

The Prehistoric Archaeology of Southeast San Diego County

Including

Archaeological Studies at Site CA-SDI-7074
by Brian Williams

*GIS-Based Synthesis of Prehistoric Landscapes in the
Jacumba/Mccain Valley Region*
by Don Laylander and Jerry Schaefer



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INTRODUCTION

The Jacumba Valley is situated at a strategic location in southeastern San Diego County, amid a wide range of biological and geological resources and near the periphery of several different prehistoric cultural groups. It acted as the major travel corridor between the Peninsular Range and the Colorado Desert for prehistoric and historic-period travelers alike. Even today the valley is split nearly in half by the east/west International Border and Interstate 8 is the primary east/west route into and out of San Diego County, while Mexico's Highway 2 links the border cities of Tijuana and Mexicali.

The valley still bears the evidence of a volcanic past in the form of three extinct cinder cones (Boundary Peak, Round Mountain, and Jade Peak) and a series of remnant basalt flows that ring Jacumba to the north (Table Mountain) and northwest. To the north and northeast are two gorges (Carrizo Gorge and In-Ko-Pah Gorge) that descend nearly 3,500 feet to the Colorado Desert floor in only a few miles.

One of the most important features of the Jacumba Valley is its abundance of naturally occurring resources. Surrounding the valley on all sides are the northwest/southeast-trending Jacumba Mountains, manifestations of a massive granite batholith, rich with natural springs and other resources. The Jacumba Mountains are home to a variety of stone materials. Granite, basalt and other volcanics, quartz, quartzite, and soapstone are all readily available and can be found in the bed of nearly every sandy creek that crisscrosses the valley floor. The plants represent a diverse desert-mountains transition, with tall chaparral, oak and juniper woodlands, stands of pine, agave, yucca, and cacti all found side by side. The absence of low ground cover exposes much of the ground surface which is generally a combination of sandy silt and decomposed granite. At the center of Jacumba is a mineral spring which sits at the base of Jacumba Peak, said to have been the home to the twin creators of the local Kumeyaay groups. The Jacumba Valley climate is generally mild and has apparently not changed drastically in the past 10,000 years.

This monograph was created in support of the East County Substation Project's Memorandum of Agreement Stipulation III.c.ii.(5). The purpose of the study described here has been to tease out the intricacies of prehistoric people's interaction with this diverse landscape. This has been done using site-specific data in conjunction with a broader regional review of cultural resource studies. The site-focused aspect discusses the interpretations informed by three phases of archaeological investigation (evaluation, data recovery and mitigation monitoring) completed at site CA-SDI-7074 as part of the East County Substation Project (Figure 1) (Williams 2014). In addition to the site-specific study, a synthesis of information on prehistoric archaeological landscapes in the surrounding region was conducted for the closely related Jacumba/McCain Valley and Ocotillo regions. This landscape analysis presents the results from the creation and analysis of a geographical information system (GIS) database. The investigations were undertaken by ASM Affiliates, Inc. under subcontract with Insignia Environmental and under Insignia's contract with San Diego Gas & Electric Company.

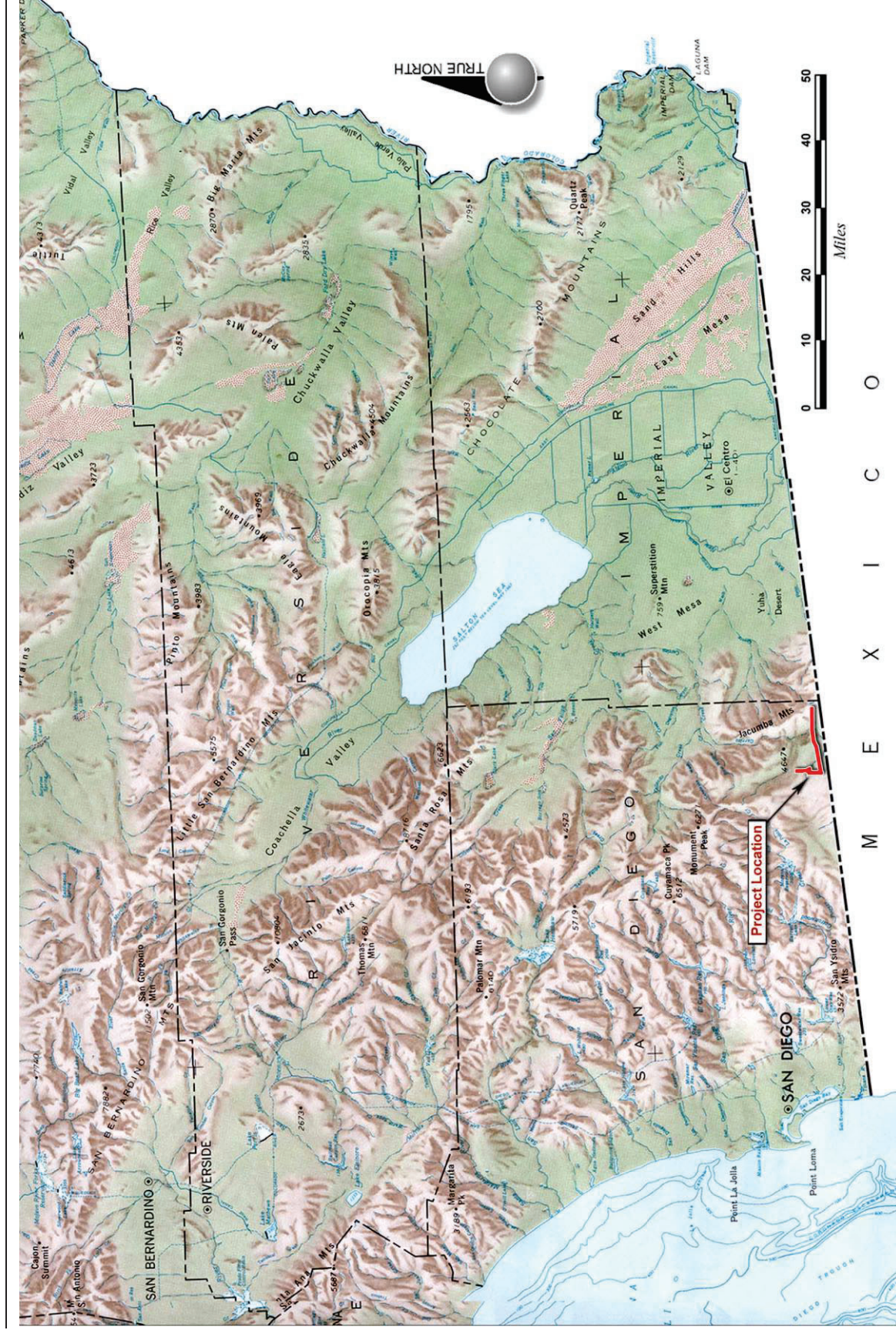


Figure 1. Location of ECSP Project.

To set the specific studies presented here within their research context, it is necessary first to look at the picture offered by previous investigations. Archaeological fieldwork in southern California has identified a diverse range of human occupation extending from the early Holocene into the ethnohistoric period (Erlandson and Colten 1991; Jones 1992; Moratto 1984). The prehistory of San Diego County is most frequently divided into three major periods: Paleo-Indian, Archaic, and Late Prehistoric. These time periods are characterized by material culture patterns that are thought to represent distinct regional trends in the economic and social organization of prehistoric groups. In addition, some scholars, referring to specific areas, utilize a number of terms for archaeological complexes, often used interchangeably with these temporal labels: San Dieguito for Paleo-Indian, La Jolla for Archaic, and Yuman, Cuyamaca, or Patayan for Late Prehistoric (Meighan 1959; Moriarty 1966; Rogers 1939, 1945; True 1966, 1970; Wallace 1978; Warren 1964). Archaeological studies in western San Diego County as well as research conducted in the Colorado Desert are summarized below.

PAST ENVIRONMENTS

Reconstructing past environments is a crucial step toward understanding how humans adapted to their natural settings. Past patterns of rainfall, sea surface temperature, and plant communities, preserved respectively in tree ring data, fossil ocean zooplankton, and pollen records and fossil packrat (*Neotoma* spp.) middens, as well as other types of data, have been important sources of information about past regional environments in the western United States. Floral and faunal remains recovered from archaeological sites have allowed for more site-specific reconstructions. However, the region's paleoenvironments are imperfectly known as yet.

Packrat middens have been especially important for reconstructing desert environments. They may be well preserved in dry caves, they contain fairly complete records of plant species (and sometimes some small animals) that were present within a radius of approximately 50 m around the packrat nest, and they can be dated by radiocarbon. Although approximately 200 packrat middens have been analyzed in the Sonoran Desert, only three of the locations are in the Colorado Desert, and all are well to the east of the project area (Cole 1986; Rinehart and McFarlane 1995; Van Devender 1990).

Data from these packrat middens reveal that, at the close of the Late Wisconsin glacial period, the low mountainous slopes of the Colorado Desert appear to have had plant associations similar to those found presently in the Mojave Desert, most notably Joshua tree (*Yucca brevifolia*), California juniper (*Juniperus californica*), and single leaf pinyon pine (*Pinus monophylla*), the last of these being documented only in the Whipple Mountains. The Whipple Mountains, located at the northeast corner of the Colorado Desert on the west side of the Colorado River across from Parker, Arizona, appear to have supported a woodland environment at this time. However, Picacho Peak, located at a lower elevation and squarely within the Colorado Desert, is described as one of few places in the North American deserts that were not invaded by woodland between 13,000 and 11,000 years ago.

The early Holocene record shows a transition toward an interglacial plant community, with Joshua tree dropping out of the record at both Picacho Peak and in the Whipple Mountains. By the middle Holocene, California juniper had also disappeared, and catclaw (*Senegalia greggii*) and Mormon tea (*Ephedra* spp.) were present. By the end of the middle Holocene, a few subtropical desert plants had appeared in the Whipple Mountains. The Salt Creek midden in the Chocolate Mountains represents something of an anomaly. Dated at about 7600 B.C., Joshua tree, mesquite (*Prosopis juliflora*), and catclaw, along with bones from two reptile species presently uncommon at low elevations (western fence lizard, *Sceloporus occidentalis* and ground snake, *Sonora semiannulata*), suggest a cooler, more mesic environment. The presence of abundant vertebral remains of *Gila elegans* (bonytail chub), a Colorado River species associated with periods when Lake Cahuilla was present in the Salton Trough, may indicate a lake stand at that time,

or the remains may have originated in the Colorado River. However, since the bones themselves were not radiocarbon dated, it is not possible to say they do not represent intrusive material from an earlier period.

The packrat midden record suggests that the modern Colorado Desert plant associations were largely in place by about 5,000 years ago. This is consistent with abundant evidence from the Mojave Desert for aridity greater than at present between ca. 5000 and 3000 B.C. (Spaulding 1991).

Conditions in the region appear to have been fairly consistent over the past 2,000 years at least. Pollen samples collected and analyzed for the SDG&E's Southwest Powerlink project (Townsend 1986) as well as the East County Substation project all represented taxa that are still common in the region today. The samples analyzed for the East County Substation project identified a heavy occurrence of high-spine Asteraceae pollen, with smaller quantities of other pollen types, including juniper (*Juniperus* sp.), oak (*Quercus* sp.), sagebrush (*Artemisia* sp.), low-spine Asteraceae, *Chenopodium/Amaranthus* (members of the ragweed/cocklebur portion of the sunflower family, saltbush, and related plants), Mormon tea (*Ephedra nevadensis*), wild buckwheat (*Eriogonum* sp.), legumes (Fabaceae), grasses (Poaceae), and chamise (*Adenostoma* sp.).

PALEO-INDIAN PERIOD

The antiquity of human occupation in the New World has been the subject of considerable debate over the many decades. The currently most widely accepted model is that humans first entered the western hemisphere between 13,000 and 10,000 B.C. There is no undisputed evidence of human occupation in coastal southern California prior to 10,000 B.C. Although dates as early as 21,000 B.C. and even 46,000 B.C. have been reported (Bada et al. 1974; Carter 1980; Rogers 1974), those dates are not generally accepted (cf. Taylor et al. 1985). Despite intense interest and a long history of research, no widely accepted evidence of human occupation of North America dating before 13,000 B.C. has emerged.

As in most of North America, the earliest recognized period of California prehistory is termed Paleo-Indian. The classic Paleo-Indian period is meagerly represented in the Peninsular Ranges and Colorado Desert by a few finds of isolated fluted ("Clovis") projectile points (Kline 2014; Rondeau et al. 2007). In southern California, the Paleo-Indian period is usually considered to date from at least 8000 B.C. until 6500 to 5200 B.C. (Moratto 1984; Warren et al. 2008), and is represented locally by what is known as the San Dieguito complex (Rogers 1966). Rogers (1966) defined three San Dieguito chronological phases. Although later researchers have not substantiated the existence of three phases, the San Dieguito complex as a whole is generally considered to be fairly well established. San Dieguito assemblages are composed almost entirely of flaked stone tools, including scrapers, choppers, and large projectile points (Warren 1987; Warren et al. 2008). Until recently, the near absence of milling tools in San Dieguito components was viewed as the major difference between Paleo-Indian economies and the lifeways that characterized the later Archaic period. Lacking indications of a big game hunting focus, San Dieguito is sometimes considered to belong more properly to an Archaic rather than a Paleo-Indian stage.

Based upon rather scant evidence from a small number of sites throughout San Diego County, it has been hypothesized that the people linked to the San Dieguito complex were generalized hunter-gatherers with band-level organization. This hypothesis is essentially an extension to the inland and coastal areas of San Diego County of what has long been considered a continent-wide Paleo-Indian pattern. This immediate post-Pleistocene adaptation occurred within a climatic period characterized by somewhat cooler and moister conditions than exist presently.

This interpretation of the San Dieguito complex as the local extension of a post-Clovis big-game-hunting tradition is based primarily on materials from the C. W. Harris site (Ezell 1983, 1987; Warren 1966, 1967). An unusually high percentage of large bifaces in the Harris assemblage seems indicative of the site's

function as a retooling station; this is a pattern not found at most other purported San Dieguito sites, the exception being a campsite on Laguna Mountain (SDI-18219). The Harris site, a stratified site in western San Diego County, first excavated by Rogers in 1938, established a San Dieguito component as stratigraphically underlying the local Archaic expression known as the La Jolla complex (Warren 1966). A date of $9,030 \pm 300$ radiocarbon years B.P. (9133-7529 B.C.) was obtained on a soil/charcoal sample (Warren et al. 2008). The assemblage consists of leaf-shaped knives and points, short-bladed weakly shouldered points, a flaked crescentic stone, engraving tools, choppers, and a wide variety of scrapers (Warren 1966). These tools have been described as technologically similar to those making up Lake Mojave collections (Justice 2002; Moratto 1984:97; Warren and True 1961).

The Lake Mojave complex of the Mojave Desert cultural sequence is also relevant to Paleo-Indian studies in the Colorado Desert. First defined by Elizabeth Campbell and her colleagues at Pleistocene Lake Mojave (Campbell et al. 1937), the assemblage is marked by a variety of projectile points, including leaf-shaped forms, long-stemmed points with weak shoulders (Lake Mojave points), short-bladed long-stemmed points with more pronounced shoulders (Silver Lake points), and crescentics. This collection has been interpreted as consisting of points for thrusting spears (e.g., Sutton 1996). Engraving tools, a variety of distinctive scraper types, leaf-shaped knives, large core tools, and a near absence of milling stones are also characteristic of the Lake Mojave complex (Warren and Crabtree 1986:184). It is difficult to deny the similarities between the assemblages of Campbell's Lake Mojave complex and Rogers's San Dieguito complex. Campbell proposed that the Lake Mojave period dated to a wet period at the end of the Pleistocene and that lakeshores were the focus of habitation at that time (Campbell et al. 1937:40-42).

Although a series of large projectile points and knives and a paucity of milling tools characterize the San Dieguito and Lake Mojave assemblages, archaeologists generally agree that these early cultures represent a generalized hunting and food collecting pattern. According to Warren and his colleagues:

San Dieguito appears to take an intermediate position somewhere between the classic Clovis pattern and the Archaic cultures of California. On the other hand, the San Dieguito pattern as defined by the Harris Site and Rogers' desert sites has an artifact assemblage that is distinct from that of the La Jolla (coastal Archaic) pattern (Warren et al. 2008:13).

An alternative perspective based on evidence from the San Diego coast views the producers of the San Dieguito and La Jolla complexes as a single people employing different toolkits depending on site location and resources exploited. Evidence cited for combining these complexes into a single culture includes overlaps in radiocarbon dates from sites classified as San Dieguito and La Jolla, as well as several assemblages from non-stratified sites that include artifact types characteristic of both complexes (Gallegos 1987). Based on analysis of two sites in northern Baja California with San Dieguito assemblages, Porcayo (2009:2) defined the San Dieguito lithic industry as "behavior characterized by commitment to a specific manufacturing technique and to the systematic replication of lithic artifact forms." In this view, a site containing just a few San Dieguito or similar artifacts within an assemblage characteristic of another defined archaeological culture should not be considered San Dieguito (Porcayo 2009:5).

Lake Mojave series projectile points have been documented in the western Colorado Desert. At the Salton Sea Test Base on the southwestern shoreline of the Salton Sea, a large Lake Mojave point and two crescentics were recovered (Apple et al. 1997; Cleland 1999). The point was manufactured from San Felipe obsidian, the source of which is about 240 km (140 miles) to the south in northeastern Baja California, a distance consistent with models of large resource procurement areas and high mobility during the Paleo-Indian period (Cleland 1999). However, there is no reason to assume that the material was quarried by the same individual who subsequently discarded the point. An obsidian Lake Mojave point has recently been documented in the Imperial Valley (Farmer et al. 2010). The heavily weathered obsidian appears to lack the white phenocrysts that characterize much of the material from the local Obsidian Butte source (Noah

2012). A green volcanic crescentic has also been recently recorded near the town of Ocotillo (Underwood and Baksh 2012).

The Cerro Pinto wonderstone quarry in northeastern Baja California has produced an assemblage consisting of bifacial preforms, knives, scrapers, and apparent chopping tools, along with hammer stones employed in tool production. Analysis of a sample of artifacts revealed a well-controlled percussion technique, some pressure flaking, and selective preference for fine-grained rock. These characteristics, along with an unprovenanced wonderstone eccentric in collections of the Instituto Nacional de Antropología e Historia (INAH), suggest that a San Dieguito pattern is present at Cerro Pinto (Eckhardt and Porcayo 2008; Porcayo 2007, 2009).

To the northwest of Jacumba Valley, a campsite on Laguna Mountain (SDI-18219) containing 20 quartzite bifaces in various stages of completion was documented by Pignuolo (2005). The assemblage includes leaf-shaped and bi-pointed points similar in size to those recovered at the Harris Site. An unfinished biface with apparently purposeful stemming, reminiscent of a Lake Mojave point, was also found. Of note, however, is the presence in the assemblage of three slab metates and four manos; one of the latter was carefully shaped. This evidence suggests that the economic focus of the area's people was shifting during the early Holocene from hunting to gathering (Pignuolo 2005:253).

ARCHAIC PERIOD

The Archaic (also referred to as the Early Milling period) extended back at least to 5200 B.C., possibly to as early as 7000 B.C. (Rogers 1966; Warren et al. 2008). Archaic subsistence is generally considered to have differed from Paleo-Indian subsistence in two major ways. First, gathering activities were emphasized over hunting, with shellfish and seed collecting being of particular importance. Second, milling technology was developed, frequently employing portable ground stone slabs. The shift from a mostly littoral-based subsistence focus to a terrestrial focus is traditionally seen as marking the transition from the Paleo-Indian to the Archaic period. However, the implications of this transition are poorly understood from both an economic and cultural standpoint (see Warren et al. 2008 for a broader review).

Early Archaic occupations in San Diego County are most in evidence on the coast and along the major drainage systems that extend inland from the coastal plains (Moratto 1984). Coastal Archaic sites are characterized by cobble tools, basin metates, manos, discoidals (disk-shaped ground stones), a small number of Pinto- and Elko-series dart points, and flexed human burials. Together, these elements typify what is termed the La Jolla complex in San Diego County, which appears as the early coastal manifestation of a more diversified way of life.

Inland sites are less extensively represented than coastal sites. For many years, the common model for culture history has included what True (1958) termed the Pauma complex, an archaeological construct based upon a number of inland Archaic period sites in northern San Diego County that appeared to exhibit assemblage attributes different from coastal Archaic sites. Pauma complex sites are typically located on small saddles and hills overlooking stream drainages, and are characterized by artifact scatters of basin and slab metates, manos, some scraper planes, debitage, and occasionally discoidals. Further analysis suggests that the Pauma complex is simply an inland counterpart to the coastal La Jolla complex (Cardenas and Van Wormer 1984; Gallegos 1987). It may be parsimonious to consider the differences in materials between the La Jolla and Pauma complexes as seasonal manifestations of a mobile residential strategy making use of both coastal and inland resources.

The Colorado Desert Archaic may be divided into Early (7000-2000 B.C.) and Late Archaic (2000 B.C.-A.D. 500) periods (Cleland 1999; Cleland and Apple 2003). This division is based on sequences defined in the Mojave Desert, where a much more robust dated archaeological record exists, including a variety of

chronologically diagnostic projectile point types, which occur only in much smaller numbers in the Colorado Desert and Peninsular Ranges.

The hallmark artifact of the Early Archaic is the Pinto point, which appears predominantly in the Mojave Desert. Obsidian hydration and radiocarbon dates published for approximately 170 Pinto projectile points in the Great Basin indicate that the series appeared around 9300 B.C. and persisted until around 2000 B.C. (Basgall 1995; Duke 2011; Hamilton 2012; Haynes 2004; Jenkins 1987, 1991; Warren 1991, 2002; Warren and Crabtree 1986). The Pinto period assemblage is not dramatically different from that of the preceding Lake Mojave period, except that a simple milling technology was more extensively used. Indeed, Lake Mojave and Pinto series points are often found together on site surfaces along playa shorelines (Warren and Crabtree 1986) and in several excavated contexts at Rogers Ridge at Fort Irwin and at the Stahl site, among others (Duke 2011; Schroth 1994). Charcoal from a feature containing the two point types produced a radiocarbon date of $8,180 \pm 140$ B.P. (7526-6714 B.C.), but micro-stratigraphic analysis suggests that the Lake Mojave point may be somewhat older (Jenkins 1987:222-223). In the Old River Bed site in Utah, Duke (2011) indicated the Pinto series may be as old as 10,100 B.C., assuming that it is associated with a dated gravel bed. Pinto sites in the Mojave Desert have been described as seasonal camps of highly mobile people who were not well adapted to the arid lower-desert environments except when moist periods allowed them to take advantage of shallow lakes, marshes, and springs (Warren and Crabtree 1986).

The Early Archaic period is poorly represented in the Colorado Desert. However, three Pinto series points were recovered as surface finds at the Salton Sea Test Base (Cleland 1999). Elsewhere, although Pinto points were not recovered, two deposits in the Colorado Desert date to the Early Archaic. An initial radiocarbon date of $4,070 \pm 100$ B.P. (2891-2347 B.C.) for the stratified deposits at Indian Hill Rockshelter is based on a flexed human burial within a preexisting cultural deposit that was at least 24 inches thick (Wilke et al. 1986). The second Early Archaic deposit consists of five charcoal lenses exposed in an arroyo bank along San Felipe Creek between 4 and 10 m below the ground surface. One of these lenses was associated with a projectile point of uncertain description and was radiocarbon dated as $4,980 \pm 100$ B.P. (3979-3536 B.C.) (McDonald 1992:15-16). In addition, a single example of a recently named dart point type, Descanso Notched (Pignuolo and Porcayo 2009) has been identified in the region (Farmer et al. 2010). This type, believed to have been centered in the vicinity of Descanso in coastal northwestern Baja California and extending into southern San Diego County, is now known to be present in the western Colorado Desert. This point type is believed to date to approximately 5000 B.C. (Pignuolo and Porcayo 2009). A dated stratigraphic level from a site at La Playa in the Sonoran Desert suggests that Pinto-series points did not come into that area until as late as 4840 B.C. (Sanchez and Carpenter 2012). Less than seven of the 254 points recovered from the La Playa site were identified as Pinto series, indicating to Sanchez and Carpenter (2012) that the points reflected brief incursions by northern groups from the Great Basin during wetter periods of the Altithermal (discussed below); this suggestion that agreed with Warren and Crabtree's (1986) earlier observations on the limits of Pinto technology in arid environments.

