation. Sediment that may have accumulated over the site, if any, has eroded away to expose the scatter. More likely it never was extensively covered by lake sediments. Although limited in research value, the site does remain from a previous recessional period not often represented by archaeological sites at this low an elevation.

6. *INTERPRETATIONS AND CONCLUSIONS by Jerry Schaefer*

The information derived from IMP-7750 far exceeds what might be expected from such a small, limited activity site. This is in part due to the excellent preservation, surprising wealth of ecofactual data, and clearly interpretable archaeological assemblage from the site. The benefits of a multi-disciplinary approach with problem-based technical studies are readily apparent from the results presented here.

Discrete architectural features are rare enough in the Colorado Desert, but this area west of the Salton Sea is rich in such features as previous research and survey results have shown. Many of these rock features appear to have been used even less intensively than IMP-7750 with little apparent depth and few associated artifacts. Here, though, is one of probably many that can yield sufficient information to reconstruct the economic activities of a discrete domestic household. One can only imagine what could be done with results from a comparative study of several similar sites.

Larger questions of cultural affiliation, seasonality, settlement, and cultural ecology related to the final recession of Lake Cahuilla are addressed below. They bear on even more far reaching questions of the nature of Late Prehistoric adaptations to the Colorado Desert during maximal stands of Lake Cahuilla and in general, to fluctuating environmental conditions.

CULTURAL AFFILIATION

Assigning a tribal identity to a prehistoric site, even one as late as CA-RIV-7750, is a difficult and tenuous prospect. A review of ethno-geography , the location 19 km (12 miles) north of San Felipe Creek, and the established protohistoric date do suggest that it could have been occupied by either the Cahuilla or Kumeyaay. Fray Pedro Font on the 1775-1776 Anza Expedition identified the occupants of San Sebastian, at the confluence of San Felipe and Fish creeks, as *Jecuiches* (Bolton 31:130) while Fr. Francisco Garcés uses the term, *Cajuenches* (Coues 1900:42). The former term is used in clearly Cahuilla territory while the latter is used in reference to Yuman speakers such as the Kumeyaay. There appears to be some confusion on their part, and subsequent interpreters of their writings, as to whether they are describing Cahuilla or Kumeyaay at San Sebastian (Luomala 1976:607). Ethnographic information by Spier (1923:304) indicates that this area was in the territory of the Kumeyaay *litc* clan. According to Shipek (1982) the southern boundaries of the Desert Cahuilla extended to San Felipe Creek, apparently favoring Font. In my opinion, descriptions of the people and their associations with groups to the south in Baja and gathering territories to the west, strongly indicate Kumeyaay occupation at the time of Spanish contact (Schaefer et al 1987).

Strong (1929) indicates the boundary between the Cahuilla and the Kumeyaay as being well north around the present day Riverside/Imperial county lines, 17.7 km (11 miles) north of Salton City.

For the desert Kumeyaay (Kamia), Heintzelman (1857) apparently conducted a census on the New River in 1849 and recorded 118 men, 82 woman, and 54 children (Gifford 1931:16), although the actual household numbers are not available to the author. The 1860 census of San Diego County was available for "New River Indian Village" in which 11 households were counted on August 4 (San Diego Genealogical Society, n.d.:98-100). Household size ranged from 6 to 13 with an average of 9.5 ± 1.9. Children under twelve made up from 0 to 40 percent of each household. There were many individuals over 45 years of age and few men under 45, suggesting many able-bodied men were away working in the cash economy or possibly involved in food gathering activities. Still, most households contained several adult men and women, including the elderly. Thus, the same pattern of larger extended family households seen among the Cahuilla also applied to the late ethnohistoric Kumeyaay.

These numbers have very limited applicability to a temporary camp such as IMP-7750. Perhaps a better analog can be found among the Western Shoshone where the family-based household constituted a stable self-sufficient economic unit. These units were still functioning at the time Julian Steward conducted his research. Steward (1938:240) estimated the average household to contain six people, but with additions that could bring the number to 10. Factors influencing household size included divorce, wife abduction, resident grandparents or other relatives, polygyny, and polyandry. A household of no more than six would seem a more reasonable number given the size and complexity of IMP-7750.

Estimating Household Nutritional Requirements

The minimal nutritional requirements of a family of six hunters and gatherers can be estimated from studies of the !Kung Bushmen (Lee 1979:271-272). Using nutritional data on basal metabolic requirements, measurements of food brought into camps each day, and daily charting of camp member weights, Lee was able to estimate the average !Kung Bushmen caloric requirements at 1975 kcal per day. The !Kung are very small people. the average male is only 157 cm tall and weights 46 kg. Both the Cahuilla and Kumeyaay are much more robust. Caloric requirements were therefore increased by 20 percent to 2370 kcal per day for California. It is estimated that children's caloric requirements would be about half that of an adult.

Minimal protein requirements are more difficult to establish and are dependent on the protein sources, age, sex, reproductive status, and other factors. The Food and Agricultural Organization/World Heath Organization (1973) recommendation is 0.57 gm of protein per kg of body weight. The U.S. National Academy of Sciences/National Research Council raised this by 30 percent to account for the efficiencies of different protein sources, with the FAO/WHO standard being for eggs. An additional 7 percent was also added to all or for variations in efficiency of protein utilization in mixed diets. The adjusted standard is therefore 0.80 gm per kg of body weight. The standard for small growing children is 2.0 gm per kg of body weight. A 70 kg man would therefore require 56 gm of protein per day and a 55 kg woman would require 44 gm (Lieberman 1987:229). A 3-year old of 10 kg would require 20 g per day.

From the above estimates, the daily minimum protein and caloric requirements of a hunter and gatherer household of six can be calculated. For the purposes of this simulation, we hypothesize at the site (Figure 27). Lithic remains indicate at least one adult male. It is very likely that a single domestic group composed of a small nuclear family with possibly a few extended kin and children are present; no more than that. Secondly, almost all of the artifacts and ecofacts deposited during the occupation were recovered; we estimate at least 80 percent. Taking into account that some foods leave no preserved remains, we will attempt to estimate how long a single domestic group could be supported by food remains recovered at IMP-7750.

Figure 27. Milling tool kit from IMP-7750: metate, mano, and ceramic parching tray fragments.