Shortly after 2000 B.C., Elko-series points began to characterize assemblages in wide areas of the Desert West (Justice 2002; Weide 1976). Malcolm Rogers called assemblages with Elko-series points Amargosa (Rogers 1939). Sparse evidence for the Amargosa pattern in the Colorado Desert includes more milling stones than in Early Archaic sites (Cleland 1999). A handful of habitation sites suggest an adaptation similar to the coeval well-developed hunting and collecting subsistence pattern, which included lacustrine resources, found in the northern Great Basin, but seemingly with a smaller population in the Colorado Desert (Weide 1976).

Late Archaic evidence includes occasional surface finds of dart points, either as isolates (including two finds at the Salton Sea Test Base; Apple et al. 1997) or with other artifacts. More extensive deposits include 11 dart points from site surface contexts in the Ocotillo Wind Energy Facility (OWEF) project area (Underwood and Baksh 2012), a cairn burial from the Yuha Basin dated between 1850 B.C. and A.D. 350

(Taylor et al. 1985), stratified deposits at Indian Hill Rockshelter (McDonald 1992; Wilke et al. 1986), a mesa-top site in the Jacumba Valley (Williams 2013b), and several sites in Coachella Valley.

Indian Hill Rockshelter, where 21 Elko Eared points were recovered, produced 11 rock-lined cache pits in the pre-ceramic stratum. The pits have been interpreted as evidence for food storage within a logistical foraging system in which groups returned to the hunting camp or base camp on a seasonal or other predictable basis (McDonald 1992; Wilke et al. 1986). Bighorn sheep and jackrabbits were the primary prey.

The Late Archaic period sites in Coachella Valley include three lake-related deposits (RIV-1974, RIV-5771/5773, and RIV-5771/5773 Feature 43) containing fish, lagomorph (rabbit and jackrabbit), and waterfowl bones, all dated in the 500 B.C. to A.D. 1 range. These sites also contained ground stone, flaked lithics, shell beads, and burned freshwater shells. Another site (RIV-2936), described as a village, exhibited multiple living surfaces, hearths, flaked lithics, ground stone, shell ornaments, and two obsidian bifaces. Radiocarbon dates for this site are in the A.D. 1 to 500 range. The most common lithic debitage material was wonderstone (49 percent), which likely came from the closer Rainbow Rock source in northwestern Imperial County, rather than from the Cerro Pinto source in Baja California. Obsidian constituted 30 percent of the flaked lithic assemblage, and all of it was sourced to the Coso source, rather than to nearby Obsidian Butte, although the latter (if it was in existence geologically) may have been exposed at the time. There was no evidence of lacustrine resources at this site. The site size and wide variety and range of artifact types demonstrate that village life in the Coachella Valley during the Late Archaic was not entirely dependent upon the presence of Lake Cahuilla, although there were clearly associations with the lake at some periods (Love and Dahdul 2002).

In short, our understanding of the interplay between human land use, social organization, and material culture for the first several millennia of San Diego prehistory is poorly developed, although some progress has been made. Recent advances have accelerated in the areas of paleoenvironmental analysis, paleoethnobotany, faunal analysis, and lithic technology studies. Efforts are being made to re-examine the assumptions surrounding existing artifact typologies and climatic reconstructions that form the basis of the standard systematics.

LATE PREHISTORIC PERIOD

The Late Prehistoric period is marked in the archaeological record by the presence of pottery, small projectile points denoting the use of bow and arrow, and cremation burial practices. Development or at least florescence of bedrock mortar milling technology is also generally attributed to this period. These traits did not appear simultaneously. Small projectile points are found in pre-ceramic levels in the Mojave Desert and in San Diego County (Pignuolo 1995), and dates as early as A.D. 400 have been suggested for the appearance of the bow and arrow in the northern Mojave Desert and Los Angeles Basin (Sutton 2011:48; Yohe 1992). Dates of around A.D. 900 are more often cited based on archaeological evidence further to the south (Warren 1984). Sutton (2011:48) proposed that Desert Side-notched points entered Imperial Valley and the southern Peninsular Ranges from the east about 1,000 years ago, with Cottonwood Triangular points moving eastward into the Coachella Valley about a hundred years later. Pottery may have been introduced in the western Colorado Desert around A.D. 900 and had reached western San Diego County prior to A.D. 1000 (Griset 1996; Love and Dahdul 2002; May 1976). The chronology for the replacement of inhumation with cremation is not well defined, and the replacement may have occurred gradually. Moriarty (1966) proposed that cremation practices began as early as 500 B.C. in coastal San Diego County (see Sutton 2011:13 for a similar date in the Los Angeles Basin), while later researchers encountered inhumations dating as late as A.D. 700 to 1280 in San Diego and northern Baja California coastal sites, respectively (Laylander 2011:163).

The Late Prehistoric period is represented by the Cuyamaca complex in the southern portion of the county (True 1970). According to True et al. (1974), the Cuyamaca complex is differentiated from the San Luis Rey complex within environmentally similar settings (Cuyamaca State Park and Palomar Mountain) by Cuyamaca's greater frequencies of side-notched points and flaked stone tools, pottery, and milling stone implements, a wider range of pottery forms (e.g., Hakataya figurines; Hedges 1973), a steatite industry, and cremations placed in pottery vessels. Extending these distinctions to other settings should be done with caution, however, since seasonal camps in upland areas would reflect a different economic focus and would involve a slightly different set of trade relations than would be expected for populations focused on the Pacific Coast.

Rogers proposed a three-phase sequence for the Colorado Desert area, consisting of Yuman I, II, and III (Rogers 1945). While his sequence is still widely employed by archaeologists, the terms Patayan I, II, and III have generally replaced Rogers's labels to avoid the implication that the prehistoric people producing these patterns necessarily spoke Yuman languages (Schaefer 1994b; Warren 1984). Patayan I was represented along the lower Colorado River, with a minimal presence on the eastern shore of Lake Cahuilla. On the basis of occasional dated Southwestern pottery sherds in Patayan I contexts, Rogers placed the origins of this stage in the ninth century A.D. Patayan II was dated between A.D. 1050 and 1500, nearly coinciding with what Rogers thought were the chronological limits of Lake Cahuilla's stand. Rogers's Lower Colorado Buff Ware typology was left uncompleted at the time of his death in 1960. Studying Rogers' notes and type collections along with over 1,000 vessels in museum collections and radiocarbon-dated contexts, Waters described 17 types and placed them chronologically within Rogers' three stages (Waters 1982). These Patayan I, II, and III phases are not widely used west of the Colorado Desert because buff ware usually make up only a very small percent of sherds in Late Prehistoric sites west of the Laguna Mountains (Schaefer 1994b). Tizon Brown Ware, which antedated A.D. 1000 and continued into historic times (Griset 1996; May 1976; Schaefer 1994b), dominates the pottery assemblages of most sites in the Peninsular Ranges, although brown wares and buff wares commonly occur together in areas between the desert floor and the mountains, such as Jacumba Valley. Local research into brown ware varieties has suggested that prehistoric Jacumba inhabitants may have produced their own pottery from local clays, labeled the Jacumé group (Schaefer, personal communication 2014).

The establishment of relatively large seasonal settlements, with trends toward increased population size and increased territorial exclusivity, are seen as hallmarks of the Late Prehistoric period in California. In the Colorado Desert, the intermittent presence of Lake Cahuilla during the Late Prehistoric period created a unique situation. Lake Cahuilla's resources may have promoted a population growth, which may have been maintained during periods of lake desiccation by intensified subsistence focused on acorns and agave. For example, following the demise of Lake Cahuilla, the large San Sebastian village complex formed at a perennial water source on San Felipe Creek. This site appears to have been a Patayan III residential base that supported a large population in late spring and early summer and a small year-round population consisting of individuals unable to make the ascent to fall and winter camps in the mountains (Schaefer 1994a:73). In the Peninsular Ranges, population levels appear to have increased substantially during late prehistory, perhaps precipitated in part by the final desiccation of Lake Cahuilla (Hildebrand and Hagstrum 1995), although the magnitude of the demographic effects from the lake is debatable (Weide 1976; Schaefer 1994a). With the beginnings of European occupation of the West Coast after A.D. 1769, inland migration would likely also have contributed to population growth as coastal clan members opted to join their inland kin (Hildebrand and Hagstrum 1995).

ETHNOGRAPHIC EVIDENCE

Available ethnographic evidence is based on the descriptions of aspects of traditional culture that were remembered and recorded during the historic period. If used with appropriate caution, this evidence can provide an invaluable source of analogies and inferences concerning earlier, prehistoric cultural patterns.

Of particular importance here is the relationship between behavioral and descriptive information and the archaeological data.

For the Kumeyaay and Tipai of the Peninsular Range, the principal ethnographic references are by Constance Goddard DuBois (Laylander 2004), Thomas T. Waterman (1910), Leslie Spier (1923), Philip Drucker (1937, 1941), William D. Hohenthal, Jr. (2001), and Florence C. Shippek (1982, 1989, 1991, 1993). The principal studies that specifically discuss the desert-adapted Kumeyaay of Imperial Valley (also known, at least in part, as the Kamia) were written by Edward W. Gifford (1918, 1931). A major study by Edward F. Castetter and William H. Bell (1951) addressed ethnobotany, agriculture, and land-use patterns among the Yumans on the Lower Colorado River, including the Kamia. Overviews and interpretations of Kumeyaay ethnography include those prepared by Frederic N. Hicks (1963), James P. Barker (1976), Katherine Luomala (1978), and Martha Knack (1981).

The prehistoric Kumeyaay spoke a language (also commonly termed Diegueño) belonging to the Yuman family, which includes about 10 aboriginal languages in southern California, western Arizona, and northern Baja California. The Yuman family is linked with a sister family, Cochimi, in central Baja California. On a larger geographical scale, but much more dubiously, Yuman may have belonged to a Hokan phylum, containing languages and language families scattered around the margins of California and in western Mexico, and even to an Amerindian group encompassing most of the native languages of the New World (Golla 2007; Laylander 2011).

Within the Yuman family, Kumeyaay belongs to Core Yuman, consisting of the entire family except for Kiliwa in northern Baja California. Core Yuman in turn contains three branches: Delta-California Yuman, River Yuman, and Pai. Kumeyaay and Cocopa, spoken in the Colorado River's delta, are both Delta-California Yuman languages. River Yuman includes Quechan, Mohave, and Maricopa. Pai consists of two languages: Upland Yuman (Yavapai, Walapai, and Havasupai) in western Arizona, and Paipai in northern Baja California. Because these Pai languages geographically straddle the Salton Basin and the Colorado River delta, there is good reason to believe that Pai speakers played a role in the region's prehistory (Laylander 2011, 2013).

Linguistic analyses can offer at least tentative clues concerning when and where linguistic divisions arose. Hokan, if it is a valid grouping, must have split apart well back in the middle Holocene, if not earlier. There is no specific reason to associate ancestral Hokan with the Colorado Desert. Yuman-Cochimi may have split apart around 2000 B.C.; based on center-of-gravity arguments, the most likely homeland for Yuman-Cochimi would have been in northern Baja California. Kiliwa may have split from Core Yuman around A.D. 1, and again northern Baja California is a likely location. The next split, between the three branches of Core Yuman, may have occurred around A.D. 500, and it is the first that almost certainly had implications for Colorado Desert prehistory. The linguistic ancestors of the Cocopa and Kumeyaay may have separated by around A.D. 1000, but whether their homeland was most likely to have been in the Colorado Desert or near the Pacific Coast is unresolved. Divisions within Diegueño have most commonly been treated as constituting at least three distinct languages: Ipai in the north; Kumeyaay in the center and east, presumably including the area of site SDI-7074; Tipai in the south, primarily in Baja California; and perhaps also Kwatl in the far south, at Santa Catarina. Others have interpreted these differences within the Diegueño group as being only at the level of dialects rather than languages; in any case, the separations that they represent probably began within the second millennium A.D. and most likely in the western portion of Yuman territory (Laylander 2011).

The western Kumeyaay inhabited a diverse environment that included littoral, valley, foothill, mountain, and desert resource zones. Because of the early incorporation of coastal Kumeyaay into the mission system, most of the available ethnographic information relates to inland groups that lived in the Peninsular Range or the Colorado Desert. There may have been considerable variability among the Kumeyaay in settlement

and subsistence strategies and in social organization (Laylander 1991, 1997a; Luomala 1978; Spier 1923; but cf. Shipek 1982). Acorns were a key resource, but a wide range of other mineral, plant, and animal resources were exploited (Hedges 1986; Shipek 1991; Wilken 2012). Pre-contact practices of land management and agriculture west of the Colorado Desert have been suggested but not confirmed (Shipek 1993; cf. Laylander 1995). Some degree of residential mobility seems to have been practiced, although its extent and nature (e.g., within patterns of community fission and fusion) may have varied considerably among different communities and settings. The fundamental Kumeyaay social unit above the family was the *šimul* (patrilineage) and the residential community or band, to the extent that those two units were not identical. Leaders performed ceremonial, advisory, and diplomatic functions, rather than judicial, redistributive, or military ones. There seems to have been no national level of political unity and perhaps little sense of commonality within the language group (but cf. Shipek 1982).

Kumeyaay material culture was effective, but it was not highly elaborated. Structures included houses with excavated floors, ramadas, sweathouses, ceremonial enclosures, and acorn granaries. Hunting equipment included bows and arrows, curved throwing sticks, nets, and snares. Processing and storage equipment included a variety of flaked stone tools, milling implements, pottery vessels, and baskets.

Nonutilitarian culture was not neglected. A range of community ceremonies were performed, with particular emphases placed on making individuals' coming of age and on death and mourning. Oral literature included, in particular, an elaborate creation myth that was shared with other Yuman groups as well as with Takic speakers (Luiseño, Cupeño, Cahuilla, and Serrano) to the north (Kroeber 1925; Laylander 2001; Waterman 1909).

The Kamia occupied areas along the New and Alamo rivers, as well as springs and walk-in wells in Imperial Valley. During the ethnohistoric period, the Kamia were politically and militarily allied with the Quechan and Mohave, in opposition to the Cocopa, Halchidhoma, and Maricopa. The Kamia were permitted a farming rancheria at the large Quechan settlement of Xuksil, located a few miles south of the modern Mexican town of Algodones (Gifford 1931).

The Kamia were organized into 10 or 11 non-localized, exogamous patrilineages. Many Kumeyaay living to the west were also members of these same lineages, leading Gifford (1918, 1931:301) to conclude that the Kamia were, in essence, desert Kumeyaay who had assimilated many aspects of River Yuman culture. Lineage identification with specific locations was probably related to the settlement preferences of individual families who moved as lineage segments, rather than as the result of lineage territoriality. Gifford (1931:14) did suggest that a greater degree of lineage localization may have existed in the past but that it was inhibited by the mobility requirements for making use of the shifting arable lands. As most of the lineages' totemic associations were with either the wildcat or the coyote, which were the totems of Cahuilla, Cupeño, and Serrano moieties, the Kamia may have had elements of a moiety system, although the Kamia were exogamous by lineage and not by totemic association. The economic unit was the extended family household consisting of a man and his wife or wives, their parents, and their children. Probably as a result of close contacts with the River Yumans, the Kamia maintained a greater degree of "tribal" identification than their Kumeyaay kinsmen to the west, recognizing a tribal "chief" over all of the lineages, who held an achieved rather than ascribed status and a role focusing on the organization of economic activities, warfare, and diplomacy.

The Kamia lived in rectangular, semi-subterranean structures of post-and-beam construction with thatch and earthen roofs. They also built ramadas, lean-tos, and conical sweathouses. They constructed their dwellings some distance apart, on or adjacent to arable alluvial terraces and as close as possible to running water, hand-dug walk-in wells, or sloughs. They had no permanent villages, and their moves were dependent on the availability of floodwater farming areas and ripening stands of wild plants. They would move to higher terraces if flooding occurred. Some years, seasonal overflow from the Colorado River into

the New and Alamo river sloughs failed to occur and the Kamia had to move to other locations, including the Colorado River valley (Gifford 1931).

The Kamia practiced a mixed economy of horticulture and hunting and gathering. Mesquite (*Prosopis pubescens*) was the most important wild staple crop. Acorns were either obtained directly in the Peninsular Range or through trade with the western Kumeyaay in exchange for cultigens, especially watermelons. The Kamia also procured baked and dried agave cakes from the western Kumeyaay but did not participate in the early spring agave harvest. Tule pollen and roots were gathered from sloughs, one favorite spot being Seven Wells on the east/west portion of the Alamo River south of the U.S./Mexico border. Gifford (1931:24) reported on another marsh plant called *wāró*. The seed capsules were pulled off by hand over a ceramic pot and the capsules were rubbed until the seeds were freed. The pods were then winnowed away with a ceramic dish. The seeds were ground on a metate and eaten dry. Either wooden mortars or stone metates were used on many wild seeds, followed by cooking. Among them were saltbush (*Atriplex* sp.), yerba mansa (*Anemopsis californica*), and sedge (*Cyperus erythrorhizos*). Gifford's (1931:27) informants apparently had no knowledge of the widespread practice of parching seeds prior to grinding. As with the River Yumans, fish were a principal protein source, supplemented by hunting of rabbits and large mammals.

Ethnographic and ethnohistoric evidence bearing directly on native activity in Jacumba Valley has also been documented. Generalized or specific locations have been reported in the ethnographic record as having been used as villages and camps, springs, vegetal and mineral resource gathering areas, processing sites (for instance, to roast agave), trails, and sacred sites (Bailey 1938; DuBois 1908; Gifford 1918, 1931; Heizer and Treganza 1944; Hohenthal 2001; Kroeber 1925; Laylander 2006; Meigs 1939; Rogers 1936; Spier 1923; SRS 1982; Waring 1915; Woods 1982). Ethnohistoric documentation has traced the often-troubled relations between Native peoples and nonnatives in Jacumba Valley during the nineteenth century (Bancroft 1886; Carrico 1983; Ellison and Price 1953; Hogue 2000; Ives 1984; Odens 1977; Pourade 1961, 1963; Sullivan 1977; Van Wormer 1984).

ARCHAEOLOGICAL STUDIES AT SITE CA-SDI-7074

by Brian Williams

SDI-7074 was originally recorded in 1979 by Jan Moore. During subsequent studies, its boundaries were expanded multiple times, so that it now encompasses 11 previously recorded prehistoric and historical resources. During 2010-2014 fieldwork, 130 intact thermal features, some with associated artifact assemblages, were encountered at the site. Archaeological monitoring of mass grading identified a significant deeply buried component, ranging in depth from 3 to 6 m below the ground surface.

RESEARCH QUESTIONS

A set of research questions was formulated to address the site. Research domains included paleoenvironment, cultural chronology and culture history, site formation processes, subsistence and settlement, technology, mobility and exchange, ceremony and religion, and ethnicity/cultural affiliation. This study also utilized a prehistoric archaeological context study developed for the Yuha-Jacumba Corridor of southeastern San Diego County and southwestern Imperial County (Noah 2012).

The majority of research questions that are applicable to SDI-7074 concern prehistoric earth ovens, including their chronological contexts in relation to regional intensification and changes in the availability of food and fuel sources. Radiocarbon dates, when they can be obtained, provide the most reliable and precise method for establishing chronological contexts.

Deep fire-affected rock features presented special challenges and opportunities. The “deep feature” label was assigned to any find more than 2.5 m below the original ground surface. Dating of a sample of these features revealed that they represented early Holocene activity. The research design for these features focused on interpreting the construction and composition of the features, the plant species that were processed, and environmental changes that might be evidenced

Alston Thoms (2008, 2009) argued that high concentrations of hot-rock technology features within specific time periods are a good measure of land-use intensification, often in response to higher population densities and reduced mobility. Indirect cooking of foods by first heating rocks for earth ovens requires more fuel than direct cooking over a fire, not to mention more labor to construct the ovens. These are all forms of intensification. “Hot-rock cookery”, as Thoms defined it, had important advantages that were directly relevant to the western Colorado Desert and eastern Peninsular Ranges. Durable rocks, like granite, capture heat and radiate it for long periods of time, up to 72 hours in an earth oven. The longer cooking periods are required to detoxify and properly hydrolyze inulin-rich and other fructan-rich roots, such as geophytes (e.g., agave and yucca), bulbs, roots, and rhizomes. Inulin is a high-fiber polysaccharide with about 25 to 35 percent of the food energy value of carbohydrates. The lower energy content may be offset by the general abundance of these species (Thoms 2008:445). Heated rocks also have a fuel-sparing potential; they can retain heat for long cooking intervals that cannot be attained with fast burning and charcoal-poor brush that prevails in lowland desert habitats, although this may not have been a factor in the early Holocene. Stones can be used to steam food in situ within the earth oven.

Earth ovens also permitted the consumption of previously unused or underutilized foods. Thoms (1989, 2009) specifically identified the target resource for large earth oven hot-rock cookery: perennial “root foods” or geophytes with underground roots, tubers, rhizomes, or bulbs. One of the best-documented ethnographic examples is the baking of camas lily bulbs throughout northern California, the Great Basin, the southern Plateau, and the Northwest Coast (Thoms 2009:576). Features to cook agave, however, are the

best-documented examples for southern California's Peninsular Ranges. Slow, low-heat baking appears to have produced the best results for any inulin-rich products.

Several research questions were suggested for SDI-7074's deep features. Did the early Holocene features represent the same type of hot-rock cookery for agave hearts as represented by late Holocene features at the site? Were they comparable in morphology to later features, or was there evidence of systematic change over time? What were the target species of these features?

If continuity in adaptive patterns from the earliest Holocene were seen, this would suggest that the cultural and technological hallmarks of the later Archaic were established much earlier than would be expected if early hunter-gatherers were organized in smaller and more mobile bands. The labor, organization, and knowledge of the resource involved in agave processing is presumed to represent an intensification on a specific seasonally available resource as part of a broad-spectrum subsistence strategy. One possibility is that hot-rock cookery of specific target species began at a relatively low level of intensification but that intensification increased over time in response to changing environmental and demographic conditions.

Alternatively, the early thermal features may not be functionally equivalent to later features. Differences in morphology and in target species may indicate changes in adaptive patterns over time. Such changes may be examined within the context of different optimal foraging models, including diet-breadth, patch choice, and others (Bettinger 1987; Kelly 1995). Granted that only a very specialized element of the early Holocene hunter-gatherer adaptive tool kit is represented by these deeply buried features, the unprecedented early dates and the fact that a respectable sample of features is available for study means that these questions can be addressed for the first time in this area.

ARTIFACTS AT SDI-7074

Ceramic Artifacts

A total of 345 sherds were recovered from SDI-7074 and were analysed collectively as one assemblage. Despite recognized difficulties in applying the ware/type system to California pottery (Quinn, Burton, and Byrne-Bowles 2011; Schaefer and Laylander 2008), this collection displayed very limited variance from established pottery type descriptions, and therefore type assignments were applied with considerable confidence and replicability. Greater discrimination of identifiable brown ware mineral and chemical compositions is possible but requires thin-section petrography and chemical fingerprinting, as Quinn and Burton (2009) and Quinn, Stringer, Rout, Alexander, Armstrong, and Olmstead (2011) have shown. Those investigators identified 19 different fabric groups from the Anza-Borrego Desert. Only a few of the groups could be linked to clay sources, but work is continuing to link pottery with the sources of their clays and inclusions.