Estimating Household Size

The actual size and composition of the household can only be speculated. Very little is known of the basic domestic or food-gathering unit in southern California logistical foraging camps. This type of activity largely ceased by the time of ethnographic studies or were not directly observed during the short stays of most early ethnographers. There was no doubt considerable variability in domestic unit composition, as well as possible changes in camp population from day to day. Bean (1972, 1978) and Strong (1929) do admirable jobs reconstructing larger Cahuilla corporate groups but have little to say of the basic family unit. Strong (1929) does provide some censuses of Cahuilla households although it is difficult to apply these to prehistoric contexts before the demographic upheavals of historic times. In village localities that were the subject of Strong's censuses, the entire lineage might be living in one communal structure. In-laws and cousins were frequently members of extended family households, often representing surviving members of groups that had lost their land base or been decimated by decease.

Cahuilla between July and September, but *Atriplex* spp. is known to set seed in late Fall-Winter (Zabriskie 1979:16). This would also apply to other *Chenopodium* sp. and *Suaeda* sp. This is a pattern seen elsewhere in the Great Basin where marsh and lacustrine habitats occur in relatively resource-rich alkali sink habitats, such as Carson Sink. The abundance of fall-ripening halophyte seeds tended to extend the period of seed gathering and higher population density into the winter months (Fowler 1990:18).

A winter occupation is also probable if, and I must emphasize *if,* fish trap usage involved exploitation of natural spawning behavior. Razorback sucker (*Xyrachen texanus*), the most abundant species in the IMP-7750 faunal assemblage, is known to spawn from early Winter to early Spring in Lake Mohave (Bozek et al. 1990). Created behind Davis Dam on the Lower Colorado River, Lake Mohave provides about the closest parallel to Lake Cahuilla that can be found where this species is still relatively abundant, although threatened. The start of the spawning season coincides with decreases in water temperature to 13^{0}C in November and continue until water temperatures rise to 20^{0}C in May. Modern era Salton Sea temperatures tend to be in this range at the same time of year (Walker 1961:22). The peak spawning period on Lake Mohave is between January and March. During this time, adult razorbacks enter shallow waters and spawn over lap-zone gravel substrates where the eggs are more likely to fall into crevasses out of the reach of predators (Gobalet and Wake, in press; Loudermilk 19**). During this time small numbers of bonytail (*Gila elegans*) were also observed among the spawning fish, although they are so rare in Lake Mohave that no inferences can be drawn about their co-occurrence in the same spawning areas in Lake Cahuilla. For both species, gravel-based fish traps may have been attractive spawning environments. If Lake Mohave analogs can be applied to Lake Cahuilla, then fish traps might be most effective in late Fall and Winter months.

High pollen counts from creosote bush (*Larrea tridentata*) from within the structure have been interpreted as evidence of building material and possibly fuel brought to the site. Counts were so much higher than natural control samples that a cultural use is well indicated. Creosote pollen suggests an occupation somewhat later than other evidence. It blooms in April and May according to Jaeger (1940:136), although it may bloom slightly earlier at very low elevations.

BIO-ENERGETICS AND NUTRITION AT IMP-7750

A synthesis of the floral and faunal data, combined with some reasonable calculations of the dietary contribution they represent, provides some valuable insights about intensity of subsistence pursuits and potential occupation span of IMP-7750. These inferences have a direct bearing on models of adaptation to the dynamic environmental conditions of Lake Cahuilla, both during it maximal stands and major recessions. Calculations of protein and caloric input from subsistence activities and caloric output of hunter-gatherer activities is always a "numbers game" with many assumptions. Even with these uncertainties, some general trends are readily apparent. The following nutrient and energy input-output simulation may have more validity at IMP-7750 than might be expected elsewhere for several reasons. One reason is the high likelihood that the activities of only one domestic unit or household are represented. The seed gathering complex that includes carbonized remains, single milling tool kit, and parching tray suggest one adult female total of 22 fish traps were recorded within five sites. Whenever found, they occur in clusters of from three to eight traps and usually occur near habitation remains.

Among all of these sites, a total of 198 rock enclosures were recorded, ranging in interior dimensions from 0.3 m^2 to 10 m^2. They vary from superficial constructions interpreted as windbreaks to more substantial constructions that are probably pit houses like IMP-7750. Many of the smallest are likely hearths and container supports. Most of the larger residential constructions open to the east (75 percent), as prevailing winds come from the west, and only 11 percent open to the south like IMP-7750. Ninety shovel test pits and 20 excavation units within or adjacent to the rock structures indicated only shallow deposits with fish bone being the most commonly recovered item. Artifacts were sparse or absent. While a few radiocarbon dates (N=4) appear to be in the A.D. 1400-1500 range during the previous Lake Cahuilla recessional phase, the majority (N=9) were in the A.D. 1650-1700 range, contemporary with IMP-7750 and representing the last recessional phase.

Many of the Salton Sea Base sites are located quite close to each other, often less than 300 m apart. As a group, they indicate larger task groups involved in fishing than that represented at IMP-7750. Some discrete households may also be represented. Multiple rock enclosures, associated features, and fish trap clusters suggest cooperating domestic units, some probably related by kinship. Testing still suggested short-term occupations specialized toward fish procurement and processing (Apple et al 1997:5.22). There thus appears to be some variability in the size and internal settlement structure of individual camps.

SEASONALITY

Determinations of seasonality are important for understanding settlement and subsistence schedules and in the overall interpretation of Lake Cahuilla adaptations. Did recessional shoreline environmental dynamics offer opportunities or impose constraints on settlement during different seasons? Where fish camps established as part of seasonal scheduling of subsistence activities. If so, a determination has ramifications for understanding the nature of settlement during high stands of Lake Cahuilla and if the maximal shoreline was stable enough to support year-round residential bases. Even the methods for using fish traps may be better understood if seasons of occupation are known that might coincide with spawning cycles.

In terms of environmental opportunities, the Carnegie Institution studies showed that Salton Sea recessions slowed considerably in the winter months of reduced evaporation rates (MacDougal 1914a). The recession proceeded so rapidly in summer months that it would have been only days before they would be above water. The temporary strands also provided opportunities for lacustrine plants to establish themselves and be exploited.

Evidence from IMP-7750 suggests a late Winter-late Spring occupation, although there are conflicting lines of evidence. The remains from two Coots (*Fulica americana*) were recovered. Coots are winter migrants to the desert, occupying the Salton Sea area between October and March (Unitt 1984:69). Bean and Saubel (1972:45) report that *Atriplex lentiformis* was harvested by the mortuary feature from the same site also produce hundreds of the same type (Schaefer 1999:37-40). With only five *Olivella* spp. beads from IMP-7750, it would be premature to make any conclusions as to cultural affiliation. No beads derive from the Salton Sea Test Base. Absence of side wall beads from a larger regional sample would strengthen any arguments, however.

On face value alone, the disparity between Wonderstone frequencies at IMP-7750 and the Salton Sea Test Base would suggest a Cahuilla affinity for IMP-7750 and potentially a border between Salton City and the Salton Sea Test Base. Too small a number of sites are also reviewed here to make definitive assessments. On a larger regional scale, the fact that most of the Wonderstone from sites south of San Felipe Creek comes from the Cerro Colorado source does support some territorial boundary or regional trade and transport patterns that are effecting lithic distributions (Pigñiolo 1995). It would appear that area between San Felipe Creek and the Salton City area lies in an area of that tribal boundary. Ceramics and beads provide no real help at this time. Who occupied these sites must therefore remain an open question. However, the location of IMP-7750 well north of San Felipe Creek and associations with fish traps that more commonly occur in Cahuilla territory, leave the clear possibility that the site is Cahuilla.

REGIONAL SETTLEMENT PATTERNS

It appears that IMP-7750 represents a spatially discrete fishing camp occupied by a single domestic household. No other pit house structures were observed within 100 m of the site and there are no broad artifact scatters connecting it to a larger occupation. Other habitation sites, however, may be located in the general vicinity. IMP-7750 is located in the partially developed area of Salton City where there has been significant grading of house plots. In addition, no systematic survey been undertaken in Salton City outside the L-line right-of-way. The closest site of any substance is a large ceramic, lithic, and milling tool scatter located 3.2 km to the south along State Route 86 (IMP-3178) (Rosen 1984a, b). The closest recorded rock enclosure that resembles IMP-7750, this one in proximity to a fish trap, is located 7 km to the north between Coral Wash and Grave Wash near the L-Line right-of-way (IMP-7751 & 7752) (Schaefer et al. 1998). The next closest rock enclosure is located 7.5 km to the southeast on the Salton Sea Test Base (IMP-7500).

The survey of the 10 square mile Salton Sea Test Base is one of the only studies of a large contiguous area where some measure of the variability of site morphology and spatial distributions can be assessed (Apple et al 1997). Their survey indicate that some fish camps were composed of multiple households and are considerably more complex than IMP-7750. Of 166 recorded prehistoric sites, 81 were classified as habitation sites, and 73 percent of these contained at least one rock enclosure. Habitation sites ranged in size from $6m^2$ to 205, $932m^2$. The largest of these (IMP-7631) contains six large loci that appear to each represent a short-term temporary camp. Five of the loci contain multiple rock enclosures and one locus contains a rock enclosure with six fish traps. Hearths and artifact scatters make up most of the other associated features. Two sites contained twelve rock enclosures, the most recorded at any locality. At sites with multiple enclosures, they tend to cluster in groups, and in some cases abut each other. The majority of habitation sites are much smaller and consist of a single rock enclosures, sometimes quite ephemeral and in association with artifact scatters. Some habitation sites have no enclosures. A

With regard to ceramics, the arguments given by Apple et al. (1997:7.20-21) also fail to support their conclusions. The most diagnostic artifact was a straight ceramic pipe. This style is supposed to be associated with the Cahuilla and other Takic speakers while the curved bow pipe is more frequently found at sites in Yuman territory (Rogers 1936). They recognize the apparent contradiction with their other results and leave it at that. In fact, this may be a reasonable approach as both pipe styles actually occur at Cahuilla sites. Of the more than 76 pipe fragments from RIV-45 in Tahquitz Canyon, 24 could be identified as to shape. Among these, straight and bow shaped pipes occur in roughly equal proportions. In addition, both shapes were found to be made from the same clay source (Schaefer 1995:IX.49). True (1966) also found no correlation between pipe shape and tribal territory in his attempts to distinguish Takic and Yuman diagnostics.

Apple et al. also attribute the high proportion of brown ware at the Salton Sea Test Base to east-west movements and an origin in the Peninsular Range for the people occupying the fish camps. Almost 44 percent of the assemblage was brown ware, of which 28 percent was classified as Salton Brown and 15 percent as Tizon Brown. Unfortunately Apple et al. do not provide explicit type descriptions so the attributes for discriminating between Salton Brown and Tizon Brown are not given. Recent petrographic and Neutron Activation Analysis (NAA) by Hildebrand et al. (in press) demonstrate that Salton Brown can be classified as a distinct desert ware made from Brawley formation clays. Furthermore, it was found that discrimination of the two brown ware types on the hand specimen level was found to be difficult if only a 10x hand lens is used but that they could be more confidently distinguished with at least a 20x microscope setting. Salton Brown contains mainly quartz and mica while Tizon Brown contain quantities of other minerals including amphibole (hornblend). It is the hornblend that is often overlooked. While more Tizon is likely to be mistaken for Salton on the hand specimen level, chemical analyses of sherds previously classified as Tizon from desert sites were often found to be desert-derived Salton Brown (Hildebrand et al. in press). I suspect that might be the case at the Salton Sea Test Base. At IMP-7750, 36 percent (N=110) of the ceramics were Salton Brown while only 1 sherd was classified as Tizon. Petrographic analysis confirmed the classification although and NAA results are pending. An interpretation of substantial mountain-derived ceramics at the Salton Sea Test Base therefore appears to be unsupported. Furthermore, sites further to the north along the Lake Cahuilla shoreline in what is definitely Cahuilla territory also contain large amounts of brown wares (Schaefer 1994b). Unfortunately most of the ceramic studied used by Schaefer were undertaken before more reliable methods were understood for discriminating different brown wares. Even if more Tizon Brown Ware is demonstrated for the Salton Sea Test Base, it might just as well be derived from Cahuilla clays in the Santa Rosa Mountains than Kumeyaay clays in the Laguna Mountains.