Fabric characteristics and pottery types were determined by examination of freshly broken sherd profiles under 20x to 40x magnification with a dissecting microscope. Only a single sherd from a group was examined if the surface characteristics, color, and thickness of the sherds in the group indicated that they all derived from the same vessel. The type classification was then assigned to all the sherds in that group. Sherds were examined for fabric and surface characteristics or treatment (stucco, scum coat, incising). Rim sherds were examined for rim shape (recurved or straight) and lip shape (following May 1976; see Figure 2). These attributes were applied to the standard pottery typology that was developed for Lower Colorado Buff Ware by Malcolm Rogers and refined by Michael Waters (1982). Brown ware pottery were discriminated into just two categories, Salton Brown and Tizon Brown, based on fabric traits (Gallucci 2001; Hildebrand et al. 2002). Specific attributes of each type, as applied to this collection, are summarized below. Only rim sherds were used to derive vessel shapes, applying the criteria reviewed by Laylander (1997b).

Vessels with mouths that are smaller in diameter than the maximum vessel diameter were identified as jars. Vessels with approximately equal aperture and body diameters were identified as bowls. Vessels with the radius of the rim roughly parallel to the sherd were identified as plates, although the designation of bowl/plate had to be used when rim sherds did not include enough of the body to indicate whether the body continued straight down or flared out. Only one vessel with a relatively narrow mouth (<8 cm diameter) would be classified as an olla.

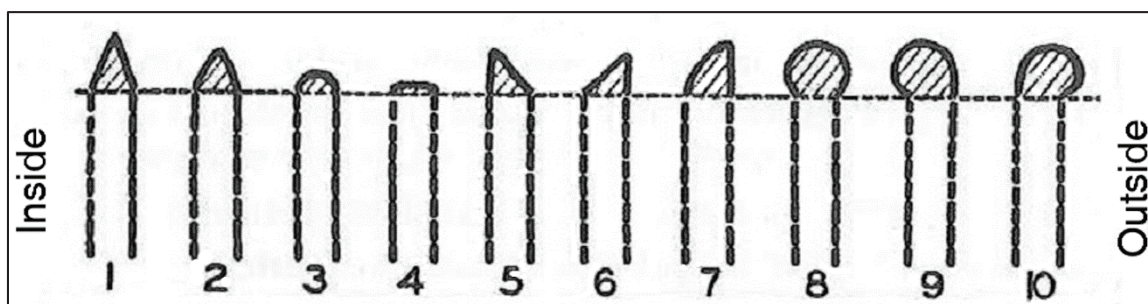


Figure 2. Pottery lip forms

Six pottery types were identified in the collection (Table 1). In the Lower Colorado Buff Ware series were Tumco Buff, Salton Buff, Parker Buff, and Colorado Buff. Among the brown wares were Salton Brown and Tizon Brown.

Table 1. Pottery Recovered from SDI-7074

Type	Rim Sherds		Body Sherds	
	Count	Weight (g)	Count	Weight (g)
Tumco Buff	9	99.9	33	136.4
Salton Buff	--	--	24	119.5
Parker Buff	--	--	--	--
Colorado Buff	--	--	1	8.2
Salton Brown	29	227.6	239	760.3
Tizon Brown	2	14.3	39	216.9
Total	40	341.8	336	1241.3

Tumco Buff

Tumco Buff is the most common Lower Colorado Buff Ware type at SDI-7074, accounting for almost 12 percent of the entire assemblage (n = 45). Lower Colorado Buff Ware was made from sedimentary clay sources in the alluvial clays from the Colorado River or its delta, including Holocene Lake Cahuilla. Much older clays of the Brawley and Imperial formations in the Salton Trough were also suitable for making Lower Colorado River Buff Ware pottery (Hildebrand et al. 2002; Morton 1977). Tumco Buff is easily recognizable by its beige to gray color and the apparent absence of mineral temper and inclusions but an abundance of angular, cube-shaped clay particles. Sometimes the clay particles differ in color from the paste, suggesting that they represent crushed sherd temper. In other cases, these particles are exactly the same color as the remainder of the clay and appear to be a byproduct of the clay preparation rather than a deliberate tempering additive. All of the Tumco Buff sherds in the present collection had particles that were the same color as the surrounding fabric. Tumco Buff is usually described as having no visible mineral constituents to the fabric when observed under 10-15x magnification with a hand lens. Under 40x

magnification or in thin section, however, very small mineral grains or even an occasional large grain can be identified in some Tumco Buff sherds. Such grains were identified under high magnification in one Tumco Buff sherd from SDI-7074.

Some Colorado Desert collections contain pottery that defy normative typology because they contain diagnostic characteristics of more than one type. For example, some sherds contain crushed clay or pottery that typifies Tumco Buff (Waters 1982) but also contain similar quantities of mineral inclusions. This exemplifies the difficulty of applying a normative pottery typology. Waters (1982) offered no provisions for the identification of a pottery type with both of these fabric constituents, but the trait has been previously seen in pottery found closer to the Colorado River (Schaefer 1994a) and in some pottery from Anza-Borrego (Quinn and Burton 2009). This mixing of tempering materials was observed by Rogers (1936) among the contemporary Quechan potters whom he interviewed. In the SDI-7074 collection, sherds with both rounded quartz sand and some clay cubes (such as found in Tumco Buff) were classified as Salton Buff because the abundant rounded sand temper protruding through the surface was more diagnostic of that type.

One of the Tumco sherds, likely a plate or parching dish/tray, appears to belong to the Hedges variety of Tumco Buff. The Hedges Buff sherds are identical to the other Tumco Buff sherds in the range of rim types and surface treatment, but the angular bits of clay in the fabric differ in color from the paste. Sometimes the surface has a mottled appearance because of this variagated fabric color. Small exposures of smoothed sherd surface can also be observed on some of the temper particles, demonstrating that crushed sherds were deliberately added as temper. The Hedges Buff subset is generally attributed to the ethnohistoric period and believed to have been manufactured by the Colorado River groups because it dominates historic period contexts near the Colorado River (Hemphill 1993), although some variagated crushed sherd temper pottery may rarely be found in prehistoric sites.

Three sherds have stuccoed exteriors. Stuccoing is the application of a rough, often sandy, clay exterior coating after the paddle-and-anvil modelling but before firing. It was more often used on buff ware cooking pots than on brown ware and served to reduce thermal shock from use as cooking vessels. Tumco Buff may have been more vulnerable to thermal shock due to its lack of mineral temper.

Tumco Buff was originally considered by Waters (1982) to have been localized to the lower Colorado River around Yuma, but it was found in such high quantities at some sites on the western maximum and recessional shores of ancient Lake Cahuilla that it is now presumed to have been produced locally there as well (Schaefer 1994). The pottery from SDI-7074 likely derive from the shoreline of Lake Cahuilla, although if they are dated subsequent to Lake Cahuilla they may derive from the Colorado river or delta areas.

Salton Buff

Salton Buff is the second most common Lower Colorado River Buff Ware type in the collection, accounting for 6.4 percent of the assemblage ($n = 22$). This ceramic is unmistakable because of the abundant rounded-to-subrounded grains of quartz, feldspar, and other minerals. This tempering source derives from the shoreline of Lake Cahuilla. The grains almost always protrude through the surface, although in this collection they do not produce the rough exterior texture often seen in Salton Buff. As previously mentioned, a few sherds also contained blocky clay particles in addition to the minerals. One Salton Buff sherd is stuccoed.

Parker Buff

Five sherds of the Parker Buff type were recovered. Parker Buff is a Lower Colorado Buff Ware type with a fabric characterized by abundant medium to fine grained, usually poorly sorted, angular quartz and feldspar grains in a fine clay matrix. Amphibole grains may also occur in Parker Buff, but not in the present

collection's sherds. The inclusions usually appear to be intentionally added crushed rock temper. A diagnostic attribute of Parker Buff is that the surface is sufficiently wet-smoothed that none of the grains show through the surface (Waters 1982). The few sherds in this collection range in their amounts of angular temper from medium to abundant, with colors ranging from buff to gray. This type was typically manufactured on the Colorado River from Mohave Valley south to Palo Verde Valley. The type also extended south to Yuma, although it is very scarce in that area.

Colorado Buff

Only one sherd of Colorado Buff was found. It was distinguished by the absence or scarcity of mineral inclusions or temper and the very fine-grained clay fabric. The vessel walls were very evenly modelled, with fine, wet-smoothed surfaces. The higher firing and excellent clay preparation are apparent from the hard composition and clean fracture of sherds. This pottery type is found in greatest frequency at Late Patayan II and Patayan III phase sites postdating A.D. 1500. It is most frequent at ethnohistoric period sites. Quantities were found at the Elmore site, dating to around A.D. 1600-1700 (Laylander 1997b), but it is very rarely found at earlier Lake Cahuilla shoreline sites. It commonly occurs at ethnohistoric-period sites.

Salton Brown Ware

Salton Brown is the most common type at SDI-7074. It constitutes almost 70 percent of the assemblage ($n = 222$). It most commonly occurs at Lake Cahuilla shoreline sites or nearby sites on West Mesa (Schaefer 1994). Petrographic analysis and instrumental neutron activation analysis (INAA) strongly suggest that it derived from Imperial Formation clays above and to the west of Lake Cahuilla (Hildebrand et al. 2002). Its chemistry is intermediate between that of Lake Cahuilla and mountain clays, representing the contribution of upland mineral constituents that washed down and intermixed with clay minerals of the Salton Trough. As such, it is made from a sedimentary brown ware clay source. The ceramic is characterized by its brown color and abundant, poorly sorted, angular-to-subrounded quartz, feldspar and other mineral grains, including variable amounts of mica, although mica tends to be low in quantity. Previous petrographic study of sherds and clay sources have identified one especially important attribute that distinguishes it from Tizon Brown Ware from the Peninsular Ranges and Pacific coast: it lacks amphibole (hornblende), or that mineral only occurs in trace amounts (Gallucci 2001; Hildebrand et al. 2002). This dark black mineral is easily identified in hand specimens under 20x-40x magnification and was the basis for discriminating Salton Brown from Tizon Brown in this collection.

Tizon Brown Ware

Approximately 12 percent of the assemblage ($n = 50$) was identified as Tizon Brown Ware. This ceramic is made from residual clays in the Peninsular Ranges and coastal California. Generally, clay sources occur from the in situ breakdown of granitic rock. It is a generally coarse ware with high proportions of angular or subangular, poorly sorted mineral inclusions. Quartz, feldspar and variable amounts of biotite and/or muscovite mica typically occur as the major mineral components. Amphibole (hornblende) is an important mineral inclusion that distinguishes it from Salton Brown. It also tends to be more micaceous than Salton Brown. Ron May (1978) (working from Malcolm Rogers's initial type descriptions and type collections at the San Diego Museum of Man) attempted to identify five regional series and 14 types within Tizon Brown Ware of the Colorado Desert and Peninsular Ranges. (Salton Brown also was included.) Among these was Hakum Brown, which was described as centered in the area of the Jacumba and In-Ko-Pah Mountains, as well as the eastern Sierra Juárez and its foothills west of Laguna Salada in Baja California. May suggested that Hakum Brown was made by women of desert Kamia clans who married into Mountain Kumeyaay villages. It is described as being lighter than other Tizon Brown Ware types and having abundant subangular to rounded white quartz and feldspar sand grains with high amounts of muscovite mica and traces of biotite mica (but no mention of amphibole).

Only two highly micaceous brown ware sherds occur in the collection, one lacking amphibole and classified as Salton Brown and the other containing amphibole and thus classified generally as Tizon Brown. In this analysis, no differentiation of upland brown ware series or types was attempted, due to an apparent continuum of attribute characteristics between normative types. Perhaps in the future, the fabric groups developed by Quinn and Burton (2009) can be applied to the brown ware pottery.

Vessel Shapes and Functions

A total of 39 rim sherds were catalogued, from which vessel shapes and functions could be inferred to some degree (Table 1). Criteria for discriminating bowls, (wide-mouth) jars, and (narrow neck) ollas are discussed above. Some of the rim sherds represent multiple fragments from the same vessel. Rims from the same vessel were often found in proximity to one another and collected in the group. Additionally some rims that were collected at different localities could be assigned to a single vessel by profile and fabric. The entire range of rim shapes is shown in Figure 3. Jar sherds are most often recurved while about half the bowls rims are recurved. This supports a Patayan II-III dating for the occupation; straight bowl rims occur in all ceramic phases. By matching rims of the same vessel, some 20 different vessels could be discriminated. This provides a better measure of vessel shape variability within the assemblage and perhaps an estimated minimum number of vessels that are represented by the entire pottery assemblage.

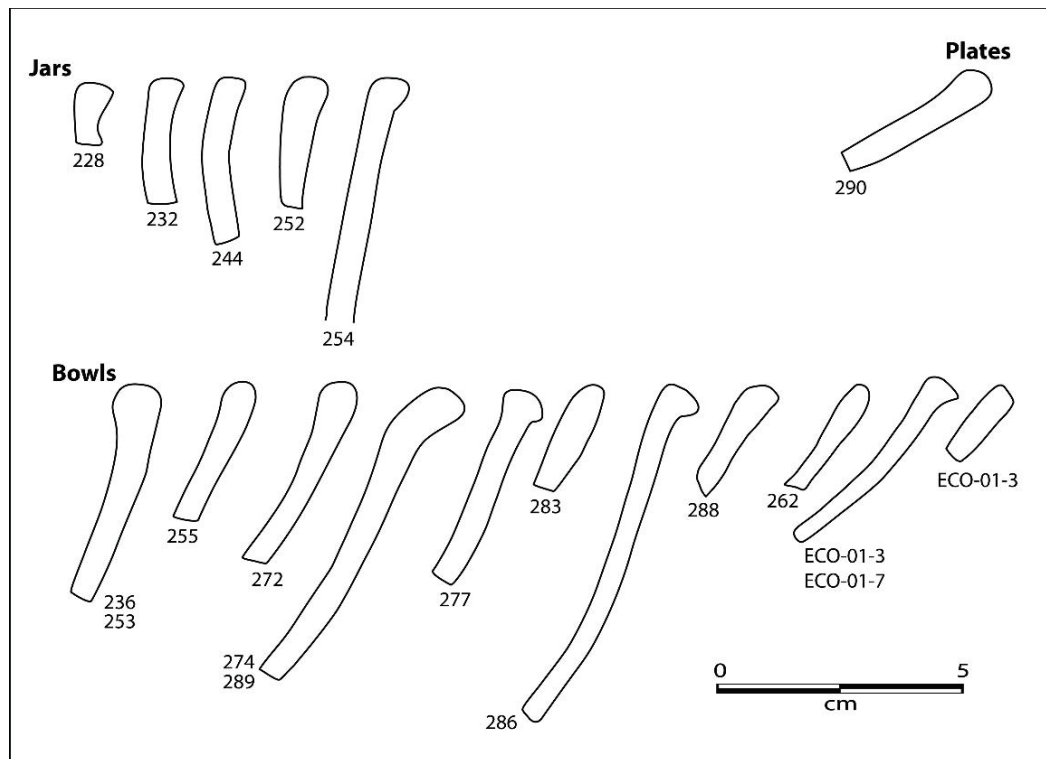


Figure 3. Range of rim sherd shapes from SDI-7074.

Using this aggregated total of rims as a sample (Table 1) and accounting for rims where inferred vessel shapes were ambiguous, it can be seen that from 60 to 65 percent of the vessels forms are wide-mouth bowls ($n = 12-13$), between 16 and 21 percent of the vessels are jars ($n = 3-4$), no more than 15 percent of vessels are flat plates or very shallow bowls ($n = 3$), and five percent are narrow-necked ollas ($n = 1$). These percentages suggests that the majority of pottery forms that are represented by broken vessels are bowls that were likely associated with food preparation and consumption. A much smaller number are larger jars that are likely associated with food preparation, storage, or transport. The distribution of vessel forms

among pottery types is expressed in Table 2. The sample is too small to make any conclusions other than that vessels that appear to be cooking pots based on their size and shape were made from brown ware. This is likely because the minerals in the fabric make them more resistant to thermal shock. While there were no sherds with sooted exteriors, an indication of use over a fire, seven buff ware sherds (Salton Buff and Tumco Buff) had stuccoed exteriors that imply preparation for thermal shock when used for cooking. The relative rarity of olla rim sherds may be partly a result of the fact that a small, narrow-necked vessel will produce fewer rim sherds than a wide-mouthed vessel. With this caveat, it appears that ollas that might be used for water storage are not well represented. Rims with larger diameters and thickness and very thick body sherds that might derive from large-size vessels were absent from the collection, as these type of bulk storage vessels were likely moved only short distances from residential bases or cache locations.

Surface Decoration

Only two Tumco Buff body sherds in the collection, from the same vessel, show any surface decoration. Each exhibits a single deeply incised line that appears to have been made horizontally across the exterior surface. The thick crème-colored scum coat that covers the entire exterior surface also fills the interior of the incision, indicating that it was incised prior to firing. As mentioned, the only other exterior surface treatment is stuccoing on several Tumco Buff sherds.

Table 2. Pottery Vessel Types Inferred from Available Rim Sherds

Cat. No.	Type	Rim Shape	Lip Shape *	Diameter (cm)	Shape	Comments
228	Tumco Buff	Recurved	10	--	Jar	--
232	Tizon Brown	Recurved	8	21	Bowl/Jar	--
236	Tumco Buff	Direct	8	23	Bowl	--
244	Tizon Brown	Recurved	10	5	Olla	narrow neck olla
252	Salton Brown	Recurved	10	17	Bowl	--
253	Tumco Buff	Direct	9	18	Bowl	--
254	Salton Brown	Recurved	10	22	Jar	3 mendable sherds
255	Salton Brown	Direct	3	12	Bowl	--
262	Salton Brown	Direct	3	12	Bowl	--
272	Tumco Buff	Direct	9	17	Bowl	scum coat both sides
274	Salton Brown	Recurved	4	20	Bowl	mend with 289
277	Tumco Buff	Recurved	10	25	Bowl	--
283	Tumco Buff	Direct	3	13	Bowl	--
286	Salton Brown	Recurved	10	12	Jar	possible cooking
287	Salton Brown	Direct	10	--	--	--
288	Salton Brown	Recurved	10	28	Bowl	--

Cat. No.	Type	Rim Shape	Lip Shape *	Diameter (cm)	Shape	Comments
289	Salton Brown	Recurved	4	20	Bowl	reinforced rim, unusual shape, possible cooking; mend with 289
290	Salton Brown	Direct	10	17	Bowl	sooted interior
3	Salton Brown	Direct	10	19	Bowl/Plate	rim sherds from 2 vessels
5	Salton Brown	Direct	10	19	Bowl/Plate	--

* Based on May 1976

Interpretation

The high occurrence of Salton Brown at SDI-7074 presents a dilemma for interpreting its geographical source, as the most abundant pottery type at any site is usually presumed to have been locally produced. Salton Brown Ware, however, has been proposed as being derived from Imperial Formation clays in sediments above the Lake Cahuilla shoreline on West Mesa and in the Yuha Desert (Hildebrand et al. 2002). It therefore needs to be considered whether pastes of similar mineralogy to those found around the western perimeter of the Salton Trough also occur in upland contexts.

To address this question, clay samples were collected for comparison from nearby site SDI-7060. Sand tempering material was collected from an adjacent wash downslope, and within view of SDI-7074. The clay occurs in readily visible outcrops. Unmodified clay and tempered clay test tiles were prepared from those samples and compared with the SDI-7074 pottery. We found that the clays and sands generally resembled the pottery in containing large quantities of angular to subangular quartz and other minerals, including muscovite mica, but lacking noticeable amounts of amphibole. This is not entirely surprising in that much of the hard mineral constituents of Imperial Formation clays derived from the same upland plutonics that are found in In-Ko-Pah Gorge and other granitic formations on the eastern side of the Peninsular Ranges.

Even higher proportions of brown ware pottery are reported for the Jacumba Valley at site SDI-7016, although a reassessment may be in order to determine what percentage of the brown ware may actually be desert-derived. The percentage of desert pottery may be larger than would be suggested by a simple ratio of brown to buff if that comparison were made without consideration of the desert origins of some of the brown ware. A case in point is IMP-5204, in Imperial Valley, at which Salton Brown occurs in high frequency relative to other lowland sites. The issue remains unsettled, therefore, until testing of pottery and clay sources can be done with optical petrography and chemical fingerprinting. These analyses will be needed to ascertain if the Salton Brown pottery at SDI-7074 derive from local or lowland clays, which may affect our interpretations of mobility patterns between upland and lowland. Perhaps the simple tabulation of buff ware and brown ware types can be used as a measure of mobility, but additional study is needed to support such an approach. Ethnohistoric information may support the existence of much more elevational mobility in the Jacumba/In-Ko-Pah area than at points further west, involving the transport of lowland pottery to this upland area in the course of seasonal transhumance and cultural exchange.

Sufficient amounts of Tumco Buff and Salton Buff were found at the site to make it plausible to infer that much of the Salton Brown also derived from the lowlands. Tizon Brown Ware, represented by only 11 percent of the assemblage and possibly derived from only two vessels, a bowl/jar and the single olla, was likely manufactured from residual clays to the west or south, or in other upland areas. The presence of Parker Buff is indicative of cultural exchange or visitation to the area by people from the lower Colorado River valley, perhaps from as far north as Blythe or beyond. The Parker Buff type is sometimes associated

with Mohave tribal affiliation, although this is likely a gross generalization. The Mohave and Quechan were allies and trading partners, so the pottery may have reached Jacumba by down-the-line cultural interaction. Mohave settlements extended south of their principal occupation area north of the Bill Williams River to the Palo Verde Valley for only a year or two after they and the Quechan expelled the Halchidhoma in 1825-1830 (Kroeber 1959). After that, presumably the Quechan were in residence in Palo Verde Valley.

As a whole, the assemblage suggests a substantial connection between Jacumba Valley and the lowlands of the Salton Trough during much of the Late Prehistoric period, including the stands of Lake Cahuilla and its recessional phases. This connection extended perhaps even as far east as the Colorado River. The single Colorado Buff sherd is the only ceramic evidence for a later phase of occupation contemporary with the A.D. 1600-1700 phase of Lake Cahuilla or postdating the final recession of Lake Cahuilla.

Flaked Lithic Artifacts

Archaeological recovery at SDI-7074 produced a total of 2,442 flaked stone artifacts from both surface and subsurface contexts. Flaked stone artifacts recovered from the site include 97 retouched flakes/scraping tools, 73 cores, 18 modified cobbles, 12 percussing tools, eight bifaces, seven utilized flakes, one projectile point, one graver, one drill, and 2,224 pieces of debitage. An unworked quartz crystal was also collected. A specific study of the lithic materials recovered from one of the deep features (FX-TRT-56) is included with that feature's description below. The following sections provide brief descriptions of the flaked stone artifacts.

In addition to typology, weight, and material, six additional attributes were recorded for each flake tool: blank type, completeness, size, orientation of retouch, type of modification, and flake type. Blank type identifies whether a flake tool was made on a primary, secondary, or interior flake, or made from an indeterminate blank. Completeness records the same variables taken for bifaces: complete, length missing, width missing, length/width missing, indeterminate. Size was measured with three variables: length, width, and thickness. Orientation of retouch defines whether the retouch was observed on the distal/proximal ends, lateral edges, or on multiple edges. Type of modification defines how the edge was modified, such as obverse, inverse, inverse-obverse, alternating, and bifacial retouch. Obverse retouch refers to unifacial retouch on the dorsal side of a flake, while inverse retouch is located on the ventral side. Inverse-obverse retouch refers to opposite lateral edges that are flaked on different faces.

Raw Materials

Locally occurring volcanic materials account for the majority of the flaked stone artifacts recovered from the site. Volcanic material comprises 41.8 percent ($n = 1,021$) of the entire assemblage. Volcanic materials account for 80.3 percent ($n = 174$) of the flaked stone tools and cores, and 38.1 percent ($n = 847$) of the debitage. The volcanic materials are typically varying shades of black, gray, brown, red, or green, and both porphyritic and nonporphyritic varieties. Quartz, also occurring locally, accounted for 44.3 percent ($n = 1,081$) of all flaked stone artifacts recovered from the site and 44.9 percent ($n = 999$) of the debitage assemblage. Regarding formed tools and cores, on the other hand, quartz accounts for 16.5 percent ($n = 36$) of the assemblage. Various types of jasper comprise 7.9 percent ($n = 199$) of the collection, accounting for 1.4 percent ($n = 3$) of the formal tools and cores and 8.7 percent ($n = 196$) of the debitage assemblage. Silicified wood accounts for 7.7 percent ($n = 195$) of the flaked stone artifacts, including 1.8 percent ($n = 4$) of the formed tools and 8.5 percent ($n = 191$) of the debitage. The remainder of the lithic assemblage consists of trace amounts of granite ($n = 2$), obsidian ($n = 1$), quartzite ($n = 7$), and sandstone ($n = 1$).

Bifaces

Ten bifaces were recovered from surface and subsurface contexts at SDI-7074 (Figure 4). The assemblage consists of four quartz, two volcanic, two jasper, and two silicified wood bifaces, all apparently representing

early-stage production. The silicified wood bifaces are end fragments of roughly equal size and shape, with maximum lengths of 4.1 and 4.3 cm. Both of the silicified wood bifaces were recovered from 0-10 cm below surface (cmbs) in CU 88, while the remaining bifaces were collected from the site surface.

One of the volcanic bifaces (DR-CAT-523) is complete. The biface retains a small amount of cortical material on one side. The other volcanic biface (DR-CAT-198) is derived from a bifacially flaked cobble. The biface contains limited amounts of cortex on both faces and a flat cortical surface on the edge opposite the single bifacially worked edge.

One quartz biface (DR-CAT-504) consists of the proximal end of a lanceolate-shaped biface. The biface displays non-invasive flake scars that do not extend to the centerline of the piece, with relatively thick and uneven edges. The lithic collection also includes a relatively large (16.7-x-10.6-x-5.6 cm) quartz biface (DR-CAT-647) with non-invasive, irregular flake scars. The complete biface is comprised of a relatively low-quality quartz material with extensive fracture planes. However, the edge of the artifact displays no macroscopic evidence of utilization. The second quartz biface is an end fragment (DR-CAT-530).



Figure 4. Biface tools and fragments.
(Top Row, Left to Right: DR-CAT-523, DR-CAT-826, DR-CAT-504, and DR-CAT-530;
Bottom Row, Left to Right: DR-CAT-527, E-CAT-163, DR-CAT-814, and E-CAT-283).

Projectile Points

The artifact assemblage from the site includes one quartz projectile point (DR-CAT-823) recovered from 0-10 cmbs in CU 72, associated with the excavation of Feature-65 (Figure 5). The artifact is nearly complete, measuring 3.4 x 2.1 x 6.0 cm, with a small fracture of unknown origin at the proximal end. The projectile point is roughly made with relatively thick, uneven edges, and a wide hafting element. Distinct

barbs flank both sides of the point above and below the hafting element. The artifact displays morphological characteristics similar to those associated with Elko projectile points. An Elko dart point would suggest that at least part of the assemblage dates to 2000 B.C. – A.D. 1100 (4000-900 B.P.).



Figure 5. Detail of Elko dart point (DR-CAT-823).

Cores

The SDI-7074 assemblage includes a total of 21 cores from the site surface, including 17 multidirectional cores, two bifacial cores, and two tested cobbles, as well as one multidirectional core from a subsurface context (Figure 6). CU 104, associated with the excavation of Feature-67, produced a multidirectional quartz core from 20-30 cmbs with a maximum linear dimension (MLD) of 10.1 cm. The multidirectional cores from the site surface include 11 volcanic cores and six quartz cores. The volcanic cores range from 13.8 to 7.0 cm in MLD, while the quartz cores range from 11.5 to 7.9 cm in MLD. One of the larger volcanic multidirectional cores (DR-CAT-923) contains an unused bifacial edge, with flakes removed from additional platforms progressing away from that edge to the center of the artifact. Both of the bifacial cores were made from volcanic material, and they have MLDs of 11.4 and 8.1 cm. The smaller bifacial core (DR-CAT-251) is discoid in shape with multiple bifacially flaked edges. The tested cobbles consist of cortical volcanic stones with two flake removals each, and MLDs of 8.3 and 10.0 cm. An additional 46 cores and seven tested cobbles were recovered during the monitoring phase. Forty-three of these are of volcanic materials, one is silicified wood, and two were made on quartz.



Figure 6. Sample of lithic cores from SDI-7074.
 (Top Row, Left to Right: DR-CAT-513 and DR-CAT-503;
 Bottom Row, Left to Right: DR-CAT-520, DR-CAT-923 and DR-CAT-251).

Modified Cobbles

Thirty-six modified cobbles were collected (Figure 7). These artifacts consist of 30 flaked cobbles and six battered cobbles. Materials include volcanic rock ($n = 28$), quartz ($n = 7$), and quartzite ($n = 1$). The modified cobbles retain at least some cortex. The negative flake scars on 13 volcanic cobbles and two quartz cobbles do not appear to represent core-type flake removals but rather shaping of the cobbles for possible utilization as tools. The flaked volcanic cobbles range in MLD from 12.8 to 7.6 cm, while the flaked quartz cobbles contain MLDs of 6.4 and 6.2 cm. A relatively small (8.4-x-6.2-x-3.2-cm) flaked volcanic cobble (DR-CAT-903) contains two negative flake scars, with a combination of stepped and scalar edge damage along an acute edge of the cobble produced by the larger of the two flake removals, possibly representing utilization of this edge. Another of the flaked volcanic cobbles (DR-CAT-914) displays discoloration and breakage patterns characteristic of fire-affected rock. The battered cobbles include two quartz cobbles with MLDs of 7.2 and 5.3 cm and a volcanic cobble with an MLD of 8.4 cm. A quartzite cobble (DR-CAT-899) with relatively extensive battering along the majority of its edge represents the only example of this material type recovered from the site. The cobble is nearly complete, consisting of two pieces that refit, and is 11.5 x 8.5 x 3.8 cm in size.



Figure 7. Sample of modified cobbles from SDI-7074.
 (Top Row, Left to Right: DR-CAT-519 and DR-CAT-914;
 Bottom Row, Left to Right: DR-CAT-522 and DR-CAT-911).

Percussing Tools

A total of nine percussing tools were collected from the site surface. These tools include six hammer stones and three choppers. The hammers have battering concentrated along one or multiple margins of the cobble. The one exception (DR-CAT-920) is a relatively elongated volcanic cobble (10.1 x 6.7 x 4.5 cm) roughly triangular in cross section, with extensive battering at two ends and along one edge. Three of the hammer stones are comprised of volcanic material, two of quartz, and one of granite. The hammers range in MLD from 10.1 to 6.9 cm. One of the quartz hammer stones (DR-CAT-194) displays only small amounts of battering along several edges and may be a manuport with merely natural edge damage. One of the choppers is a flaked quartz cobble, 8.0 x 7.2 x 4.1 cm in size, while the other two are flaked volcanic cobbles measuring 10.1 x 9.1 x 5.8 and 10.3 x 9.5 x 7.7 cm. Although the choppers in the assemblage are flaked cobbles, they are classified here as percussing tools based on their morphological characteristics, specifically thick bifacial edges with at least some battering damage along the bifacial edge. Figure 8 shows a sample of the percussing tools recovered from SDI-7074.



Figure 8. Sample of percussing tools from SDI-7074.
 (Top Row, Left to Right: DR-CAT-897, DR-CAT-248 and DR-CAT-524;
 Bottom Row, Left to Right: DR-CAT-194 and DR-CAT-920).

Retouched Flakes

Retouched flakes represent the most abundant flaked lithic tool type recovered from SDI-7074 ($n = 97$). A total of 54 retouched flakes were collected from the surface of the site, two bifacially retouched flakes were recovered through subsurface excavations, and 41 were collected during the monitoring effort. The retouched flakes include 63 scrapers, 24 denticulated retouched flakes, five bifacially retouched flakes, and five flakes displaying non-standard retouch.

Several of the scrapers from the site consist of relatively large, thick flakes, roughly dome-shaped, with obverse retouch forming steep-angled edges. Dome-shaped scrapers are typically phased artifacts: they begin as cores, and when a sufficient number of large flakes have been removed, the core is retouched along its margins to create a scraping edge. These domed-shaped scrapers generally have undercutting of their margins (from retouch) and parallel or overlapping unifacial flake scars; the resulting use-edge is steep-edged, and the tool has a domed appearance. Most of these tools have some cortex remaining on the dome portion (Figure 9). Utilizing naturally shaped cobbles that are close to the suitable shape and producing artifacts that required limited working suggests a strategy focused on investment-minimization as opposed to investing in more heavily refined tools that would be more efficient over a longer period of use.



Figure 9. Examples of domed-shaped scrapers from SDI-7074.

A total of 19 of the scrapers consist of retouched volcanic flakes with maximum lengths ranging from 11.8 to 4.9 cm (Figure 10). One of these volcanic flakes (DR-CAT-177) consists of an obversely retouched cortical flake with stepped edge damage along one lateral edge, possibly resulting from utilization. This retouched flake is complete and measures 11.8 x 6.3 x 2.8 cm. The 15 quartz scrapers range from 8.8 to 3.8 cm in maximum length, and typically consist of obversely retouched interior flakes. At least some of the identified retouch on one of the quartz scrapers (DR-CAT-521) may represent natural edge damage.

Nine of the denticulates represent obversely retouched volcanic flakes that range from 11.6 to 4.7 cm in maximum length. One cortical volcanic flake (DR-CAT-599) contains inverse denticulated retouch at its distal end. The flake is broken laterally and measures 11.0 x 7.4 x 3.5 cm. The final denticulate (DR-CAT-180) consists of a quartz interior flake with obverse retouch forming fine denticulation along its lateral edge. The flake is broken laterally and measures 4.7 x 3.8 x 1.5 cm.

The bifacially retouched flakes range from 4.7 to 7.0 cm in maximum length (Figure 11). Two of the bifacially retouched flakes were collected from CU 72, associated with the excavation of Feature-65. Denticulated retouch forms three distinct points on the lateral edge of one of the artifacts (DR-CAT-185), with step fractures associated with the central point. The flake is broken laterally and measures 7.5 x 2.9 x 2.3 cm.

All five of the non-standard retouched flakes are composed of quartz. One quartz interior flake (DR-CAT-179) contains non-standard retouch on its proximal end, with possible obverse retouch forming denticulation along one lateral edge. The flake is 8.9 x 4.3 x 3.0 cm in size, with a small portion of its distal end missing. Another non-standard retouched flake (DR-CAT-183) consists of a cortical quartz flake with obverse and inverse retouch along several margins. The flake is complete and measures 6.3 x 3.2 x 2.3 cm. At least some of the identified retouch on both of these flakes may represent natural edge damage.



Figure 10. Sample of retouched flakes from SDI-7074.
(Left to Right: DR-CAT-599, DR-CAT-177 and DR-CAT-180).



Figure 11. Sample of bifacially retouched flakes from SDI-7074.
(Top Row, Left to Right: DR-CAT-185 and DR-CAT-197;
Bottom Row, Left to Right: DR-CAT-183 and DR-CAT-902).



Figure 12. Detail of possible graver (M-CAT-465).

Drill and Graver

Three artifacts recovered from SDI-7074 are drills and/or graving tools. The first, a graver/perforator (DR-CAT-902) is roughly pyramidal in shape, with retouch along its entire distal end and along one lateral edge, forming a distinct point. The flake is complete, volcanic, contains some cortex, and measures 7.9 x 7.1 x 4.0 cm. A second possible graver (M-CAT-465, Figure 12, above) was made from a primary volcanic flake and measures 74 x 54 x 21 mm. A lateral edge of the flake was modified with two contiguous notches to form a spur or graver. M-CAT-464 is a possible drill made on an interior volcanic flake (Figure 13). It measures 86 x 48 x 30 mm. The flake's margins were retouched to produce an elongated tip that morphologically resembles a drill.

Utilized Flakes

Eleven utilized flakes were recovered from the site surface, including five utilized quartz flakes and six utilized volcanic flakes (Figure 14). Two interior quartz flakes display scalar edge damage, while one piece of quartz debitage has stepped edge damage. One of the interior quartz flakes (DR-CAT-371) has a cortical platform, with scalar edge damage along one entire lateral edge and part of its distal end. The flake is broken laterally and measures 4.9 x 2.2 x 1.4 cm. The other interior quartz flake (DR-CAT-254) contains scalar edge damage on its distal end and along portions of both lateral edges. The flake measures 3.8 x 2.7 x 1.2 cm and appears complete, although its proximal end may be missing.



Figure 13. Detail of possible drill (M-CAT-464).



Figure 14. Utilized flakes recovered from SDI-7074.
(Top Row, Left to Right: DR-CAT-733, DR-CAT-469, and DR-CAT-566;
Bottom Row, Left to Right: DR-CAT-735, DR-CAT-371, DR-CAT-254, DR-CAT-63).

A primary quartz flake from Concentration 5 displays scalar edge damage at its distal end. The flake is nearly complete, with a portion of its cortical platform missing, and is 7.4 x 5.2 x 2.6 cm in size. An obverse flake scar at the proximal end of the artifact may represent intentional retouch.

The debitage artifact with stepped edge damage (DR-CAT-63) is 3.8 x 2.9 x 0.7 cm in size, with utilization damage present on one end. What appears to be the ventral side of the artifact is relatively concave, with no clear indication of a platform or other orienting flake features, and the piece may represent a utilized piece of shatter.

A volcanic interior flake with a cortical platform (DR-CAT-469) displays relatively extensive battering edge damage at its distal end. The flake is nearly complete, measuring 8.5 x 5.0 x 1.9 cm. A large negative flake scar on the distal end of the artifact opposite the utilized edge may represent intentional retouch of the flake or may have resulted from use.

Finally, a relatively thick (5.0-x-2.8-x-2.6-cm) volcanic flake fragment from Concentration 14 contains battering edge damage along its entire intact margin. The dorsal side of the flake associated with the battering edge damage displays non-patterned retouch that may or may not be intentional.

Debitage

A total of 2,224 pieces of debitage were analyzed from SDI-7074 (Figures 15 and 16). The majority of the debitage consists of interior flakes, accounting for 56.1 percent (n = 1,249) of the assemblage, with cortical elements and shatter comprising the remaining 43.8 percent (n = 975). Among the quartz debitage, interior flakes comprise 48.9 percent (n = 486), cortical flakes account for 18.1 percent (n = 180), and 33.0 percent (n = 327) represented by shatter. The relatively high percentage of quartz shatter potentially is explained by the fracture characteristics of that material type and its availability within the site's boundary. The volcanic debitage from the site consists of 53.4 percent interior flakes (n = 447), 33.7 percent (n = 282) cortical flakes, and only 12.7 percent (n = 107) shatter. Chert and silicified wood debitage from the site is almost entirely composed of interior flakes. Interior flakes account for 86.2 percent (n = 169) of the chert debitage and 74.3 percent (n = 142) of the silicified wood debitage. These percentages suggest that while late-stage reduction may have occurred more frequently at the site with regard to some of the lithic raw materials (e.g., chert and silicified wood), all stages of lithic reduction appear to be represented, particularly in regard to locally occurring volcanic and quartz materials.

The single unmodified quartz crystal may have been brought to the site, or it may be a noncultural remnant from one of the numerous quartz veins in the area. Crystals like quartz have been associated with shamanic practices in Yuman groups, and among the Kumeyaay these stones are called *wii'iiipat* or "live rock" (Levi 1978). Traditionally *wii'iiipat* is quartz (Hohenthal 1950: 10), and a number of quartz crystals (*ipát*) were identified in possible ceremonial contexts nearby at SDI-7060 (Williams 2013b).

Protein Residue Study

Forty-nine lithic tools were submitted to Paleo Research Institute and the Laboratory of Archaeological Sciences at California State University, Bakersfield for immunological analysis. The process for extracting protein residue is discussed in Appendix F. Residues were tested against a suite of plant and animal antisera. Four of the tools returned positive results: two hammer stones (SRPL-CAT-48 and E-CAT-114), a modified cobble (E-CAT 168) and a retouched flake (DR-CAT-195).



Figure 15. Lithic material type examples.

Top Row: porphyritic volcanic (DR-CAT-141), nonporphyritic volcanic (DR-CAT-128), volcanic (DR-CAT-849), silicified wood (DR-CAT-594). Middle Row: jasper agate (DR-CAT-891, DR-CAT-29, DR-CAT-25), jasper (DR-CAT-48, DR-CAT-55). Bottom Row: clear quartz (DR-CAT-260), milky quartz (DR-CAT-627).



Figure 16. Additional lithic material types Left: the site's only example of quartzite (DR-CAT-12). Center and right: the yellow-red transition of the jasper agate (DR-CAT-889 x2 and DR-CAT-807) revealing the shared source material.

One volcanic hammer stone (SRPL-CAT-48) tested positive to deer antiserum, indicating it may have been used to process remains from a member of the Cervidae family, likely local mule deer (*Odocoileus hemionus*) (Figure 17). Typically, deer meat was cooked and/or dried for future use, and bones were boiled to extract marrow or pounded into a powder. The percussion tool type and ethnographic testimony suggest that deer bone may have been processed after boiling. Thermal features possibly constructed for the purpose of parboiling/boiling were identified in the area as well. This percussion tool was slightly buried next to a large, flat outcrop that appeared to have a pecked surface (Figure 18). The tool and outcrop were next to a large series of thermal features that were avoided by that project.

One porphyritic volcanic hammer stone (E-CAT-114; Figure 19) and a porphyritic volcanic modified cobble scraper (E-CAT-168; Figure 20) both tested positive to yucca antiserum, indicating that they were used to process plant material from a member of the Agavaceae family. The most widely used members of the Agavaceae family in this area were desert agave (*Agave deserti*) and Mojave yucca (*Yucca schidigera*). E-CAT-114 is a percussion tool, and E-CAT-168 is a scraper-type tool, indicating that two processing techniques-crushing and cutting/scraping-were done to prepare the yucca species. Ethnographic documentation confirms the use of such tools to process desert agave, which was cut, baked, and pounded to produce rope fibers, rather than the Mojave yucca, which was used predominately for fuel, though the flowers were eaten. E-CAT-114 was found on a small hill above Feature 41. E-CAT-168 was recovered on a similar hill above Feature 17. Three interior flakes of the same material (DR-CAT-402, -417, and -764) as well as a hammer stone (DR-CAT-248) were identified in the immediate vicinity, indicating that the tool was perhaps re-sharpened prior to use, which also implies that the tool may have been created elsewhere and brought to this location.

The final tool with a confirmed protein residue, a retouched nonporphyritic volcanic flake (DR-CAT-195; Figure 21), returned positive results for sheep antiserum. This indicates some processing, specifically cutting or scraping, occurred at SDI-7074. The species represented is likely bighorn sheep (*Ovis canadensis*), a known food source for peoples of this region. Bighorn sheep were prepared and consumed in ways similar to those for mule deer.



Figure 17. Detail of the volcanic hammer stone that tested positive for deer antiserum.



Figure 18. Outcrop with possible pecked surface, adjacent to hammer stone SRPL-CAT-48.



Figure 19. Porphyritic volcanic hammer stone (E-CAT-114) tested positive for yucca antiserum.



Figure 20. Porphyritic volcanic modified cobble scraper (E-CAT-168) tested positive for yucca antiserum.



Figure 21. Retouched nonporphyritic volcanic flake (DR-CAT-195) tested positive for sheep antiserum.

Ground Stone Artifacts

Sixty-four ground stone implements, including fragments many of which refit, were recovered. Ten of the ground stone tools were identified within subsurface features: Feature-16, -20, -41, -55, -62, ECO-FX-J, FX-KC-08, FX-KM-113, FX-KM-137 and FX-KM-138. Eighteen of these are hand stones, two of which show unifacial wear patterns, 13 with bifacial facets, one multi-facial, and two indeterminate fragments. The two unifacial hand stones were made from granitic and local volcanic materials. Nine of the bifacial hand stones were made from granitic rock, two from quartzite, and one each from quartz and volcanic rock. The single multi-facial hand stone is granitic and shows shouldering on all sides. Four of these hand stones are whole tools, and none of the hand stones were found in direct association with thermal features. An indeterminate ground stone fragment was also recovered.

The remaining 46 ground stone artifacts are either whole or fragmentary milling slabs: 17 are basalt, two are sandstone, and the remaining 27 are granitic. Twenty-one of the granitic milling slabs show only unifacial wear patterns, and 15 are whole or nearly complete. The single bifacial granitic milling slab was nearly complete. All 17 of the basalt milling slabs were unifacial, and none were whole. Two of the granitic fragments refit, and nine of the basalt fragments refit into three tools. Nineteen of the milling slabs (after refitting) showed slick-surface characteristics, while three were slightly basined and 17 were not complete enough to determine the intended use.

The 18 hand stones exhibited predominantly flat surfaces ($n = 14$) to convex facets ($n = 4$). Experimental and ethnographic research in San Diego County and in the broader Southwest region has shown that flat surfaces work well for grinding wet and oily seeds or other materials (Adams 1999:485-486; Spier 1923:335). By comparison, basin forms are good general-purpose surfaces that can be used to grind fresh seeds but work best when preparing hard and dry seeds and for making fine flour, especially in windy areas. The predominance of flat milling surfaces on the portable ground stone implements suggests that the people in this area collected and processed seeds or plants while they were fresh or moist (green) (Adams 1999).

Ground stone implements were recovered from either within or immediately adjacent to 10 excavated thermal features: Feature-16, Feature-20, Feature-41, Feature-55, Feature-62, ECO-FX-J, FX-KC-08, FX-KM-113, FX-KM-137, and FX-KM-138. All ground stone examples from these features were milling slabs, had evidence of being fire-affected, and had been incorporated into the features' structures. In six cases, only a single ground stone fragment was recovered from within the features. Two of the features contained multiple ground fragments that refit: five from Feature-16 and four from FX-KM-138. Features FX-KC-08, FX-KM-113, and FX-KM-137 contained two milling slab fragments each that could not be refit. The refit ground stone fragments from both features are of tabular pieces of basalt. Basalt does not absorb and store heat as well as granite so it is possible the refit pieces represent a single item that was broken during firing or cooking. The practice of artifact recycling suggests that the original ground stone artifacts had been discarded either after use or because they were broken and then were scavenged with other local stone material to construct the thermal features. Not enough of the features (7 percent) contained evidence of ground stone artifact recycling to suggest this was a common practice. One feature, FX-KM-113, had a calibrated two-sigma radiocarbon date range between 7560 and 7380 B.C., indicating the practice of recycling milling slabs for other purposes had a long history at SDI-7074, although it was a relatively rare occurrence.

Protein Residue Study

Protein residue analysis was conducted on seven ground stone implements, and three returned positive results. A basalt milling slab fragment (DR-CAT-317; Figure 22) that was part of a five-piece refit at Feature-16 matched *Suidae* (swine) antiserum, while a granitic bifacial hand stone (E-CAT-125; Figure 23) and a sandstone milling slab fragment (DR-CAT-323; Figure 24) had oak protein residues. The bifacial hand stone was found next to Feature 40, a possible earth oven, and the sandstone milling slab fragment

was recovered adjacent to ECO-FX-AC, a semi-intact hearth remnant, discussed below. Sandstone does not occur naturally in this area and may have come from the ancient Lake Cahuilla shoreline or from the Brawley Formation (e.g., in the Superstition Hills) to the northeast of the Jacumba Valley.



Figure 22. Basalt milling slab (DR-CAT-317) tested positive for *Suidae* antiserum.



Figure 23. Granitic bifacial hand stone (E-CAT-125) tested positive for oak antiserum.



Figure 24. Sandstone milling slab (DR-CAT-323) tested positive for oak antiserum.

The Suidae family (swine) match for the residue on the basalt milling slab is difficult to interpret. The five ground stone pieces were grouped into two areas roughly 20 m apart and near the surface, so they were evidently not at their initial depositional locations. The Suidae residue is probably from modern feral pig, as there are no native Suidae species recorded in the region. The positive protein results are either an indication of ethnohistoric processing of the animal, which fits within the date ranges found at this location, or are the product of site contamination.