The only artifact type in support of a Kumeyaay occupation are shell beads. Cahuilla sites further to the north consistently contain quantities of *Olivella biplicata* spp. cupped and wall disk beads, acquired from the Chumash and Gabrielino (King 1988, 1995). This type is virtually absent from desert sites in Kumeyaay territory. *O. biplicata* and *dama* spire lopped beads also occur in Cahuilla sites, however, although they are virtually the exclusive bead type on Kumeyaay sites. The only shell bead workshop in the Colorado Desert is from the Elmore Site (IMP-6427), a contemporary recessional shoreline site located several km south of San Felipe Creek. All the beads are the *O. biplicata* and *dama* spired lopped variety (Rosen 1994, 1995). A clothes-burning

Bean (1976:576) tentatively places the southern boundary of Cahuilla territory in the vicinity south of Borrego Springs, leaving RIV-7750 quite close to this border. As we well know, tribal boundaries are frequently indistinct and shift over time, especially where they meet in marginal environmental zones. Either group could therefore be represented at a site dated to A.D. 1700. No artifacts were found that could be decidedly identified with either group.

Apple et al. (1997:7.18-21) address the issue of cultural affiliation for the many house features and fish traps they recorded at the Salton Sea Test Base, located midway between IMP-7750 and San Felipe Creek. Without doubt IMP-7750 conforms in every way to the archaeological patterns at the Salton Sea Test Base and was likely occupied by people of the same cultural affiliation. Apple et al. provide a thoughtful discussion based on lithic and ceramic distributions, concluding that Kumeyaay affiliation is more likely than a Cahuilla one. Lithic data from IMP-7750 refutes that interpretation and several potential fallacies in interpretation of the ceramics also weaken their conclusions.

Their best argument for an archaeological indicator of ethnicity comes from the distribution of Wonderstone from the Rainbow Rock Source, located at the southeastern end of the Santa Rosa Mountains, 17 km northwest of IMP-7750, and only an additional 9 km further south to the Salton Sea Test Base (Apple et al. 1997:7.20). The Rainbow Rock quarry site (IMP-6300) is located well within Cahuilla territory and Wonderstone from the source is expected to be well represented at sites with probable Cahuilla affiliation to the north. Wonderstone found at sites further south in Kumeyaay territory can be attributable to the Cerro Colorado source south of the Mexican Border and near Pilot Knob (Pigñiolo 1994). Apple et al. attribute the small percentage of Rainbow Rock Wonderstone, 0.3 percent (N=308) from limited testing of numerous sites in the Salton Sea Test Base, to a lack of direct access to the source. They interpret this low count as suggesting Kumeyaay cultural affiliation for the area assuming the prehistoric Cahuilla restricted access.

In contradiction, however, are the Wonderstone debitage counts from IMP-7750. Here 12 percent of the assemblage (N=86) is Wonderstone with morphological affinities to the Rainbow Rock Quarry. When looking at other Cahuilla sites further north, it would seem that proximity to the source has more to do with its distribution than cultural affiliation. IMP-7750 in this regard resembles sites near Toro Canyon, 27 km north of the Rainbow Rock , where extensive testing and data recovery was undertaken at two Lake Cahuilla sites (Schaefer et al. 1993:75). At CA-RIV-1331, 95 percent of the debitage (N=84) was made of chaledonies and silicified tuffs attributable to the Wonderstone source, according to Pigñiolo. Schaefer et al. 1993) specifically identified 25 percent as silicified tuff. At CA-RIV-1349, 11 percent of the debitage (N=172) was Wonderstone (Pigñiolo 1995:128). It becomes increasingly rare, however, as one proceeds further north to other Cahuilla sites. Only 0.2 percent of the debitage (N=551) at CA-RIV-1179 in La Quinta was Wonderstone (Sutton and Wilke 1988:60). At the major village complex in Tahquitz Canyon, CA-RIV-45, it accounts for only 0.3 of the sizable debitage assemblage (N=16,885) (Schaefer 1994). These latter Cahuilla sites thus more closely resemble the Salton Sea Test Base with regard to Wonderstone frequency. Clearly effecting the lithic source frequencies are sample size and for both the Salton Sea Test Base complex and IMP-7750, total lithic counts are relatively small.

6. *INTERPRETATIONS AND CONCLUSIONS by Jerry Schaefer*

The information derived from IMP-7750 far exceeds what might be expected from such a small, limited activity site. This is in part due to the excellent preservation, surprising wealth of ecofactual data, and clearly interpretable archaeological assemblage from the site. The benefits of a multi-disciplinary approach with problem-based technical studies are readily apparent from the results presented here.

Discrete architectural features are rare enough in the Colorado Desert, but this area west of the Salton Sea is rich in such features as previous research and survey results have shown. Many of these rock features appear to have been used even less intensively than IMP-7750 with little apparent depth and few associated artifacts. Here, though, is one of probably many that can yield sufficient information to reconstruct the economic activities of a discrete domestic household. One can only imagine what could be done with results from a comparative study of several similar sites.

Larger questions of cultural affiliation, seasonality, settlement, and cultural ecology related to the final recession of Lake Cahuilla are addressed below. They bear on even more far reaching questions of the nature of Late Prehistoric adaptations to the Colorado Desert during maximal stands of Lake Cahuilla and in general, to fluctuating environmental conditions.

CULTURAL AFFILIATION

Assigning a tribal identity to a prehistoric site, even one as late as CA-RIV-7750, is a difficult and tenuous prospect. A review of ethno-geography , the location 19 km (12 miles) north of San Felipe Creek, and the established protohistoric date do suggest that it could have been occupied by either the Cahuilla or Kumeyaay. Fray Pedro Font on the 1775-1776 Anza Expedition identified the occupants of San Sebastian, at the confluence of San Felipe and Fish creeks, as *Jecuiches* (Bolton 31:130) while Fr. Francisco Garcés uses the term, *Cajuenches* (Coues 1900:42). The former term is used in clearly Cahuilla territory while the latter is used in reference to Yuman speakers such as the Kumeyaay. There appears to be some confusion on their part, and subsequent interpreters of their writings, as to whether they are describing Cahuilla or Kumeyaay at San Sebastian (Luomala 1976:607). Ethnographic information by Spier (1923:304) indicates that this area was in the territory of the Kumeyaay *litc* clan. According to Shipek (1982) the southern boundaries of the Desert Cahuilla extended to San Felipe Creek, apparently favoring Font. In my opinion, descriptions of the people and their associations with groups to the south in Baja and gathering territories to the west, strongly indicate Kumeyaay occupation at the time of Spanish contact (Schaefer et al 1987).

Strong (1929) indicates the boundary between the Cahuilla and the Kumeyaay as being well north around the present day Riverside/Imperial county lines, 17.7 km (11 miles) north of Salton City.

a household of two adult men, two adult women, and two children. Daily caloric requirements for this household are estimated to be 11,850 kcal and protein requirements would be 240 g.

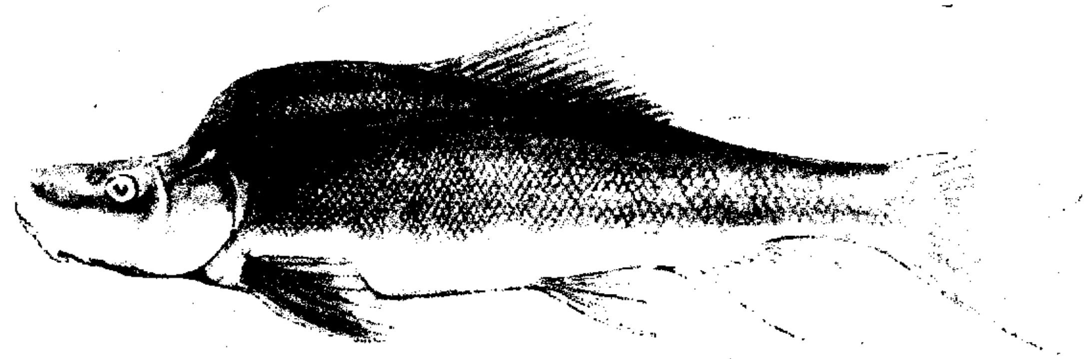
Estimating Fish Nutritional and Caloric Content

It is clear that fishing was the principal subsistence activity at IMP-7750, reflected by the more than 2,593 elements. Bonytail and razorback sucker account for over 98 percent of the total fish remains, with small numbers of Colorado pike minnow, machete, and striped mullet (see Table 10). Only three percent of the faunal assemblage was not fish. Estimated minimum number of individuals include two coots, one rabbit, and one kit fox that is probably intrusive. In comparison 267 minimum number of fish are represented. With regards to animal protein it is clear that diet breath was minimal. When conditions were right, huge catches could be acquired with apparently little effort, reducing the priority of other hunting activities.

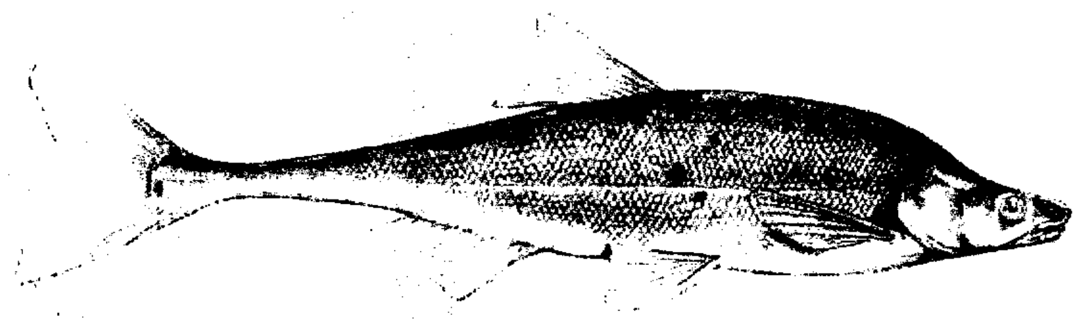
Combining MNI counts with size estimates, we can determine the approximate dietary contribution of fish at the site. Precaudal vertebra centra lengths were used to calculate average fish lengths for each species. Data from living specimens were then used to calculate weights (see Table 11). The two most abundant fish species are sizable (Figure 28). Razorback sucker grow to lengths of more than 75cm and attain weights of up to 5 kg. The bonytail chub reaches 50 cm in length and weighs more than 0.5 kg each (Mueller and Marsh 1995). Few small fish were present in the faunal assemblage, suggesting that the fish trap and weir system selected against their capture. High quantities of adult fish may also indicate capture during spawning as discussed above. Only adults were caught in Lake Mojave when netting occurred in optimal spawning habitats during the winter spawning season (Bozek et al. 1991: 65). Finally , lack of subadults may also suggest that breeding was unsuccessful in recessional Lake Cahuilla and only older fish were present. Both species can live up to 50 years.

Applying even the lowest range estimates provided by Gobalet and Hardin in Table 11, at the very least, 104 kilograms of fish are represented by the fish bone. If 75 percent of each fish was edible, then approximately 78 kilos of fish flesh was available for consumption. This does not include the much larger machete fish which is represented by only a few elements in the assemblage. It should also be noted that many Colorado River Yumans cooked the entirety of the fish, including entrails, head, and tail, so the protein yield may have been even higher than estimated here (Castetter and Bell 1951:222-223).

The nutritional content of this amount of fish can be easily assessed. In general , fish flesh contains so little carbohydrates as to be negligible (Exler 1987). Most of its nutritional value is protein, from 17-20 gm in each 100 gm portion. No nutritional studies have been conducted on Lake Cahuilla fish species, so that channel catfish (*Ictalurus punctatus*) has been used as a representative model (Exler 1987:28). A raw 100 gm portion contains 18.2 ± 0.4 gm of protein ($N=36$). The energy value, however, is only 116 kcal. Total lipid fat content is 4.26 g and major mineral contributions are calcium (40mg), magnesium (25 mg), phosphoreus (21.3 mg), potassium (349 mg), and sodium (63 mg). The only major vitamin in fish is niacin (2.14 mg).



Razorback Sucker (*Xyrauchen texanus*)



Bonytail Chub (*Gila Elegans*)

Figure 28. The two most common fish at RIV-7750: razorback sucker (*Xyrauchen texanus*) and bonytail chub (*Gila elegans*) (Illustrator: Mary Hirsch, Lower Colorado River Multiple Species Conservation Project).