FAUNAL REMAINS

A total of seven faunal remains were recovered, five are from vertebrate species and two are invertebrate remains. Three burnt vertebrate bones were identified on the surface. Two were indeterminate large mammal long bone fragments, and the third is non-mammal, identified as possibly shell from a member of the Testudinidae (turtle/tortoise) family. A small, worked bone fragment (DR-CAT-56; Figure 25) was recovered from Feature-25, a circular oven feature, and the diaphysis portion of an avian long bone was collected from Feature-62, an oblong oven feature. A number of unburnt small animal bones (rat and lizard) were also identified within a few of the thermal features, indicating that bioturbation occurred throughout SDI-7074.



Figure 25. Detail of worked bone fragment from Feature-25.

Remains from two invertebrate species were also collected from SDI-7074: an *Olivella* sp. barrel bead (E-CAT-148) collected on the surface in a small drainage, and an *Argopecten* sp. (DR-CAT-301) shell recovered from the 0 – 10 cmbs level of Unit 30 (Feature-44) (Figure 26).

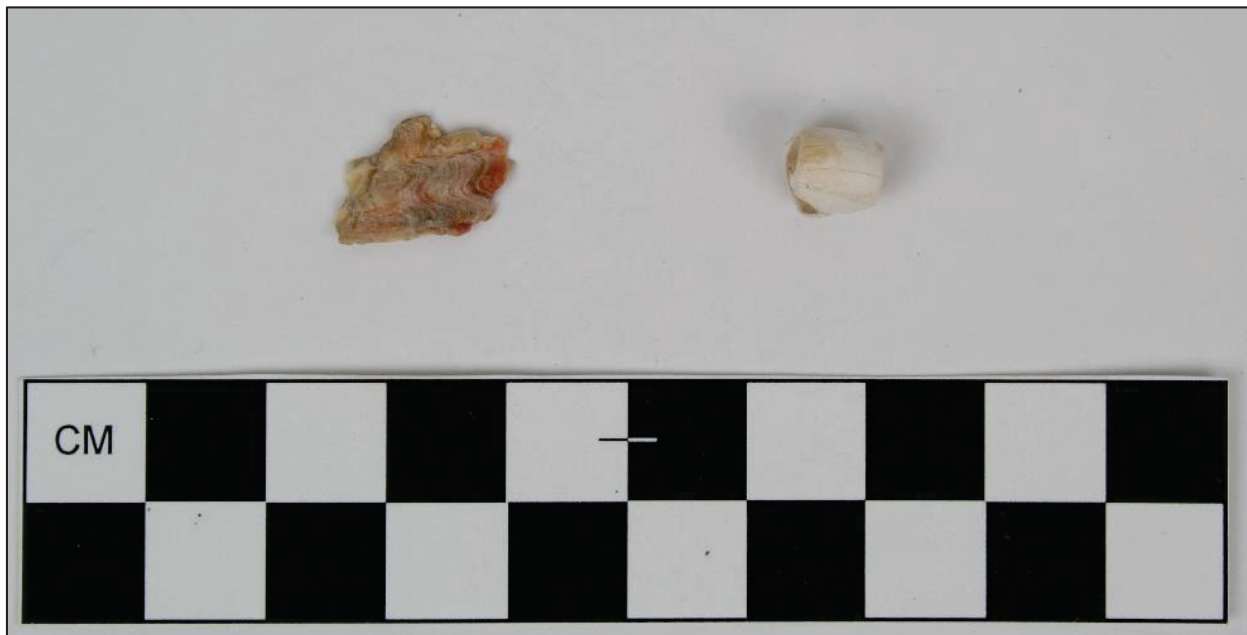


Figure 26. *Argopecten* sp. (DR-CAT-301) shell and *Olivella* sp. barrel bead (E-CAT-148).

THERMAL FEATURE ANALYSIS

Many local ethnographic accounts describe the creation of thermal features (e.g., Balls 1970; Bean and Saubel 1972; Chase 1919, Hedges 1986; Hohenthal 2001; Wilken 2012). While these thermal features have been identified for use in boiling, baking or direct-firing (e.g., Bean and Saubel 1972; Shackley 1984), functional distinctions are not easily made on the basis of archaeological evidence. Hearths and direct-fire applications are generally smaller and shallower than earth oven remains, and it is the type of heat transfer (open-air fire versus closed oven) that is important to differentiate and difficult to identify in the archaeological record. Size is not the only defining factor, as small earth ovens were constructed for cooking smaller items such as rabbits (True and True 1992). Additionally, hearths are typically prominent features within house pits and platforms that create deposits similar to earth ovens over time, through reuse. To aid in the distinction between the feature types in the current study a set of expectations was established. Hearths were typically defined by size, being considered smaller and more discrete than earth ovens, and their use was presumed to be for warmth, light, direct open-air cooking, or for heating vessels used to boil or cook rather than to bake.

The ethnographic accounts mention a variety of flora and fauna that may have been cooked in earth ovens. Plant foods are predominant, especially those, such as yucca, agave, and lily bulbs, that require hydrolysis to extract their maximum nutritional content (Thoms 1989; Wandsnider 1997). High-lipid and collagen-rich meat that requires hydrolysis was also known to have been baked in earth ovens (Wandsnider 1997). Faunal bone is more durable and more often preserved than cooked plant material, making it easier to identify features used for processing meat. The easiest plant material to identify archaeologically is seeds, as these preserve well when charred and occur more often as incidental waste in features (Eerkens and Rosenthal 2002). However, seed finds can also be easily misinterpreted: Greenhouse and colleagues (1981) conducted monitoring of active cholla bud ovens for two consecutive years and noticed that within a single year significant seed intrusion had occurred at the features. Intrusive seeds become stained when deposited in burnt, ashy soil, taking on the appearance of charring. Plant food remains other than seeds tend to preserve only when in charred form, which presumably represents routine wastage from cooking mishaps (Thoms 2008:452). Consequently, chemical tests on starch grains and phytoliths become extremely important for identifying target geophyte species (Thoms 2008:452). However, local geophytes generally produce calcium oxalate phytoliths that are easily degraded and destroyed, rather than opal or glass phytoliths that are more resistant to weathering.

Another plant product that is known ethnographically to be exploited throughout the Holocene in this region is pine nuts, which are high in polyunsaturated fat content (Bettinger 1977; Campbell 1999; Farris 1993; Gamble and Mattingly 2012; Hildebrandt and Ruby 2006). The methods used in roasting pine cones are not well understood. Several ethnographic sources describe the collection of pine nuts both near the San Diego coast and in the eastern Peninsular Ranges, mentioning that cones needed to be roasted first to collect the seeds (Shipek 1991:94; Wilken 2012:106). In central and northern California ethnographic accounts report that cones were piled in a clearing, covered with needles and ignited (Farris 1982). These accounts contain no mention of a rock-lined thermal features; the archaeological remains would consist of a thin burn layer that may potentially carry charred cone or seed remains. Gamble and Mattingly (2012) assert that earth ovens excavated at Torrey Pines State Natural Reserve were constructed for roasting pine nuts. However, that interpretation is based on the current distribution of Torrey pine trees and not direct evidence of pine nut cooking. The Torrey Pines State Natural Reserve thermal features also contain intact levels of fuel; if ethnographic accounts are accurate, the pine cones were burnt directly, negating any need for additional fuel sources.

Studies of thermal features have shown that earth ovens, steaming pits, and stone-boiling pits are unlikely to exhibit differences in archaeological deposits (Thoms 2008:454). Differences in earth oven morphology have not been definitively shown to correspond with specific plant species processed, and up to five

morphological variations have been identified together at a given site (Bettinger 1977:84-85; Crabtree et al. 1963; Eerkens and Rosenthal 2002; Eerkens et al. 2009; Hammond 1974:77-78; Meighan 1959; O'Brien 1974:67-68; Robarchek 1974:99-100; Wilke 1974:53-59). For example, Eerkens and Rosenthal (2002) examined 124 earth ovens from two locations in the northern Mojave Desert at China Lake Naval Air Weapons Station, in Indian Wells Valley and the adjacent Coso Range. Based on shape, size, context, and content, four different feature categories were distinguished: circular and oblong pit features, with rock floors (mosaics) and with only rock rings. Closer to the current study area, Meighan (1959) looked at 39 earth ovens in the Anza Borrego Desert and also identified both ring and cluster (mosaic) earth ovens. Most of the studies in the Jacumba/In-Ko-Pah area have shown similar results (e.g., May 1980; Shackley 1984). In general, all the previous studies reviewed for this analysis followed closely the four categories established by Eerkens and Rosenthal (2002) with an additional amorphous form identified by Thoms (1989:328-337). Amorphous features, as defined by Thoms (1989), are typically large, dense scatters of fire-affected rock that do not appear to have been excavated into a basin-shaped pit, but instead are rather flat in profile. Several features of this amorphous style have been identified on the San Diego coast at Torrey Pines State Natural Reserve (Gamble and Mattingly 2012:266). All styles of thermal feature in the region range in size anywhere from 0.5 to 4.0 m in diameter or along one axis. Where rock types were noted, granitic rock was predominant; however, locally available quartz, basalt, quartzite, volcanic, or sandstone were used either solely or to supplement the granitic materials. While the broad categories capture the basic structural differences between the features, ethnographic accounts suggest subtler variations may be due to family or lineage traditions (Bean and Saubel 1972; Shackley 1984).

The majority of archaeological studies have also shown that earth oven sites are geographically remote from habitation locations, occurring in the stands of assumed target species (Eerkens et al. 2009; May 1980; Shackley 1984; True 1981; Thoms 1989; Underwood and Baksh 2012). Conservation of fuel around habitation locations and the reduction of weight for transported food products are the presumed causes of this distribution (Thoms 1989). Additionally, pit features were excavated into sandy soils (e.g., creek beds, washes, and alluvial fans) that did not make suitable landforms for establishing habitation bases (Castetter et al. 1938; Eerkens and Rosenthal 2002; May 1980; Meighan 1959; Shackley 1984).

Evidence of reuse is fairly sparse in previous studies of earth oven features. Indications such as multiple floors or multiple charcoal lenses are rare, if they have been identified at all (Laylander 2014). Radiocarbon evidence, similarly, is inherently too imprecise to establish multiple uses within time spans of decades. The efficiency gains from creating new features in extremely close proximity to sources of harvested resources or fuel would quickly have been offset by the costs of collecting and transporting rocks and constructing the features (Schaefer et al. 2014). Moreover, working in soils already loosened by previous excavation would have saved energy. The lack of evidence for reuse may indicate that there existed some practical drawbacks to reusing features, such as pest infestations in the features after their use, though no specific basis or evidence for such a factor has been identified (Laylander 2014). Ethnographic evidence from the region points to a widespread pattern of avoiding the objects and places that were associated with other persons, especially the recently deceased (Laylander 2014). While the archaeological evidence of redundancy indicates that the same practice of avoidance occurred prehistorically, it was not an absolute prohibition (Hedges 1986:13; Lee 1928:13; Michelson 1977; True and True 1992).

Very few earth ovens are associated with diverse artifact assemblages. The ethnographic accounts suggest this is because the predominant tool type used for the excavation of pits and for harvesting geophytes were made from perishable local hardwood varieties (Bean and Saubel 1972; Chase 1919; Shackley 1984). The surviving toolkits associated with these types of features are typically limited to percussion and scraping tools, anvils, milling slabs, and pottery (Shackley 1984). A study of 255 thermal features at Torrey Pines State Natural Reserve showed little association with middens or sites containing numerous artifacts and faunal remains. The observed artifact assemblages were lightly used ground stone artifacts, most of which were burned, and chipped stone, predominantly pieces of debitage. No projectile points were found in

association with any of the features, and flaked tools were rare or nonexistent (Gamble and Mattingly 2012:266). The relationship between artifact assemblages and thermal features supports the theory that items cooked in earth ovens were frequently collected and processed away from habitation sites (Eerkens and Rosenthal 2002:30).

The creation of house pits has been documented ethnographically throughout the region. Semi-subterranean floors may be misinterpreted as oven features (Bean and Shipek 1978:550; Curtis 1926:42; DuBois 1908:184-185; Luomala 1978:592). Regional archaeological studies for hearths created for use in house pits have also shown a similar morphology to earth ovens (May 1975; Minor 1975; Oxendine 1981; Taylor and Carrico 1982; Van Wormer and Carrico 1993). Excavations within house pits have shown that the reuse of a central hearth feature creates a dense, tightly packed lens of fire-affected rock (Van Wormer and Carrico 1993). The telltale distinction between house pit and earth oven deposits is the accumulation of a diverse artifact assemblage within the fire-affected rock lens of the house pits. The accumulated midden within a house pit contains artifacts and refuse associated with habitation (e.g. domestic chores and food preparation, see Van Wormer and Carrico 1993) such as formalized tools, faunal remains and ornamentation. Like earth ovens, house pits have variations that ethnographically are attributed to individual or tribal identification as well as location and the availability of materials (Lee 1928:100-105; Michelson 1977:21). Most of the house pit excavations have been associated with Late Prehistoric assemblages. At least one house pit excavated by Rogers (1920) at SDM-W-119 (SDI-6134/13008) was associated with an earlier period. Rogers (1920) noted that stones from the house pit were used to encase an inhumation found in association. The makeup of the artifact assemblage from his excavation was similar to that found in the Late Prehistoric cases, in that the burnt cobbles of the house pit floor were intermixed with diverse habitation debris.

Not all excavated house pits have developed midden and diverse artifact types, however. A number of house pits associated with Lake Cahuilla fish camps contain only sparse artifact associations (Schaefer et al. 2010; Wilke 1978). These less diverse artifact assemblages still contain an assortment of faunal remains, indicating that the defining characteristic for house pits is variety in the consumed animal products rather than the presence of multiple tool stone groups.

Approximately 630 locations that represent some form of thermal deposit were identified at SDI-7074. The majority of these locations were patches of burnt/discolored soil, isolated fire-affected rocks, or secondary deposits created either by construction activity or natural hydrological processes. One hundred and thirty of these 630 locations revealed at least some degree of intact subsurface deposit, and those findings are discussed in this section (Figures 27 through 32). Table 3 summarizes the results for the 130 features identified with at least slightly intact deposits.

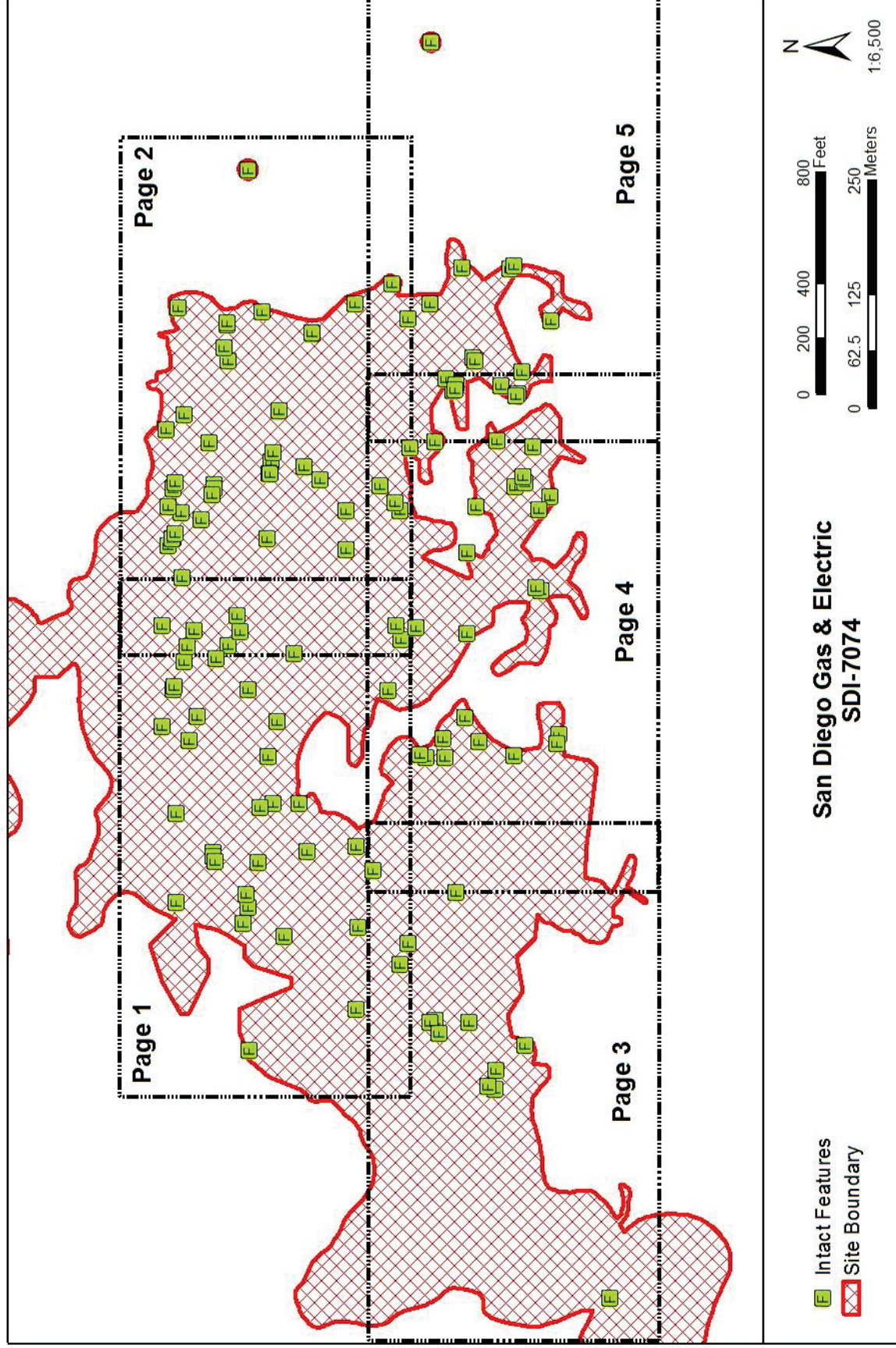
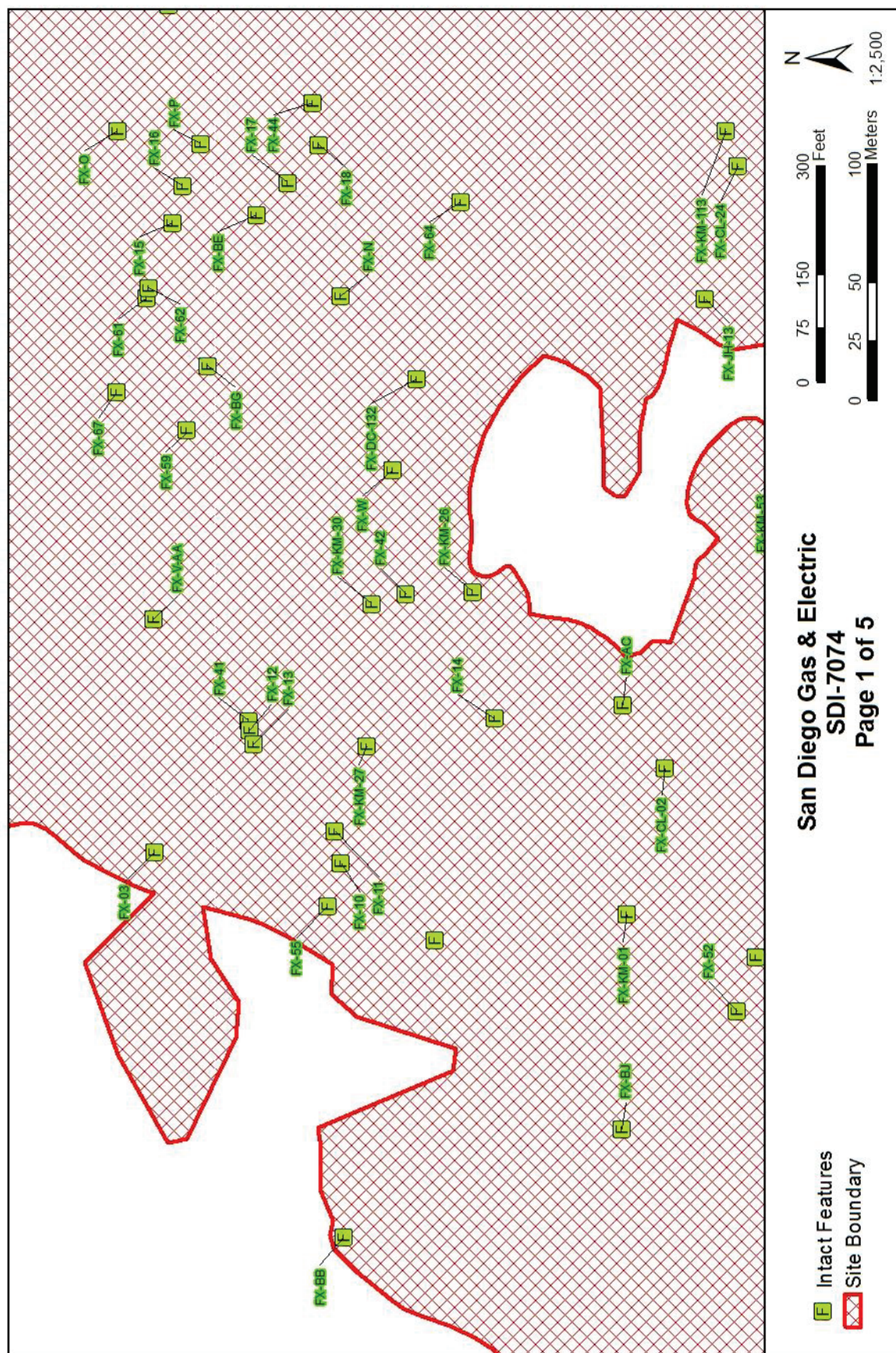
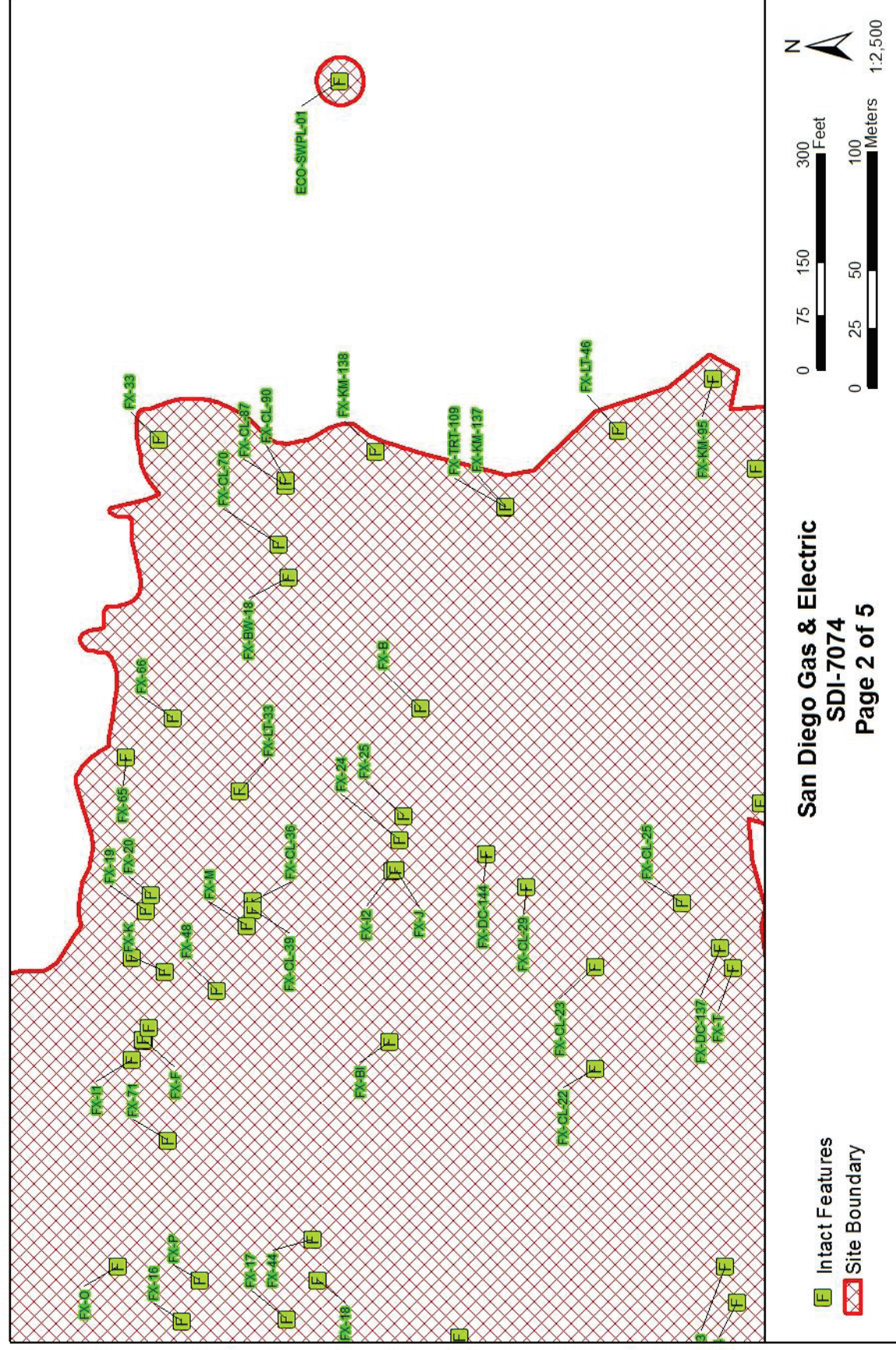


Figure 27. Overview map of intact thermal features recorded at SDI-7074.





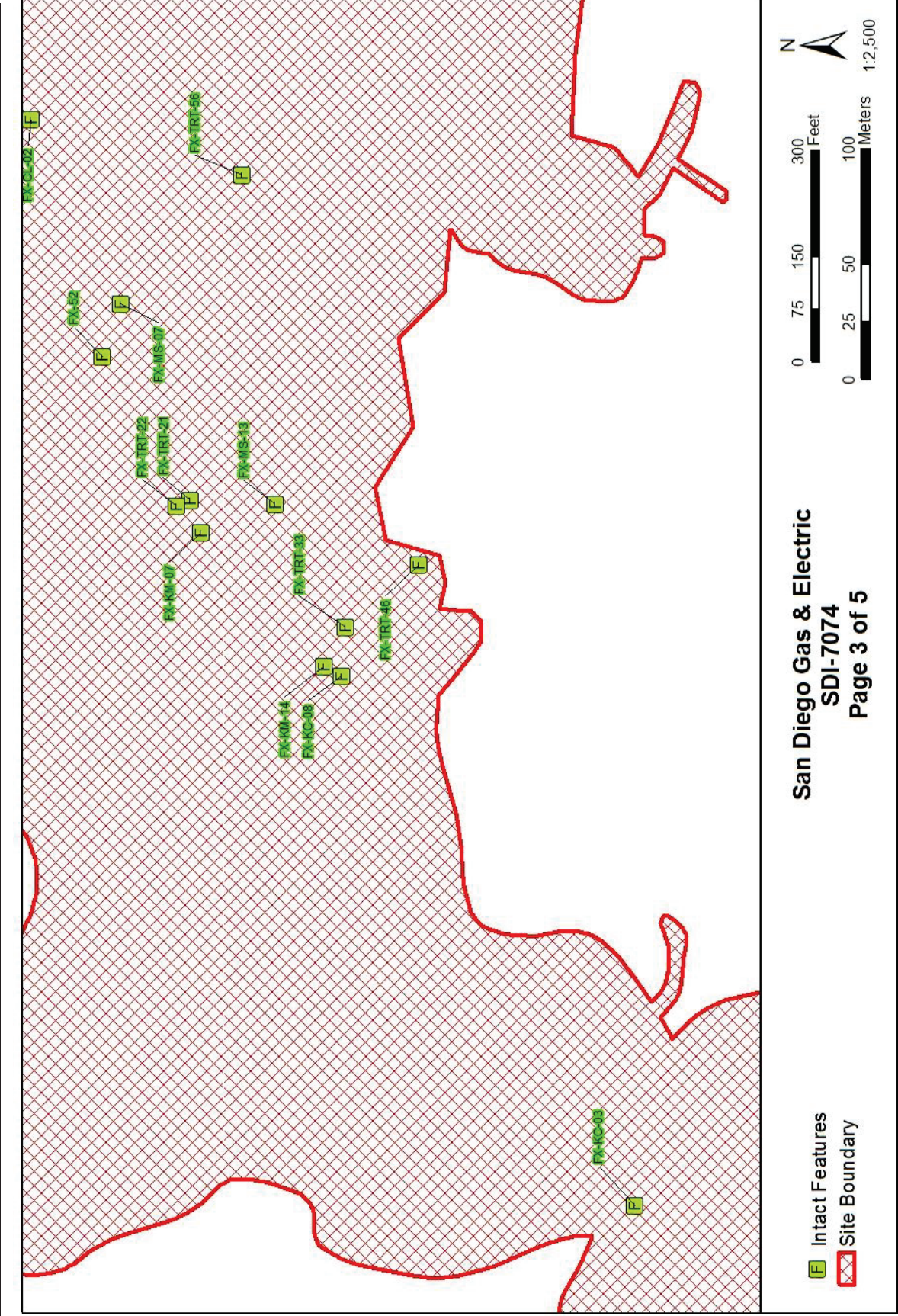
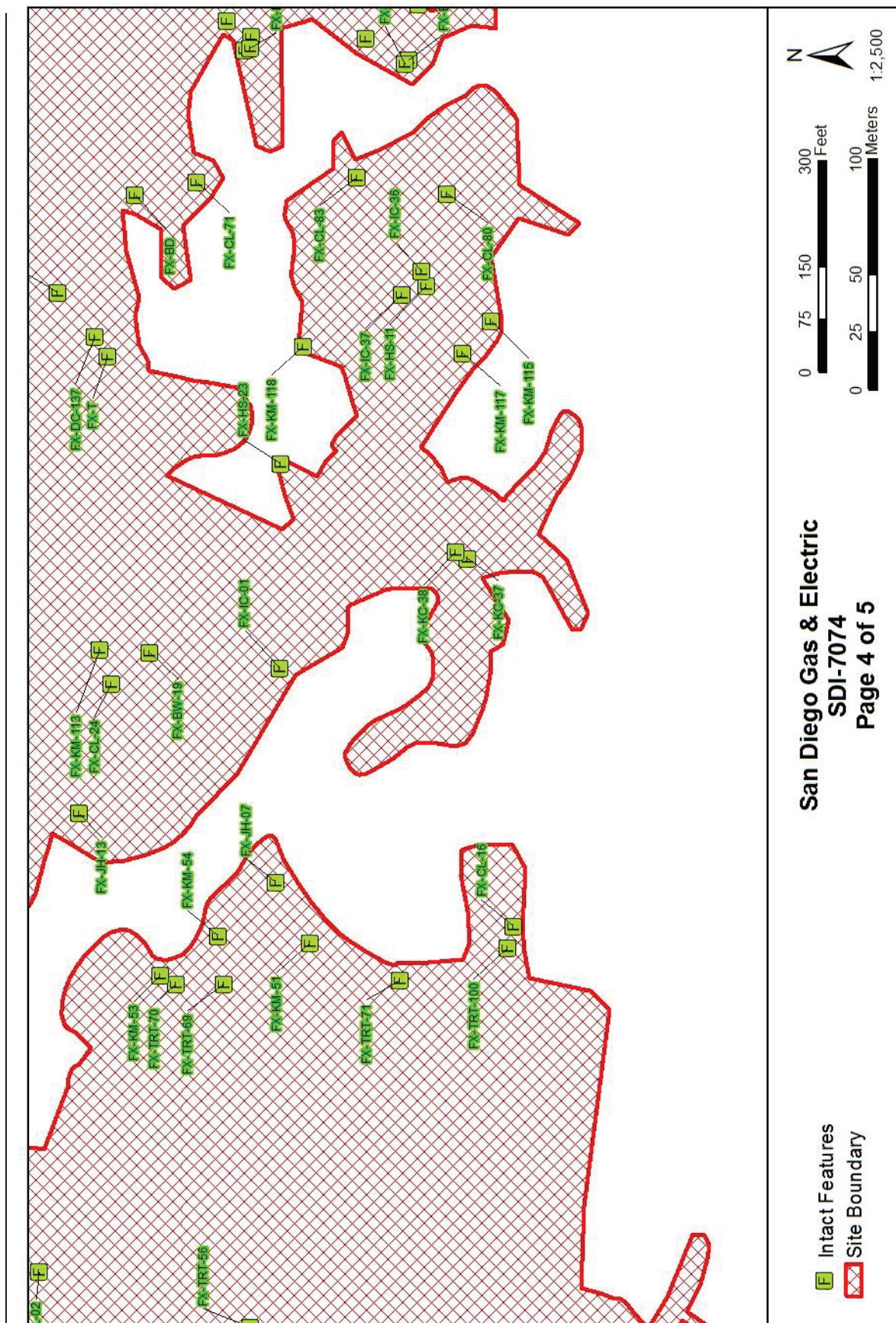


Figure 30. Detail of intact thermal features (page 3).



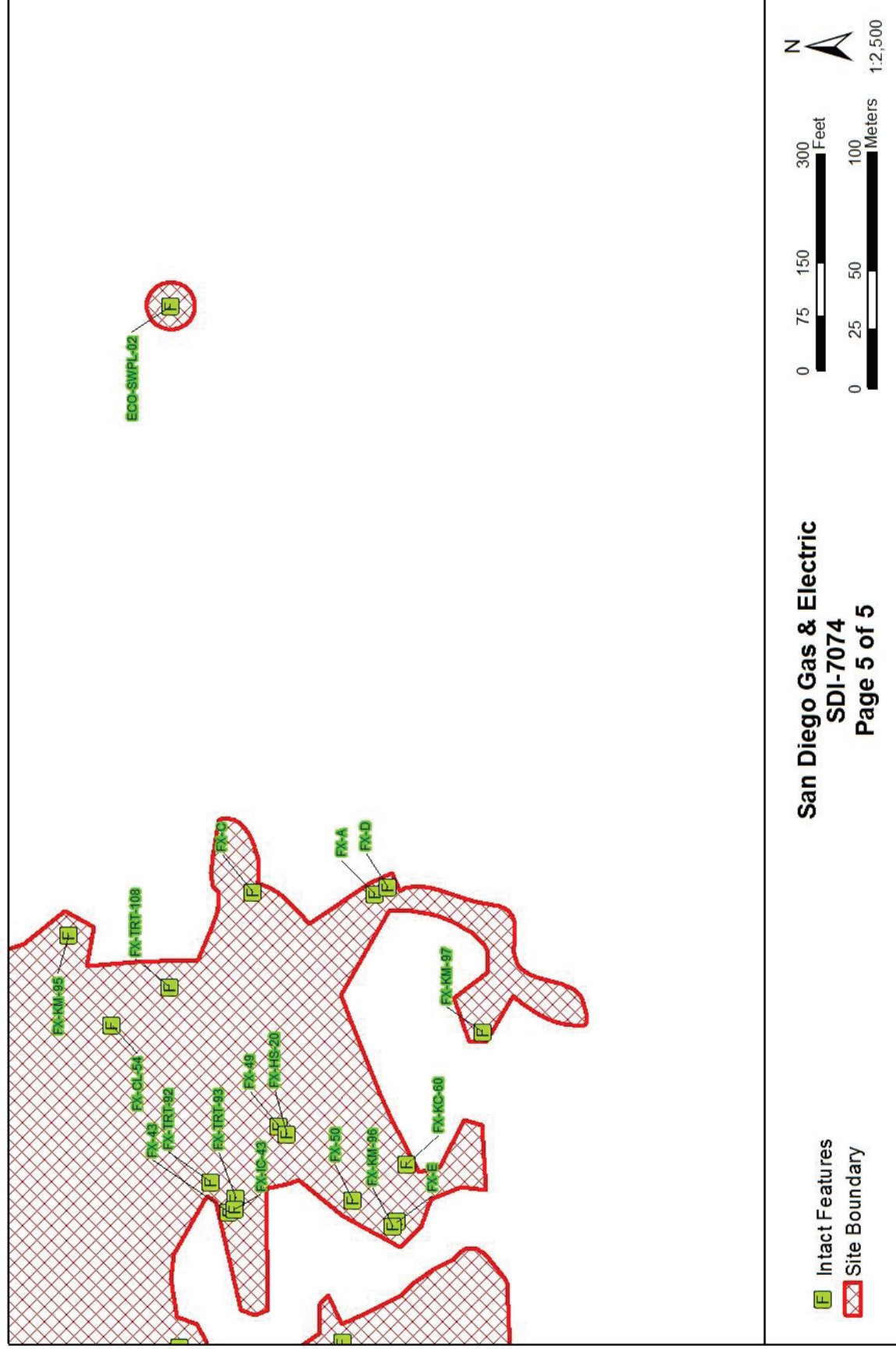


Table 3. Summary of Archaeological Investigation at 130 Thermal Features

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
ECO-FX-F	3.0 x 2.0 m	Amorphous Earth Oven	<5	>250 granitic, basalt, and quartz	-	-	-
Feature-33	3.0 x 2.5 m	Amorphous Earth Oven	30	450 granitic and quartz	A.D. 1440 to 1620	-	Sunflower family, juniper, pine, oak, sagebrush, ragweed/cocklebur, mustard family, chenopods, ephedra, wild buckwheat, legumes, grasses, chamise, and algal spores
Feature-59	2.0 x 1.5 m	Amorphous Earth Oven	20	164 granitic, quartz and basalt	-	-	Sunflower family, juniper, pine, oak, sagebrush, ragweed/cocklebur, local grasses, chenopods, ephedra, wild buckwheat, and chamise
ECO-FX-A	1.25 x 1.0 m	Circular Earth Oven	15	58 quartz, granite, and basalt	A.D. 1650 to post 1950	Yucca leaf remains, parenchymal tissue fragments, juniper and buckthorn family	Sunflower family, oak, sagebrush, ragweed/cocklebur, chamise, mustard family, saltbush, bindweed family, two types of ephedra, wild buckwheat, spurge, evening primrose family, local grasses, and sumac
ECO-FX-B	1.0 m dia.	Circular Earth Oven	<10	26 granite and quartz	-	-	-
ECO-FX-BB	2.5 x 2.0 m	Circular Earth Oven	<1	90 quartz and granitic	-	-	-
ECO-FX-BE	1.5 m dia.	Circular Earth Oven	15	85 granitic, quartz, and basalt	-	-	-
ECO-FX-BG	1.5 x 1.0 m	Circular Earth Oven	20	400 quartz and granitic	-	-	-
ECO-FX-BI	2.5 x 1.5 m	Circular Earth Oven	15	90 granitic and quartz	A.D. 1520 to post 1950	Yucca vascular bundle fragments, juniper and buckthorn family	Sunflower family, juniper, pine, oak, sagebrush, chicory, chamise, saltbush, two species of ephedra, wild buckwheat, spurge, local grasses, and sumac
ECO-FX-BJ	1.0 x 0.5 m	Circular Earth Oven	10	36 granitic	-	-	-

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
ECO-FX-D	3.0 x 3.0 m	Circular Earth Oven	10	>100 quartz and granitic	-	-	-
ECO-FX-I1	1.5 x 1.0 m	Circular Earth Oven	<5	20 basalt and granite	-	-	-
ECO-FX-M	1.5 x 1.0 m	Circular Earth Oven	30	220 quartz, granitic, and basalt	A.D. 1470 to 1650	Yucca leaf fragment and vascular bundle, juniper, buckthorn family,	Sunflower family, juniper, oak, sagebrush, ragweed/cocklebur, chamise, saltbush, ephedra, wild buckwheat, local grasses, and sumac
ECO-FX-N	1.5 m dia.	Circular Earth Oven	15	350 quartz, basalt, and granitic	-	-	-
ECO-FX-O	2.0 m dia.	Circular Earth Oven	30	350 quartz, granite, and basalt	A.D. 670 to 850	Yucca vascular bundle fragments, mallow family seed. Juniper, and buckthorn family	Sunflower family, juniper, pine, cheno-am, local grasses, sagebrush, bindweed family, two species of ephedra, and wild buckwheat
ECO-FX-P	1.5 x 1.0 m	Circular Earth Oven	10	102 granitic and quartz	-	-	-
ECO-FX-W	1.0 m dia.	Circular Earth Oven	10	28 quartz and granitic	-	-	-
ECO-SWPL-02	1.0 m dia.	Circular Earth Oven	<5	32 granitic and quartz	-	-	-
Feature-03	65 x 50 cm	Circular Earth Oven	15	95 granitic and basalt	-	-	-
Feature-05	1.0 m dia.	Circular Earth Oven	15	69 granitic, quartz, and basalt	A.D. 1280 to post 1950	Juniper	-
Feature-10	1.0 x 0.75 m	Circular Earth Oven	20	77 granitic and quartz	-	-	-
Feature-16	1.22 x 1.20 m	Circular Earth Oven	15	78 quartz and granitic	A.D. 710 to 890	Juniper	Sunflower family, juniper, pine, oak, sagebrush, ragweed/door/cocklebur, chicory, cheno-am, ephedra, wild buckwheat, spurge, prairie clover, sumac, rose family, chamise, local grasses, and algal spores

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
Feature-17	50 cm dia.	Circular Earth Oven	5	70 granitic and quartz	A.D. 580 to 660	-	Sunflower family, local grasses, juniper, pine, oak, sagebrush, ragweed/cocklebur, mustard family, cheno-am group, ephedra, two species of wild buckwheat, spurge, chamise, fern, and algal spores
Feature-19	80 cm dia.	Circular Earth Oven	10	146 granitic and quartz	A.D. 1440 to 1620	-	-
Feature-20	1.5 x 1.25 m	Circular Earth Oven	8	41 granitic and quartz	A.D. 1440 to 1660	Juniper	Sunflower family, juniper, pines, oak, cheno-am, sagebrush, ragweed/cocklebur, wild buckwheat, grasses, chamise, globe mallow, and fern
Feature-24	80 cm dia.	Circular Earth Oven	5	25 quartz, granitic, and basalt	-	-	-
Feature-25	85 x 80 cm	Circular Earth Oven	10	26 granitic and quartz	-	-	-
Feature-52	95 x 70 cm	Circular Earth Oven	20	86 granitic	A.D. 1650 to post 1950	Mojave yucca	Sunflower family, ephedra, wild buckwheat, juniper, pine, oak, sagebrush, ragweed/cocklebur, Indian paintbrush, cheno-ams, bindweed, grasses, and chamise
Feature-55	90 x 60 cm	Circular Earth Oven	10	26 granitic, quartz and basalt	-	-	-
Feature-61	1.0 m dia.	Circular Earth Oven	20	175 granitic, quartz and basalt	-	-	-
Feature-62	1.25 x 1.00 m	Circular Earth Oven	20	303 granitic, quartz and basalt	A.D. 1220 to 1280	-	Sunflower family, juniper, pine, oak, chicory, mustard family, pink families, saltbush, bindweed, ephedra, wild buckwheat, legumes, local grasses, and rose family

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
Feature-65	90 cm dia.	Circular Earth Oven	<10	48 granitic, 3 porphyritic volcanic	-	-	-
Feature-67	3.0 x 2.0 m	Circular Earth Oven	32	380 granitic and quartz	A.D. 240 to 390	0	Sunflower family, juniper, oak, sagebrush, ragweed/cocklebur, saltbush, ephedra, wild buckwheat, legumes, local grasses, and chamise
Feature-72	80 cm dia.	Circular Earth Oven	8	26 granitic	A.D. 1640 to post 1950	Buckthorn family	-
FX-BW-18	1.25 x 1.0 m	Circular Earth Oven	20	18 quartz and granitic	-	-	-
FX-CL-02	1.0 m dia.	Circular Earth Oven	15	>400 granitic	-	-	-
FX-CL-23	90 x 60 cm	Circular Earth Oven	<20	13 quartz	-	-	-
FX-CL-24	1.4 x 1.1 m	Circular Earth Oven	/	30 quartz	-	-	-
FX-CL-25	1.0 m dia.	Circular Earth Oven	/	70 granitic	-	-	-
FX-CL-29	1.5 m dia.	Circular Earth Oven	/	64 granitic	-	-	-
FX-CL-83	1.0 x 0.9 m	Circular Earth Oven	15	40 granitic	-	-	-
FX-DC-132	1.1 m dia.	Circular Earth Oven	/	65 granitic and quartz	B.C. 6690 to 6530	-	-
FX-HS-11	1.0 m dia.	Circular Earth Oven	10	40 count	-	-	-
FX-HS-20	1.0 m dia.	Circular Earth Oven	/	50 count	-	-	-
FX-IC-37	1.0 m. dia.	Circular Earth Oven	20	43 granitic and quartz	B.C. 7140 to 7040	Juniper	Sunflower family
FX-IC-53	1.0 m dia.	Circular Earth Oven	15	20 quartz and granitic	-	-	-
FX-KM-01	1.2 x 0.8 m	Circular Earth Oven	10	40 count	-	-	-
FX-KM-113	3.0 x 2.7 m	Circular Earth Oven	30	>200 granitic	B.C. 7560 to 7380	Buckthorn family, juniper, mesquite, and saltbush	Sunflower family, saltbush, juniper, pine, oak, sagebrush, ragweed/cocklebur, chicory, chamise, ephedra, wild buckwheat, and local grasses
FX-KM-95	80 x 60 cm	Circular Earth Oven	15	22 quartz	-	-	-
FX-LT-33	1.1 x 0.9 m	Circular Earth Oven	<20	66 granitic	-	-	-
FX-LT-46	50 cm dia.	Circular Earth Oven	10	102 quartz and granitic	-	-	-
FX-MS-07	1.3 m dia.	Circular Earth Oven	/	44 count	-	-	-

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
FX-MS-13	4.5 m dia.	Circular Earth Oven	/	>200 count	-	-	-
FX-TRT-100	2.0 m dia.	Circular Earth Oven	/	>100 count	-	-	-
FX-TRT-108	1.0 x 0.8 m	Circular Earth Oven	10	45 count	-	-	-
FX-TRT-33	3 m dia.	Circular Earth Oven	/	>120 count	-	-	-
ECO-FX-BD	50 cm dia.	Hearth	15	26 granitic	-	-	-
ECO-FX-C	1.0 m dia.	Hearth	4	24 granite and quartz	-	-	-
ECO-FX-I2	40 x 50 cm	Hearth	<10	74 quartz, granitic, and basalt	-	-	-
Feature-11	50 cm dia.	Hearth	10	25 granitic	A.D. 990 to 1120	0	-
Feature-13	50 x 40 cm	Hearth	2	31 granitic and quartz	A.D. 440 to 600	-	Sunflower family, juniper, pine, oak, ragweed/cocklebur, pink family, cheno-ams, bindweed, ephedra, wild buckwheat, spurge family, grasses, chamise, and globe mallow
FX-CL-71	60 x 50 cm	Hearth	15	10 granitic	-	-	-
FX-KM-138	90 cm dia.	Hearth	15	15 granitic	-	-	-
FX-KM-137	1.8 x 1.4 m	Hearth and Circular Earth Oven	15	89 quartz and granitic	-	-	-
Feature-64	50 cm dia.	Historical Hearth	<5	22 granitic and quartz	-	-	-
ECO-FX-E	2.5 x 2.0 m	Oblong Earth Oven	5	93 basalt, granite, and quartz	-	-	-
ECO-FX-J	3.5 x 2.0 m	Oblong Earth Oven	15	221 basalt, granitic, and quartz	A.D. 900 to 1020	Yucca vascular bundle fragments, juniper and buckthorn family	Sunflower family, juniper, pine, sagebrush, ragweed/cocklebur, chicory, chamise, saltbush, bindweed family, ephedra, wild buckwheat, prickly pear cactus, and local grasses
Feature-12	1.0 x 0.5 m	Oblong Earth Oven	2	12 granitic	A.D. 600 to 660	Juniper	Sunflower family, grasses, pine, oak, wild buckwheat, chamise, and algal spores
Feature-18	1.5 x 1.0 m	Oblong Earth Oven	24	80 granitic	-	-	-