Applying the above figures, the fish remains at IMP-7750 represent at least 14,196 gm of available protein (78 kg edible fish x 18.2 gm protein per 0.1 kg). The energy value of the fish catch is expectantly low, only 90,480 kcal (78 kg x 116 per 0.1 kg). Now applying the protein and caloric requirements of a hypothetical family of six, as calculated above, we estimate that protein need could be met for a period of at least 59 days (14, 196 gm ÷ 240 gm = 59) while the caloric needs could only be met for 7.6 days (90, 480 cal ÷ 11,850 kcal = 7.6). Even with the fat contribution from the two coots and one rabbit, there would be an obvious need to provide carbohydrates from other sources if the camp were to be used as a temporary residence as opposed to a specialized extractive locality.

In a high protein diet, some can be converted into carbohydrates and stored as glycogen but much of the excess protein would be expelled through the kidneys. A diet high in lean fish meat also requires additional metabolic energy. Nearly one-third of all ingested protein calories go towards metabolizing the protein (Lieberman 1987:234). If caloric needs are not met from other sources, the body uses available stored fat and then skeletal muscle protein for energy. Consumption of fats and carbohydrates therefore not only provides energy, but protects muscle from being metabolized. Lean meat diets without other carbohydrate or fat sources also result in deviancies of linoleic acid, lipoprotein, fat-soluble vitamins, and calcium (Liberman 1987:235). Hunters and gatherers can do several things to offset the dietary deficiencies of a high-protein, low- fat, low-carbohydrate diet (Speth and Spielman 1983). They can supplement with animals fats from other sources, boil animal bones to extract additional fat, selectively gather oil-rich and carbohydrate-rich plants, or selectively gorge on fatty foods so they have fat stores to metabolize protein. The consequences of high-protein, low carbohydrate resources has been well appreciated for coastal populations with intensive shellfish and fish exploitive patterns. Population mobility, density, health, and socio-political organization are likely to be influenced (Yesner 1987; Byrd 1996).

Plant Nutrition

Clearly much of the carbohydrate requirements at IMP-7750 would be provided by processed plants for which there is clear evidence in the archaeological record. But were sufficient carbohydrates being obtained to sustain an economic group for as long as the fish-derived protein yields would allow? This is more difficult to assess since most plant food remains do not preserve in the archaeological record.

The nutritional contribution of one of the plants best represented from flotation analysis can be assessed. Unfortunately no data was found on the most common species, *Suaeda* sp., or on *Chenopodium* sp. but it is assumed here that they have similar nutritional qualities as the second most abundant species, *Atriplex* sp. for which nutritional information was available. All three could be easily harvested with seed beaters, parched, ground, and consumed as mush or cakes (Barrows 1900: 57, 65,66; Bean and Saubel 1972: 45, 52, 141). *Suaeda* and *Chenopodium* greens were also eaten. The ground seed and fish may have been cooked together, much like Colorado River tribes cooked fish and ground corn in the same pot (Gifford 1933:269; Spier 1933:77). The abundance of carbonized seeds associated with a ceramic parching tray, and milling tool kit attest to their consumption at IMP-7750. Simms (1985:121) ranks two Great Basin *Atriplex* species 7th and 8th among 21 different plants with regards to caloric return rates. The ranking was based on the caloric yield per kg divided by estimated hours for collection and processing. As for other Chenopodiaceae, Barrows (1900:57) reported seeing Cahuilla granaries full of *Chenopodium* seed on the edge of Coyote Canyon.

There are numerous *Atriplex* spp. nutritional studies because of its importance as wildlife and domestic livestock browse and its use in habitat revegetation (see www.fs.fed.us/database/feis/plants/shrub). Nutritional content varies with species and growing conditions, but in general, *Atriplex* is rated fair in protein content (4-10 percent) and high in carbohydrates (68-69 percent) (Simms 1985; Tiedemann, Arthur R. et al. 1984). One kilogram of *Atriplex* produces from 2,790-3,000 cal of energy, more than enough to sustain an individual for one day. That amount could be collected in less than an hour when available in later winter-early spring (Simms 1985:120-121). However to supplement the caloric deficit of the fish catch in supporting a family of six for the maximum time that the protein yield would allow, at least 203 kg (609,090 cal) of seed would need to be collected and processed. Other carbohydrate sources possibly available at the fish camps and suggested by the Carnegie Institute botanical studies (MacDougal 1914) include arrowweed, cattail, and bulrush root that emerge from recessional strands but do not mature. There is no direct evidence of their use at IMP-7750, however. Cattail and bulrush root are ranked low with regard to return rate (Simms 1985:121) due to relatively low carbohydrate content but could be gathered in quantity. Other carbohydrate sources, of course, could be imported to the camp. Trace acorn pollen within the structure may be indicative of importing this staple, although this seems unlikely. If other carbohydrate sources were not imported, then the evidence does suggest that these recessional shoreline fish camps were scheduled to coincide with the fortuitous co-occurrence of Fall-winter slowing of the recession and Chenopodaceae seed production.

Various permutations could be made for all of the above calculations which would account for variability in household size, nutritional contribution of different food sources, sampling error due to differential preservation, and other aspects of Lake Cahuilla bio-energetics. No matter how the numbers are adjusted, however, there still appears to be more fish present than is necessary to sustain a household for the limited period of occupation indicated by the low artifact density and diversity, and the small, shallow midden at IMP-7750. The is ample evidence to indicate that Chenopodiaceae seeds were among the most important exploited plants that would provide the carbohydrates during the period the fish were caught and processed. Although no data are available, it would not appear likely that sufficient seed was present within a daily foraging radius to support a household for the maximum potential that the fish catch would allow with regards to protein. It may also be assumed that other camps were in the area at the same time. If sufficient carbohydrates were obtained from other sources, an occupation of more than 50 days could be sustained. If no, then it is unlikely the camp was occupied for more than 7-10 days.

What would they have done with all that extra fish? Possible alternatives include 1. Drying and storage of the catch, 2. sharing of surplus with neighboring households, or 3.wasting the surplus. Allowing the excess fish to rot would seem unlikely given what we know of the importance of storage in Kumeyaay and Cahuilla collector-based economies. Although some ethnocentricity may be involved, the image of heaps of dead fish outside the pit house is difficult to envision. Even processed fish waste outside the pit house may or may not have been an issue for the occupants, but certainly suggests a temporary camp situation rather than one of prolonged residence. Food sharing with other households in the general area is a likely possibility, although it is impossible to assess inequalities in food procurement outcomes between households. Most likely, a portion of the catch was processed and dried on site and transported elsewhere. Among the Colorado River Yumans, fish were prepared in a number of methods and also dried for storage (Castetter and Bell 1951:222-223). Spier (1933:77) mentions that among the Maricopa, the surplus of a days catch might be half-broiled and hung to dry from the house beams, but the fish was not kept for more than a week in this fashion. The best documented analogy comes from the Northern Paiute of Pyramid Lake. They fileted the cui-ui (*Chasmistes cujus*), discarding the boniest portions by burying them in pits, and preserving the remainder on drying racks. The flesh kept well through the winter, stored in pits or sacks (Fowler 1986:88; Wheat 1967: 62-64).

The bone counts at IMP-7750 provide no indication of how fish may have been prepared for drying. The ratio of vertebra to cranial parts in the bone assemblage does not indicate that fish were beheaded and the remainder was dried and transported. Fish bone elements occur in expected frequencies for the entire fish remains to be present (Gobalet, personal communication 2000). If fish were prepared for transport, then they were probably filleted. This may explain why only minimal Lake Cahuilla fish bone are found at inland sites (Apple et al. 1997:7.16).

The apparent intensive exploitation of a few resources, especially focusing on select animal protein sources at IMP-7750 appears to be is a characteristic aspect of recessional Lake Cahuilla shoreline sites. This was most often done in the context of logistically organized foraging camps tied to residential bases in more optimal habitats along the Peninsular Range (Apple et al 1997:7.16). Very similar high fish bone frequencies are found at comparable sites of the Salton Sea Test Base (SSTB) and at IMP-5204, the Dunaway Road site (Schaefer 1986), which is located at sea level south of Interstate-8 (Figure 29). And not only fish were the subject of intensified exploitation. At the Elmore site, located at roughly the same elevation as IMP-7750, 99 percent of the 16,000 recovered bone elements were waterfowl, with only a few fish and mammal elements. This level of specialization is not entirely due to the limited resources afforded by the rapidly receding lake, although it may certainly have been an issue on the newly exposed lake bed. A substantial number of sites on the maximal shoreline from Toro Canyon, La Quinta, and Indio display a similar pattern with terrestrial mammals the focus at some sites and fish at others, although the pattern is not quite as extreme as recessional sites (Table 21; Figure 30). Of the reviewed faunal assemblages, roughly half show high degrees of specialization. In each of the sites examined for this comparison, bone counts well exceeded 100 to limit the effects of sampling error. Those with greater equity between fish, mammal, and bird remains may reflect proximity of Lake Cahuilla to a greater number of productive terrestrial habitats that characterizes the northwestern shoreline. The data indeed suggest that the maximial stand of Lake Cahuilla provided greater opportunity to increase diet breath, but not always. The high opportunistic focus on specific resources thus characterizes prehistoric adaptations to the final recession. This pattern appears to actually be a continuation of adaptive strategies of some camps when Lake Cahuilla was full and provides additional support to the model of seasonal occupations of the shoreline for many of its prehistoric visitors, even during high stands.

The recessional Lake Cahuilla environment was one in which resource diversity was very low. There were few species to exploit and only a few were found in abundance. Alkali sink plant species provided some balance to the most abundant protein-rich resources, but probably not in sufficient quantity to sustain a family for more than a few weeks. This is the type of situation where flexibility in spatial organization, mobility, food preservation and storage, and opportunism to exploit transitory conditions were essential aspects of hunter-gatherer logistical strategies (Lee 1979:350-351).

Table 21. Faunal Remains from Lake Cahuilla Sites

Site No.	% Bird	Mammal	Fish	Data	Reference	Location
Recessional Shoreline Sites						
IMP-5204	0	0.1	99.9	MNI	Schaefer 1989	Dunaway Road, West Mesa
IMP-6427	84.7	0.6	14.6	Count	Laylander 1994	Elmore Site, Kane Springs
SSTB	1	1	98	MNI	Apple et al. 1007	Salton Sea Test Base
IMP-7750	1	1	98	MNI	Schaefer 2000	Salton City
Maximum Shoreline or above						
RIV-3880	0	22	78	Weight	Cook et al. 1990	Toro Canyon
RIV-1331	0.4	46.3	52.3	Count	Schaefer et al.1883	Toro Canyon
RIV-1349	0.8	64.9	34.2	Count	Schaefer et al.1883	Toro Canyon
RIV-4168	0.01	91.2	0.02	Count	Everson & Schroth 1991	La Quinta
RIV-2198	0	93.6	4.1	Count	Everson & Schroth 1991	La Quinta
RIV-2199	0	82	17.2	Count	Everson & Schroth 1991	La Quinta
RIV-4167	0	97.5	0.01	Count	Everson & Schroth 1991	La Quinta
RIV-1179	0.8	4.4	94.7	Count	Sutton & Wilke 1988	La Quinta
RIV-3685	13.3	77.3	9.3	Count	Arkush 1990a	La Quinta
RIV-1769	39.8	10.6	49.6	Count	Arkush 1990b	La Quinta
RIV-3793	0.1	39.8	50.2	Count	Goodman & Arkush 1990	Indio
RIV-1974	4.3	10	84.2	Count	Love 1996	Indio
RIV-5341	4.9	3.8	78.1	Count	Love 1996	Indio
RIV-5344	0	73	26.3	Count	Love 1996	Indio
RIV-5345	5.3	29.8	58.8	Count	Love 1996	Indio
RIV-5346	7.7	24.1	67.7	Count	Love 1996	Indio