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
Feature-42	1.25 x 0.8 m	Oblong Earth Oven	17	105 granitic and quartz	A.D. 690 to 880	Juniper	Sunflower family, juniper, pine, oak, sagebrush, ragweed/cocklebur, saltbush, ephedra, wild buckwheat, spurge family, legumes, prickly pear cactus, grasses, rose family, globe mallow, and grasses
FX-BW-19	1.3 x 1.4 m	Oblong Earth Oven	5	55 granitic	B.C. 4460 to 4350	Hedgehog cactus seed fragment, Juniper seed fragment, Yucca leaf fragment, saltbush, juniper, buckthorn family, and rose family	Wild Buckwheat
FX-CL-90	2.1 x 0.9 m	Oblong Earth Oven	25	16 granitic	-	-	-
FX-DC-137	3.5 x 1.3 m	Oblong Earth Oven	15	78 count	-	-	-
FX-DC-138	8.0 x 4.0 m	Oblong Earth Oven	40	24 count in situ	-	-	-
FX-DC-144	2.0 x 1.0 m	Oblong Earth Oven	15	25 count	-	-	-
FX-HS-23	2.75 x 1.5 m	Oblong Earth Oven	10	45 count	-	-	-
FX-KC-08	1.0 x 0.5 m	Oblong Earth Oven	15	20 granitic	-	Buckthorn family and juniper	Sunflower family, sagebrush, ragweed/cocklebur, wild buckwheat, spurge, and local grasses
FX-TRT-56	2.5 m long	Oblong Earth Oven	36	20 - 25 granitic and quartz	B.C. 7780 to 7590	Juniper (wood/seed), buckthorn family, cholla, and laurel	Sunflower family
Feature-15	1.25 x 0.6 m	Ringed Earth Oven	<1	47 granitic	-	-	-
Feature-44	2.0 x 1.5 m	Ringed Earth Oven	<1	79 granitic and quartz	-	-	-
Feature-66	1.3 x 1.0 m	Threshing Floor	0	90 granitic	-	-	-
Feature-69	1.5 x 1.0 m	Threshing Floor	0	158 granitic	-	-	-
Feature-71	3.0 x 2.0 m	Threshing Floor	-	470 granitic	-	-	-
ECO-FX-AC	1.0 x 0.5 m	Undetermined	>5	15 quartz and granitic	-	-	-

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
ECO-FX-K	Undetermined	Undetermined	<1	45 granitic and quartz	-	-	-
ECO-FX-T	1.5 x 1.0 m	Undetermined	10	16 granitic, quartz and basalt	-	-	-
ECO-FX-V/AA	1.5 x 1.0 m	Undetermined	10	215 quartz, granitic, and basalt	-	-	-
ECO-SWPL-01	1.0 m dia.	Undetermined	<5	21 granitic	-	-	-
Feature-14	Undetermined	Undetermined	<1	13 granitic	-	-	-
Feature-41	Undetermined	Undetermined	0	15 granitic	-	-	-
Feature-43	20 x 10 cm	Undetermined	<1	33 granitic and quartz	-	-	-
Feature-48	90 x 50 cm	Undetermined	17	11 basalt and granitic	-	-	-
Feature-49	1.0 x 0.5 m	Undetermined	10	12 granitic	A.D. 1440 to 1630	Juniper	-
FX-CL-16	Undetermined	Undetermined	/	40 granitic	-	-	-
FX-CL-22	70 x 40 cm	Undetermined	7	11 quartz and granitic	-	-	-
FX-CL-36	Undetermined	Undetermined	/	/	-	-	-
FX-CL-39	70 x 80 cm	Undetermined	8	8 quartz and granitic	-	-	-
FX-CL-54	1.1 x 0.9 m	Undetermined	5	15 quartz	-	-	-
FX-CL-70	1.0 m dia.	Undetermined	15	12 granitic	-	-	-
FX-CL-80	1.0 x 0.5 m	Undetermined	10	29 granitic	-	-	-
FX-CL-87	60 cm dia.	Undetermined	10	4 quartz and granitic	-	-	-
FX-IC-01	Undetermined	Undetermined	/	3 count	-	-	-
FX-IC-36	80 x 90 cm	Undetermined	10	None present	B.C. 7750 to 7590	-	-
FX-IC-43	Undetermined	Undetermined	/	3 count	-	-	-
FX-JH-07	Undetermined	Undetermined	/	/	-	-	-
FX-JH-13	Undetermined	Undetermined	<1	/	-	-	-
FX-KC-03	30 cm dia.	Undetermined	5	15 count	-	-	-
FX-KC-37	Undetermined	Undetermined	/	7 count	-	-	-
FX-KC-38	Undetermined	Undetermined	/	19 count	-	-	-
FX-KC-60	Undetermined	Undetermined	/	15 count	-	-	-
FX-KM-07	90 cm dia.	Undetermined	20	1 count	-	-	-
FX-KM-115	80 x 60 cm	Undetermined	/	15 count	-	-	-
FX-KM-117	1.0 x 1.4 m	Undetermined	/	44 granitic and quartz	-	-	-
FX-KM-118	1.0 x 0.8 m	Undetermined	10	3 count	-	-	-
FX-KM-14	Undetermined	Undetermined	/	10 count	-	-	-
FX-KM-26	Undetermined	Undetermined	/	13 count	-	-	-
FX-KM-27	Undetermined	Undetermined	4	3 count	-	-	-

Label	Appr. Feature Size	Presumed Construction	Fuel Level Thickness (cm)	Fire-Affected Rock	2-Sigma Date Range	Charred Macrofloral Remains	Pollen Analysis
FX-KM-30	Undetermined	Undetermined	/	/	-	-	-
FX-KM-49	1.7 x 1.5 m	Undetermined	20	4 granitic	-	-	-
FX-KM-51	1.1 x 0.7 m	Undetermined	15	5 quartz	-	-	-
FX-KM-53	80 x 70 cm	Undetermined	20	28 quartz	-	-	-
FX-KM-54	60 cm dia.	Undetermined	10	3 quartz and granitic	-	-	-
FX-KM-96	1.1 x 0.7 m	Undetermined	10	20 quartz and granitic	-	-	-
FX-KM-97	Undetermined	Undetermined	/	10 quartz and granitic	-	-	-
FX-TRT-109	80 cm dia.	Undetermined	5	7 count	-	-	-
FX-TRT-21	1.4 x 1.0 m	Undetermined	5	/	-	-	-
FX-TRT-22	1.3 x 1.0 m	Undetermined	10	4 count	-	-	-
FX-TRT-46	1.0 x 0.8 m	Undetermined	10	5 count	-	-	-
FX-TRT-92	1.0 x 0.6 m	Undetermined	15	9 quartz	-	-	-
FX-TRT-93	Undetermined	Undetermined	/	32 count	-	-	-

FEATURES EXCAVATED AND CONTEXT

What follows is a description of each of the 130 features that includes size, rough shape, quantity and material type for fire-affected rock, and any artifact/ecofact recovery from within or immediately adjacent to the feature, as well as the results of special studies such as macrofloral analysis, pollen analysis, and radiocarbon dating. Fourier Transform Infrared Spectroscopy (FTIR) analysis will be summarized following the individual feature descriptions. The features are divided into categories based on those defined by Eerkens and Rosenthal (2002) for circular and oblong earth ovens and Thoms (1989) for amorphous earth ovens, with additional categories created for discrete hearths and an historical thermal feature. The final section includes those thermal features at which at least some portion was found to be embedded or in situ when excavated but which were too marginal to be included in the mentioned categories. The use of “cmbs” is from the ground surface level the feature was identified at, this may include original ground surface (i.e., those identified during evaluation and data recovery) or grading cut surface (i.e., those identified during construction monitoring).

Hearth Features

Feature-11: This thermal feature, likely a hearth, was identified on a small knoll surrounded by drainage channels. The feature was 3 m east of Feature-10 and surrounded by artifact Concentration 12 (spatial distribution is discussed further below). Feature-11 consisted of 25 granitic fire-affected rocks, most of which were displaced slightly down slope, so that the feature’s original size was inferred at roughly 50 x 50 cm with a depth of 10 cmbs (Figure 33). The profile of this feature showed a slightly basined construction (Figure 34). One volcanic primary flake, one volcanic secondary flake, one quartz interior flake, and one piece of quartz shatter were recovered from the feature soil.



Figure 33. Feature-11 showing displaced fire-affected rock.



Figure 34. Profile of Feature-11 showing basined construction.

Radiocarbon results (Beta-340132) indicated Feature-11 was constructed within a two-sigma calibrated date range of A.D. 990 to 1120.

Feature-13: This thermal feature was identified just below the surface. The majority of the feature appeared to have washed out, but a thin layer of burnt soil and charcoal remained around the 31 embedded granitic and quartz fire-affected rocks (Figure 35). Four pieces of quartz shatter were recovered from the feature. Feature-13 was adjacent to and west of Feature-12 and in line with feature and Feature-41 in the same drainage channel.



Figure 35. Feature-13.

Radiocarbon results (Beta-340133) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 440 to 600.

A soil sample yielded a pollen record dominated by high-spine Asteraceae, representing various plants in the sunflower family. In addition, this sample exhibited small quantities of local or regional juniper (*Juniperus*), pine (*Pinus*), and oak (*Quercus*) pollen. Pollen representing shrubs and/or forbs growing locally included sagebrush (*Artemisia*), members in the ragweed/cocklebur portion of the sunflower family (low-spine Asteraceae), members of the sunflower family (high-spine Asteraceae), mustard or cabbage family (Brassicaceae), pink family (Caryophyllaceae), cheno-ams such as goosefoot and/or saltbush, (*Chenopodium/Amaranthus*), bindweed or related plant (*Convolvulus*), two types of ephedra or Mormon tea (*Ephedra nevadensis* and *E. torreyana*), wild buckwheat (*Eriogonum*), a member of the spurge family (Euphorbiaceae), grasses (Poaceae), chamise (*Adenostoma*), and globe mallow (*Sphaeralcea*). A large proportion of the pollen from this location was damaged beyond recognition, probably by fire. A very large quantity of microscopic charcoal was recovered from this sample, which is related to the burning of this floor. This fire and the presence of microscopic charcoal served both to destroy much of the pollen that was present and to distort at least a portion of the remaining pollen. It is likely that much of the pollen that was

identifiable was introduced into this location either immediately or shortly after the fire. Total pollen concentration was approximately 1,616 pollen grains per cm³ of sediment.

ECO-FX-C: This thermal feature, likely a deflated hearth, consisted of a loosely packed cluster of 24 granite and quartz fire-affected rocks surrounded by a burn layer approximately 3 to 4 cm thick. The feature measured 1.0 x 1.0 m. No artifacts or charcoal were recorded in the feature, which terminated at 30 cmbs.

ECO-FX-I2: This thermal feature, likely a hearth, consisted of approximately 74 quartz, granitic, and basalt fire-affected rocks (Figure 36). Sediments associated around the feature were consistent with the natural light brown silty sand and granitic gravel of the drainage features in this area, and they surrounded a dark brown and black burnt soil layer with a substantial amount of charcoal and burnt soil. ECO-FX-I2 measured approximately 40 x 50 cm and terminated at 30 cmbs. No artifacts were recovered from the feature. Feature was not very deep and was loosely compacted (Figure 37). The feature was likely associated with ECO-FX-J, found immediately adjacent in the same drainage and at the same depth.

ECO-FX-BD: This thermal feature was fairly isolated; no artifacts or other features were recorded within 20 m. ECO-FX-BD contained 26 granitic fire-affected rocks and appeared as a small, densely packed rock circle, 50 x 50 cm in area, with a charcoal concentration in the center and a termination depth of 15 cmbs (Figure 38). The surrounding matrix was light brown silty sand with granitic gravel. No artifacts were recovered.



Figure 36. ECO-FX-I2.



Figure 37. Profile of ECO-FX-I2 bisection.

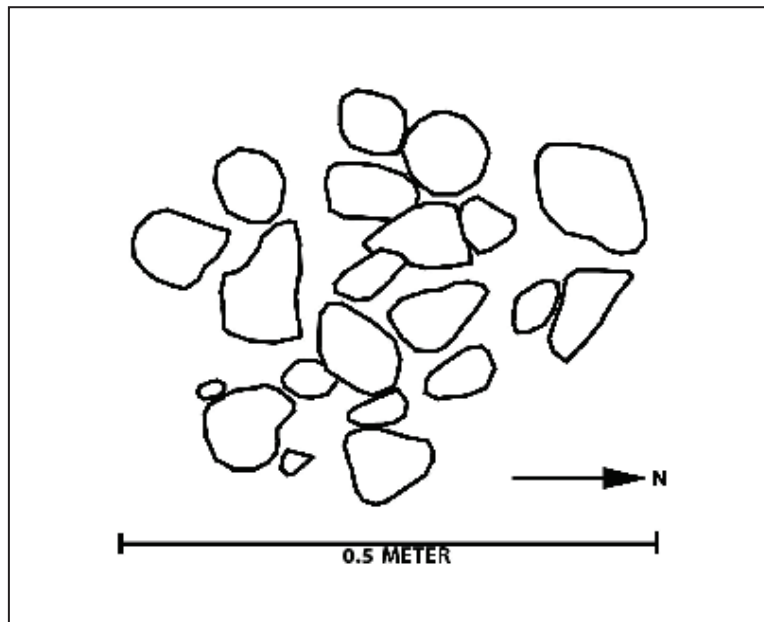


Figure 38. Overview drawing of ECO-FX-BD.

FX-CL-71: This thermal feature contained 10 fire-affected rocks surrounded by dark black soil matrix. The feature was fairly discrete, possibly a hearth, and measured approximately 60 x 50 cm, with a depth of 15 cmbs.

FX-KM-137: This thermal feature appeared to consist of two discrete elements, a hearth and an earth oven, separated by approximately 20 cm, with the entire area measuring approximately 1.8 x 1.4 m, and with a thickness of 15 cm for the earth oven. (Figure 39). A deposit of burnt soil also connected the two areas. The

northern of the two elements, the possible hearth, contained 36 quartz and granitic fire-affected rocks, while the southern deposit, the possible earth oven, had 53 quartz and granitic fire-affected rocks. Two charred granitic milling slab fragments were recovered from FX-KM-137 and did not refit. Both milling slab fragments had been incorporated into the oven feature's structure suggesting recycling of discarded ground stone fragments was practiced when local materials were scavenged to build the feature.



Figure 39. Two possible features at FX-KM-137.

FX-KM-138: This thermal feature is a small hearth containing 15 embedded granitic fire-affected rocks, with some loose burnt soil (Figure 40). The feature covered an area of roughly 90 x 90 cm, with a thickness of 15 cm. A charred basalt milling slab fragment was incorporated into the hearth's structure suggesting recycling of discarded ground stone fragments was practiced when local materials were scavenged to build the feature.



Figure 40. Feature FX-KM-138.

Circular Oven Features with Rock Floors

Feature-03: This thermal feature consisted of 95 granitic and basalt fire-affected rocks, most of which were highly fragmented and loosely arranged around the feature. Twenty-two of the identified fire-affected rocks were embedded with a small amount of charcoal and a thin burnt soil layer that measured approximately 65 x 50 cm and terminated around 15 cmbs (Figure 41).

Feature-05: This thermal feature, likely an earth oven, consisted of 69 granitic, quartz, and basalt fire-affected rocks with a large amount of charcoal bits and charred “logs” observed throughout the burn layer (Figure 42). Four large granite rocks with only their undersides burned were noted; they may have been coping stones used to regulate the heat of the fire. There was also a small pile of five large granite rocks approximately 25 cm to the northeast of the feature that may represent collected cobbles that were not used for construction of the feature. The light brown silty sand and granitic gravel of the drainage channel was noted at roughly 10 cmbs on the margins of the feature and at 15 cmbs near the center. The profile showed a “stepped” construction technique that was found in many of the features at SDI-7074 and is discussed further below (Figure 43). Invasive juniper roots were moderately abundant throughout the feature. A quartz interior flake was recovered from the soil around the feature.

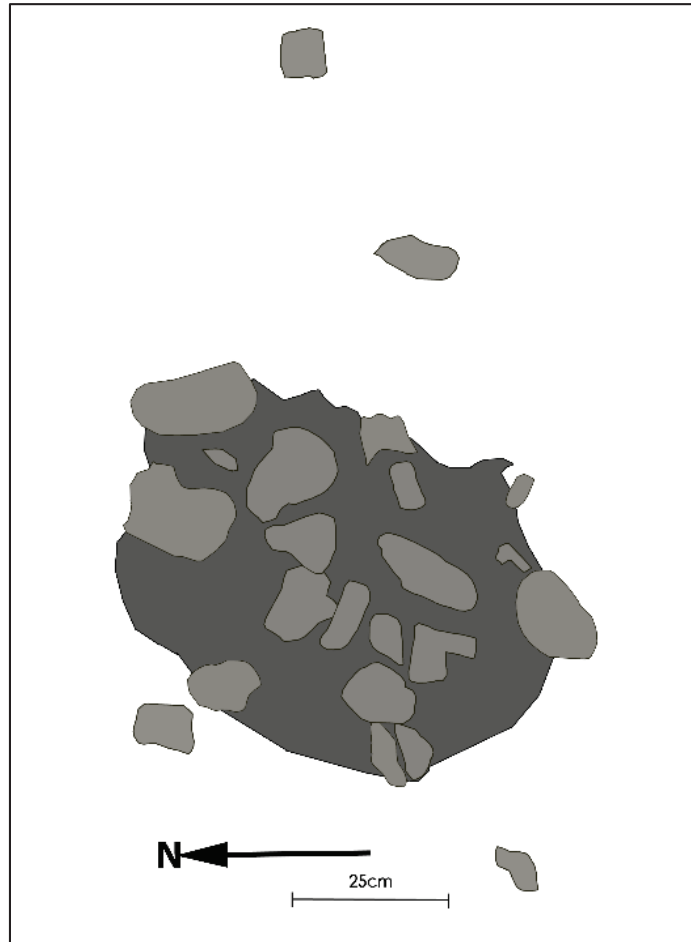


Figure 41. Overview drawing of Feature-03.

Radiocarbon results (Beta-340134 and Beta-340135) indicated that the feature was within a two-sigma calibrated date range extending from A.D. 1280 to the present.

Charcoal examined from this feature consisted of one piece of juniper charcoal.

Feature-10: This thermal feature, likely an earth oven, sits on the same knoll as does Artifact Concentration 12, indicating they may all be related. Feature-10 consisted of 77 granitic and quartz fire-affected rocks, forming a floor in a slightly elliptical arrangement (in plan view) with loosely compacted burnt soil and charcoal measuring roughly 1.0 x 0.75 m and 20 cm thick (Figure 44). The burnt soil level was fairly mottled. Six pieces of quartz and volcanic debitage were recovered.



Figure 42. Feature-05.



Figure 43. Profile of Feature-05 showing stepped construction.

Feature-16: This thermal feature was identified at approximately 20 cmbs. The feature was in the same drainage channel as Feature-15 and to the east of it, and consisted of a densely packed circular mosaic rock floor with a single course of 78 quartz and granitic fire-affected rocks, burnt soil, and charcoal (Figure 45). The burnt fuel level was most intact in the northeast portion of the feature, where it was approximately 15 cm thick. A 5-to-10-cm thick layer of burnt soil was observed over the balance of the feature, which measured 1.22 x 1.20 m and sat directly atop the old alluvium formation. Two volcanic interior flakes and one quartz interior flake were recovered from the surrounding soils.



Figure 44. Feature-10.



Figure 45. Feature-16.

Radiocarbon results (Beta-340140) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 710 to 890.

Soil from the feature showed a pollen record dominated by high-spine Asteraceae pollen, representing a variety of plants in the sunflower family. Small quantities of juniper, pine, and oak pollen. Small quantities of pollen represent a variety of shrubby and herbaceous plants that include sagebrush, various members of the ragweed or cocklebur portion of the sunflower family, members of the chicory portion of the sunflower family (Liguliflorae), members of the cheno-am group that might include goosefoot or shrubby plants such as saltbush, ephedra or Mormon tea, wild buckwheat, spurge, prairie clover (*Dalea*), sumac (*Rhus*), a member of the rose family (Rosaceae), and chamise. The grass pollen frequency was moderately high and might represent the local grass population or perhaps the use of grasses to line the oven. Recovery of sumac pollen in this sample is unusual, since it was not observed in any other of the samples from this site. A few algal spores were noted in this sample indicating that the feature probably held water at least after a rain subsequent to its abandonment, and the quantity of microscopic charcoal was far less than that observed in other features. Total pollen concentration was more than 10,500 pollen grains per cm³ of sediment. Macrofloral analysis of charcoal samples identified two large chunks of *Juniperus*.

Feature-17: This thermal feature was identified just below the surface in the same drainage as Feature-18 and ECO-FX-BE and to the northwest of them. Feature-17 consisted of two courses of fire-affected rocks (Figure 46). The first contained roughly 16 granitic and quartz rocks that were only brunt on the under sides, indicating they may have been coping stones. The second course was a tightly packed, burnt mosaic floor of 54 granitic and quartz fire-affected rocks with charred soil and charcoal throughout. One volcanic interior flake, 12 pieces of volcanic shatter, three quartz secondary flakes, and 12 pieces of quartz shatter were recovered.

Radiocarbon results (Beta-340147) indicate the feature was constructed within a two-sigma calibrated date range between A.D. 580 and 660.

Soil submitted for pollen analysis contained high-spine Asteraceae and Poaceae pollen as approximate co-dominant. In addition, small quantities of juniper, pine, and oak trees growing in the general area. Recovery of small quantities of pollen from this feature fill indicates that local vegetation also included sagebrush, members of the ragweed or cocklebur portion of the sunflower family, members of the mustard family, plants in the cheno-am group, ephedra or Mormon tea, at least two species of wild buckwheat, spurge, and chamise. A fern (trilete) spore was recovered from this sample, indicating that ferns grew in the area. A small quantity of algal spores was present, representing ponded water in the base of the feature following abandonment. A moderate quantity of microscopic charcoal was observed in this sample, indicating that the sample was collected from fill that retained some charcoal from the fuel that was burned in this feature. A total pollen concentration of approximately 7,400 pollen grains per cm³ of sediment was calculated.

Feature-19: This thermal feature was identified within the same drainage channel as Feature-20 and 10 m to the west of it. Both features fall in the same radiocarbon date range and were likely constructed contemporaneously. Feature-19 consisted of 146 granitic and quartz fire-affected rocks identified at the surface level with an approximate depth of burnt soil and charcoal to 10 cmbs (Figures 47 and 48).

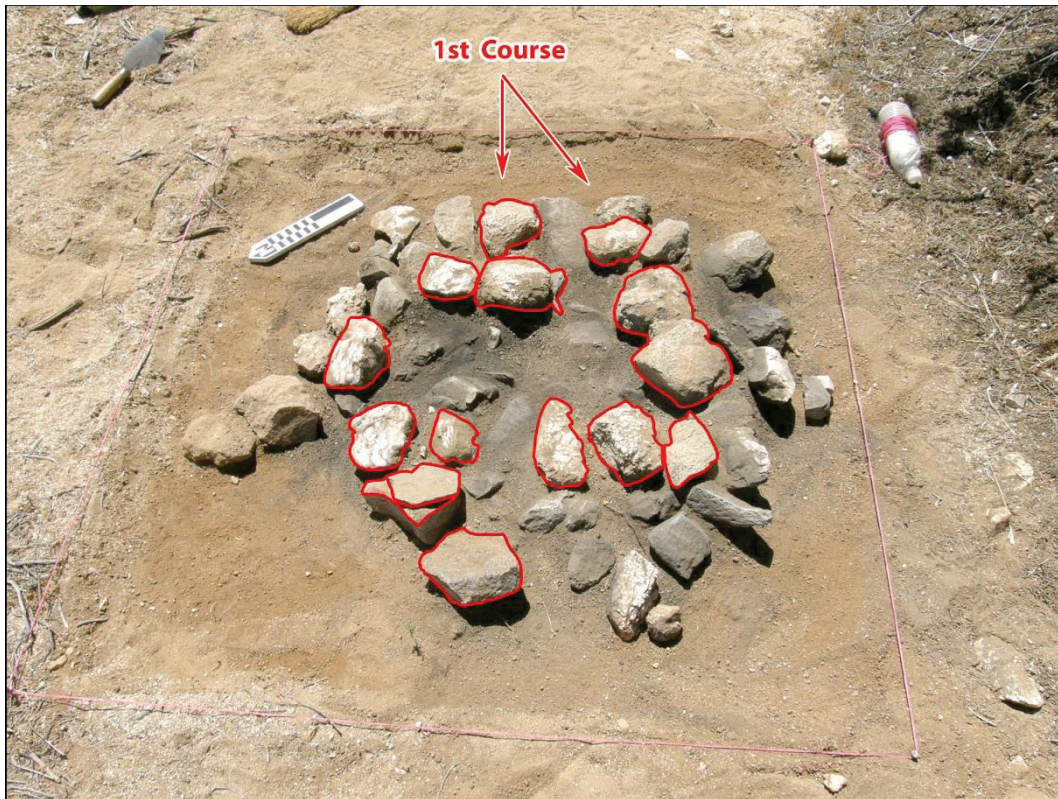


Figure 46. Feature-17.