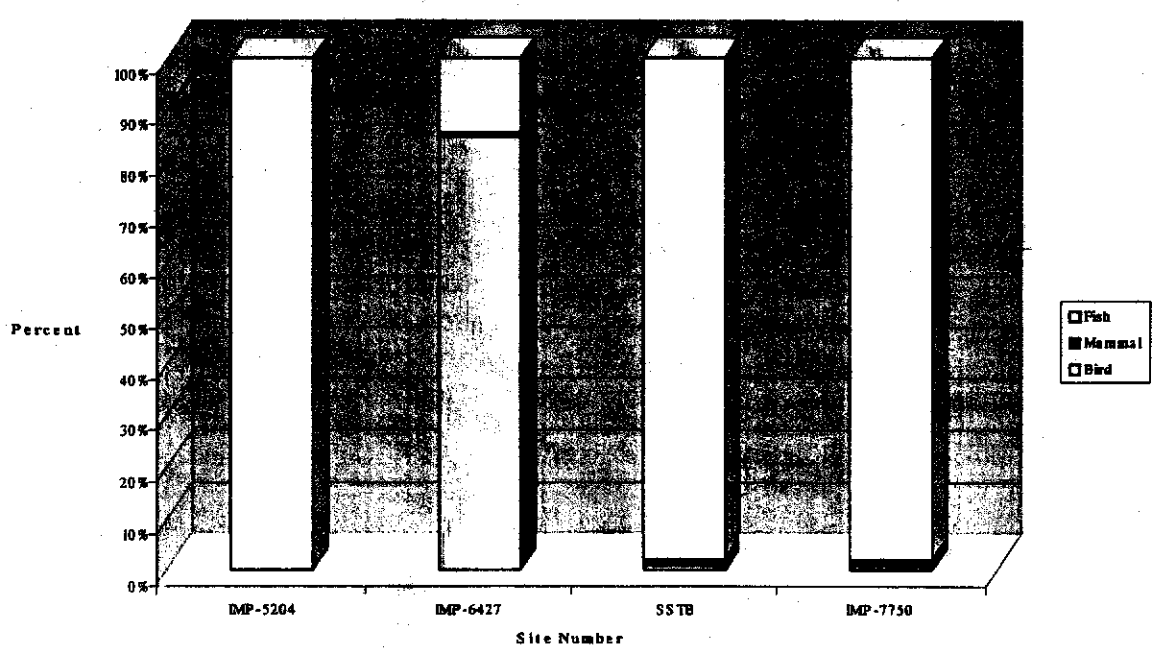


Figure 29. Lake Cahuilla recessional sites faunal assemblage.

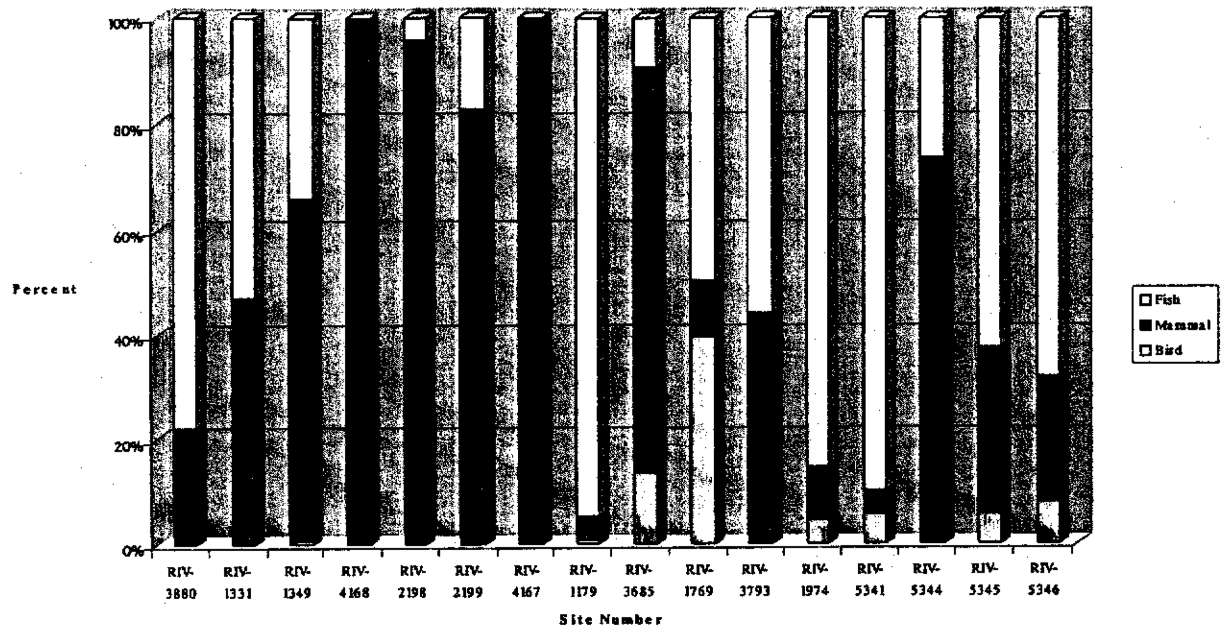


Figure 30. Maximal Lake Cahuilla stand faunal assemblage.

LAKE CAHUILLA SITE PRESERVATION

There are hundreds of sites like IMP-7750 in the area, none of which have received intensive investigations like this. A substantial number have been recorded and minimally tested for the Salton Sea Test Base (Apple et al. 1998) which in December, 1999, were listed on the National Register of Historic Places as the Southwest Lake Cahuilla Recessional Shoreline Archeological District. The results at IMP-7750, just a few km to the north, confirm the enormous research potential of this complex of well preserved house pits, rock rings, fish traps, and other features. Many more have been recorded on surveys throughout the area. What variability exists in the range of activities and intensity of resource exploitation remains to be assessed. Some house pits appear to include two structures that may represent related or cooperating domestic units. Some house pits appear to be more superficial and represent very short term, specialized fishing camps. How individual households were organized as cooperating families or autonomous economic units remains to be seen. What variability exists in size, complexity, and diet breath of domestic households can only be addressed by excavation and comparative analysis of a sample of these sites. Many of these low-elevation sites have already been destroyed during the development of Salton City, roads, utility lines, and the Salton Sea Test Base. More are likely to be threatened with future developments, including reclamation facilities that are part of the Salton Sea Restoration Project. If successful, increased recreational and residential developments are likely to occur throughout the western shoreline. We hope that efforts will be made to both preserve and continue research on this important complex.

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