Figure 47. Feature-19.



Figure 48. Profile of Feature-19 bisection.

Radiocarbon results (Beta-340148) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 1440 to 1620.

Feature-20: This thermal feature, likely an earth oven, was identified at approximately 10 cmbs, within the same drainage channel as Feature-19 and 10 m to the east of it. As mentioned above, both features fall in the same radiocarbon date range and were likely contemporaneous. Feature-20 consisted of 41 fire-affected granite and quartz rocks in a semicircular pattern that sloped slightly to the northwest, following the drainage channel (Figure 49). The feature sat directly atop the old alluvium formation. It is possible that the rock arrangement formed a complete ring, but a portion of the northwest/downslope corner appeared to have washed out. Burnt soil and charcoal bits and branches were observed at a thickness varying between 4 and 8 cm throughout the center of the feature and surrounding the fire-affected rocks. The profile of the feature showed the stepped pattering seen in other features at SDI-7074. A small patch of light brown sandy silt and granitic gravel measuring roughly 15 cm in diameter was recorded near the center of the feature; its purpose could not be determined. A volcanic interior flake was recovered, and an indeterminate ground stone fragment was identified within the mosaic floor structure.



Figure 49. Feature-20.

Radiocarbon results (Beta-340138 and Beta-340139) indicate the feature was constructed within a two-sigma calibrated date range of AD 1440 to 1660.

Pollen examined from a sample of this feature was dominated by high-spine Asteraceae, representing members of the sunflower family. Small quantities of *Juniperus*, *Pinus*, and *Quercus* pollen representing juniper, pines, and oak trees growing in the area were also represented. The cheno-am pollen frequency was slightly elevated when compared with other features, suggesting the possibility that plants in this group might have been processed in this oven feature or might have been used as part of the buffering plant layer when processing other plants. Recovery of small quantities of *Artemisia*, low-spine Asteraceae, Brassicaceae, *Eriogonum*, Poaceae, *Adenostoma*, and *Sphaeralcea* represent sagebrush, members of the ragweed/cocklebur portion of the sunflower family, members of the mustard family, wild buckwheat, grasses, chamise, and globe mallow. Recovery of a small quantity of *Lycopodiella cernua*-type spores indicates the presence of ferns in the local vegetation community. A moderately large quantity of microscopic charcoal was present in this sample, reducing visibility of pollen. Total pollen concentration was nearly 6,700 pollen grains per cm³ of sediment.

Macrofloral analysis showed fragments of *Juniperus* charcoal were present, indicating the use of juniper wood as fuel. A single charred juniper seed was identified, indicating branches may have been burned whole, with twigs and berries attached.

Feature-24: This thermal feature was identified approximately 10 cmbs adjacent to and west of Feature-25. The feature consisted of 25 quartz, granitic, and basalt fire-affected rocks and has been heavily impacted by surrounding root systems and water erosion that have redeposited much of the fuel layer to the west of the feature (Figure 50). A few of the rocks near the top of the feature were only burned on the bottom, so that they may have been coping stones, while some other rocks above the fuel level appear to have washed into the feature. The fuel level is roughly 5 cm thick at the center. Two quartz interior flakes were recovered.



Figure 50. Feature-24.

Feature-25: This thermal feature was adjacent to Feature-24 and to the east of that feature. The Feature-25 consisted of 26 granitic and quartz fire-affected rocks in a single course, in a circular arrangement measuring approximately 85 x 80 cm (Figure 51). The burnt fuel level was roughly 10 cm thick at the margins and had been nearly completely washed out through the center of the feature. Three charred lotebush (*Ziziphus parryi*) seeds were recovered, indicating either processing of lotebush seeds or, more likely given the low count, that whole branches were used as fuel. One quartz and one volcanic secondary flake were recovered, as well as a fragment of worked bone (DR-CAT-56).



Figure 51. Feature-25.

Feature-52: This thermal feature, likely an earth oven, consisted of 86 fire-affected rocks with burnt soil and charcoal, covering an area roughly 95 x 70 cm and to a depth of 20 cmbs (Figure 52). The profile revealed a relatively flat bottom under the circular, mosaic floor. Several large granitic boulders were burned on the downside only, indicating that they may have been coping stones. This feature, similar to Feature-05, had a number of large unburnt granitic cobbles surrounding it that may represent rocks that were collected but not used for construction or heat regulation of the feature. Two volcanic interior flakes, a piece of volcanic shatter, and four quartz interior flakes were recovered.

Radiocarbon results (Beta-340145) indicate the feature was constructed within a two-sigma calibrated date range extending from A.D. 1650 to the present.

Soil samples collected from the feature contained a moderate quantity of sunflower family pollen and slightly elevated quantities of ephedra or Mormon tea and wild buckwheat. The juniper pollen was slightly elevated in this sample, and small quantities of pine and oak pollen were also noted. Other plants growing locally are represented by sagebrush, members of the ragweed/cocklebur portion of the sunflower family, Indian paintbrush (*Castilleja*), cheno-ams, bindweed or a related plant, grasses, and chamise. This feature did not yield much microscopic charcoal, and the total pollen concentration was approximately 8,300 pollen grains per cm³ of sediment.

Fragments of vitrified Mojave yucca charcoal were noted in macrofloral analysis. Although vitrification of charcoal has been attributed to burning at high temperature and/or burning green wood, it currently is not clear what conditions produce vitrified charcoal. Seven charred lotebush seeds and one charred juniper seed were also recovered, indicating that lotebush and juniper seeds were used or (more likely given the low count) that whole branches were used as fuel.



Figure 52. Feature-52.

Feature-55: This thermal feature was identified on the surface of a sloped wash edge (approximately 35° slope). Twenty-six loosely configured granitic, quartz, and basalt fire-affected rocks were recorded, with some burnt soil and charcoal still present near the center of the clustered rock (Figure 53). The feature covered an area roughly 90 x 60 cm and terminated immediately below the rock floor. It is possible the feature was originally on a level surface that eroded, causing the components to spill down the slope. A charred granitic milling slab fragment was recovered and had been utilized in construction of the feature floor.



Figure 53. Feature-55.

Feature-61: This thermal feature, likely an earth oven, was identified just below the surface adjacent to and west of Feature-62. The feature consisted of approximately 175 granitic, quartz, and basalt fire-affected rocks, of which 63 were still embedded at the time of excavation (Figure 54). The fuel level was made of burnt ashy soil and charcoal and was approximately 20 cm thick, continuing under the mosaic floor following a stepped, basined construction (Figure 55). The feature was roughly circular and covered an area of approximately 1.0 x 1.0 m. The downslope (north) portion of the feature appeared to have slightly washed out, displacing some of the rocks in that area.

Feature-62: This thermal feature, likely an earth oven, was identified just below the surface, adjacent to and to the east of Feature-61. The feature consisted of 303 granitic, quartz, and basalt fire-affected rocks, of which 63 were found embedded (Figure 56). The burnt fuel floor was approximately 20 cm thick at the deepest point, covered a circular area roughly 1.25 x 1.00 m, and showed a stepped construction (Figure 57). Two dense charcoal concentrations were noted on the northeast and southwest portion of the feature under the mosaic rock floor. The downslope (north) side of Feature-62 had been slightly washed out. Two quartz interior flakes were recovered, and a burnt granitic milling slab fragment was found within the feature floor.



Figure 54. Feature-61.



Figure 55. Profile of bisected Feature-61.



Figure 56. Feature-62.

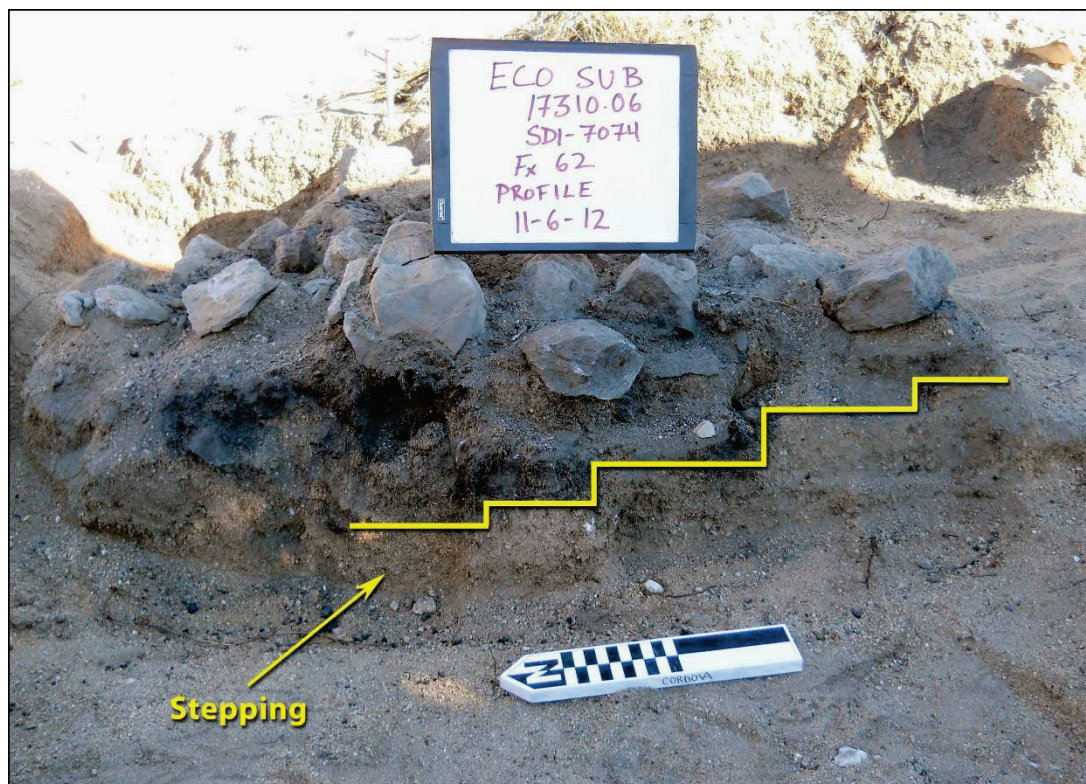


Figure 57. Profile of Feature-62 bisection showing stepped excavation.

Radiocarbon results (Beta-340144) indicated the feature was constructed within a two-sigma calibrated date range of A.D. 1220 to 1280.

Soil samples yielded a surprising quantity of arboreal pollen that included juniper, pine, and oak trees. Although high-spine Asteraceae pollen dominated the record, it was not observed in a frequency as large as that noted in most of the other samples. Recovery of small quantities of chicory tribe of the sunflower family, members of the mustard and pink families, saltbush and related plants, bindweed and related plants, ephedra or Mormon tea, wild buckwheat, legumes (Fabaceae), grasses, and members of the rose family (Rosaceae) including chamise. Total pollen concentration was approximately 5,750 pollen grains per cm³ of sediment, and the quantity of microscopic charcoal was relatively low.

Feature-65: This thermal feature was identified just below the surface. The feature consisted of 48 granitic and three porphyritic volcanic fire-affected rocks in a discrete 90-x-90-cm circular shape (Figure 58). A burnt fuel level was less than 10 cm thick, and no charcoal was present. Feature-65 was constructed immediately atop the old alluvium formation. An Elko dart point (DR-CAT-823) was recovered from the 0-10 cm level of the feature. The point was uncharred, suggesting it may have been deposited after the feature was created. The Elko dart point suggests a construction date for Feature-65 within the range of 2000 B.C. – A.D. 1100 (i.e., 4000-900 B.P.) or possibly older given its position. One volcanic interior flake, 18 quartz interior flakes, and two quartz retouched flakes were recovered. The quartz interior flakes are mostly small pressure flakes, and though a direct refit could not be found, the material quality is the same as the retouched flakes suggesting they are production waste from the creation of those two tools.

The granitic rocks formed a ring around a large red porphyritic volcanic rock in the center. The other two red porphyritic rock fragments were found on the east side of the feature atop the burnt rock floor. Red porphyry is not known to be a local volcanic variety; however, when the readily abundant green/gray porphyritic materials are fired they turn to this red color. It is possible that Feature-65 was set up to heat-treat a green porphyry cobble. Heat-treatment of lithic materials was conducted in order to reduce fracture toughness and improve the knapping qualities of porphyritic, brittle, or elastic lithic materials. Heat-treated materials require less force to produce flakes, and longer, thinner flakes can be detached from heat-treated stone than can be removed with equivalent force of unheat-treated stone (Crabtree and Butler 1964; Flenniken and Garrison 1975; Mandeville and Flenniken 1974; Rick 1978). The interior of this specific volcanic cobble was very coarse-grained and of low quality, so the cobble may have failed under firing and been left in the feature instead of being removed and worked into tools.

Feature-67: This thermal feature, likely an earth oven, was identified just below the surface immediately adjacent to Concentration 1 (jasper and silicified wood scatter). Some of the same exotic materials were recovered within Feature-67, indicating that Concentration 1 and Feature-67 may have been contemporaneous deposits. The entire feature covered an area roughly 3.0 x 2.0 m; however, the remains of the fuel floor were approximately 1.25 x 1.00 m, extending between 14 to 32 cmbs (under the mosaic feature floor) and located near the center of the excavation units (Figure 59). The portions of the feature to the east and west appeared to be toss piles from opening up the cap of the oven feature. Approximately 380 granitic and quartz fire-affected rocks were recorded. The profile showed a stepped construction to the central portion of the feature. Five jasper interior flakes, seven quartz interior flakes, one silicified wood interior flake, six volcanic interior flakes, one volcanic secondary flake, one piece of quartz shatter, and a multidirectional quartz core were recovered. The quartz flakes are of the same quality as the core material and, though a refit could not be made, are likely the result of core reduction. The relationship of Feature-67 to Concentration 1 is discussed further below in Section 6.6.2.

Radiocarbon results (Beta-340141) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 240 to 390.

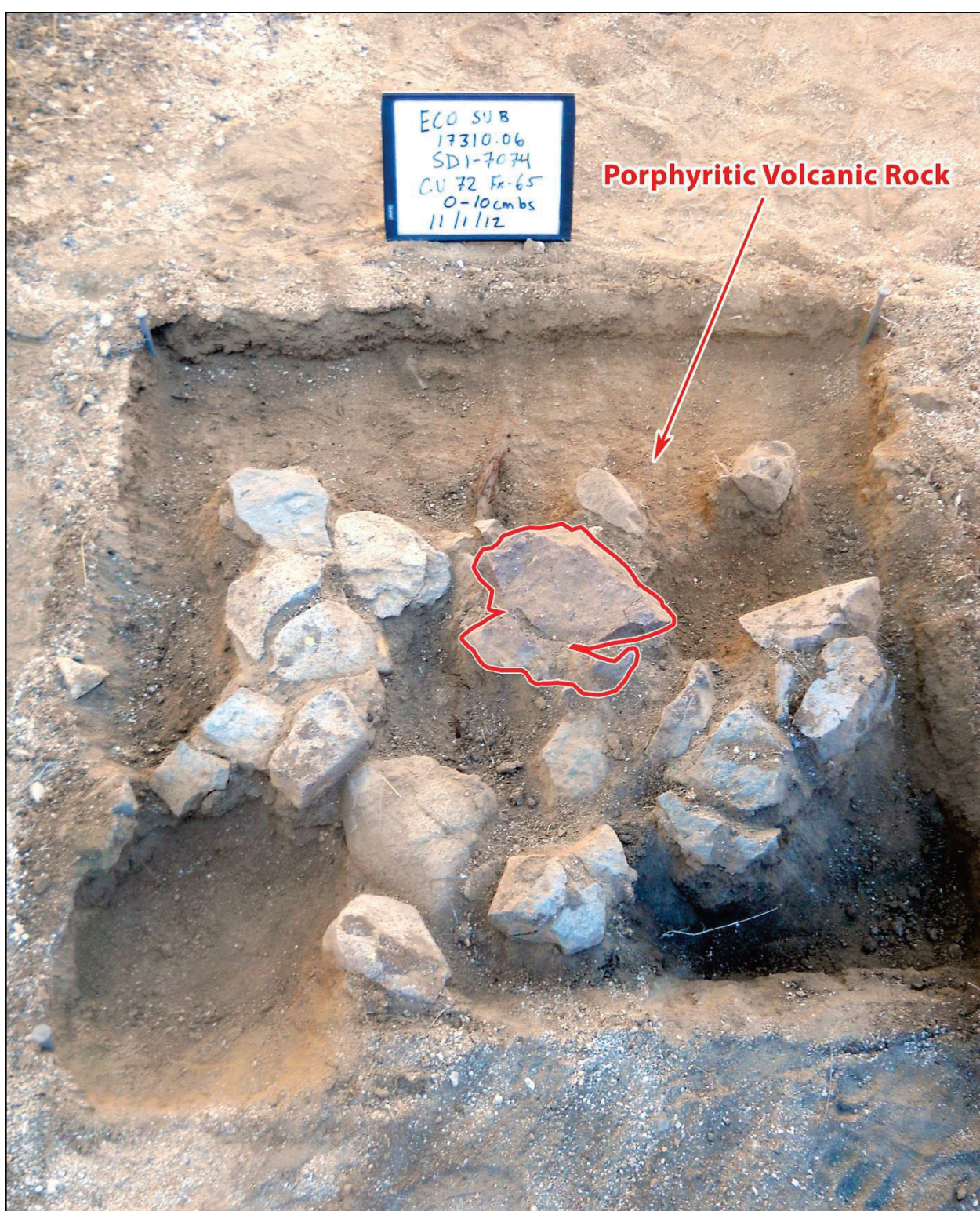


Figure 58. Feature-65.



Figure 59. Feature-67.

Soil samples collected from the feature were very heavily dominated by members of the sunflower family reflecting local growth and possibly utilization of the species. Only small quantities of other pollen types were noted, including juniper, oak, sagebrush, members of the ragweed/cocklebur portion of the sunflower family, saltbush and related plants, ephedra or Mormon tea, wild buckwheat, legumes, grasses, and chamise. The sample also contained a large quantity of microscopic charcoal (approximately 20,000 pieces in the volume required to count 100 pollen grains), which is consistent with the feature's use as an oven. Total pollen concentration was almost 3,100 pollen grains per cm³ of sediment.

Feature-72: This thermal feature was identified 10 cmbs. The feature was roughly circular, measuring 80 cm in diameter and contained 26 granitic fire-affected rocks, with an 8-cm-thick burn layer, dense with charcoal (Figure 60). The profile of the feature showed a stepped excavation. A Salton brown body sherd was recovered from the surface level above the feature, and a volcanic interior flake was collected.

Radiocarbon results (Beta-340146) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 1640 to present.



Figure 60. Feature-72

Macrofloral analysis of a charcoal sample taken from Feature-72 revealed two chunks of Rhamnaceae charcoal, reflecting a woody member of the buckthorn family, likely hollyleaf redberry (*Rhamnus ilicifolia*) or lotebush.

ECO-FX-A: This feature was identified near the original ground surface. ECO-FX-A was in relatively good condition, with most of the feature found intact after being exposed by a bulldozer pass. The oblong rock-lined pit contained approximately 58 quartz, granitic, and basalt fire-affected rocks, loose/mottled burnt soils with pieces of charcoal, and a compact layer of burnt soil in the eastern half (Figures 61 and 62). The fire-affected rock on the western side may have represented washout from the feature, as it was on the downslope side, or it may have been a discard pile from opening up the feature to remove the contents. The feature measured approximately 1.25 x 1.00 m. Charcoal and soil samples were collected, and a piece of quartz debitage was recovered. The collected samples were sent for radiocarbon, macrofloral, pollen, and FTIR analyses.



Figure 61. ECO-FX-A.



Figure 62. Profile of ECO-FX-A bisection showing the pit shape.

Radiocarbon results (Beta-370072) indicate the feature was constructed within a two-sigma calibrated date range of A.D. 1650 to the present.

The collected soil sample revealed a pollen record heavily dominated by the sunflower family (Appendix F). In addition, the sample displayed small quantities of local oak, sagebrush, members of the ragweed/cocklebur portion of the sunflower family, chamise, a member of the mustard family, saltbush and related plants, a member of the bindweed family, at least two types of ephedra or Mormon tea, wild buckwheat, spurge, a member of the evening primrose family (Onagraceae), grasses, and sumac. Total pollen concentration is nearly 3,800 pollen grains per cm³ of sediment.

The portion of the sediment sample examined for macrofloral remains yielded various charred yucca fragments, probably Mojave yucca leaf remains (i.e., leaf base, probable leaf, and vascular bundles). These charred fragments suggest the processing of yucca leaves to extract fibers. It is also possible that the leaves that were removed from the basal portion of the plant were discarded in the fire. One vitrified tissue fragment with a shiny, glassy appearance (due to fusion by heat) reflected plant tissue (charcoal) that was too vitrified for further identification. A few charred parenchymal tissue fragments (relatively undifferentiated tissue composed of many similar cells with thin primary walls) also were noted in the sample. Parenchyma occurs in many different plant tissues in varying amounts, but especially in large fleshy organs such as roots and stems (Hather 2000:1; Mauseth 1988). Uncharred floral remains included pigweed (*Amaranthus*), sandmat (*Euphorbia*), cypselea/panal (*Cypselea*-type), trefoil (*Lotus*), and unidentified seeds and seed fragments.

Macrofloral analysis of charcoal recovered from ECO-FX-A consisted of juniper and wood fragments from a member of the buckthorn family, likely hollyleaf redberry or lotebush, that were burned as fuel. Three charred lotebush seeds recovered from the feature suggest that that species was the buckhorn family source and that the branches may have been burned whole with fruit still attached. A few charred termite fecal pellets noted in the sample indicated that some of the burned wood contained termites when fired. In addition, an uncharred insect chitin fragment, moderate amounts of uncharred worm castings, and few roots/rootlets indicated limited subsurface disturbance.

ECO-FX-B: This thermal feature was identified in the same drainage as feature ECO-FX-A and was just below the surface. ECO-FX-B had little integrity following the grading pass and consisted of a loosely packed cluster of approximately 26 granite and quartz fire-affected rocks surrounded by burnt soil (Figure 63). No artifacts were recovered in this feature, which terminated at 30 cmbs and covered an area of approximately 1.0 x 1.0 m.

ECO-FX-D: This thermal feature consisted of three separate groupings of rock that contained more than 100 quartz and granitic fire-affected rocks (Figure 64). The fuel floor was near the center of the feature, with what appeared to be discarded piles of fire-affected rock on both sides of the hearth. The burn layer at the center measured approximately 1.0 x 1.0 m, with the two piles of discarded fire-affected rock also measuring approximately 1.0 x 1.0 m each. The feature appeared to be constructed in a shallow pit encountered approximately 20 cmbs and terminated at approximately 30 cmbs (Figure 65). The soil consisted of a dark brown/black sediment with charcoal throughout the feature. No artifacts were recovered.

ECO-FX-I1: This thermal feature consisted a roughly circular course of 20 basalt and granite fire-affected rocks. The feature was underlain by light brown silty sand and granitic gravel, with a concentrated burn layer on the southern half and a thin ash layer throughout the feature (Figure 66). One quartz flake was found at 30 cmbs. The dimensions of the feature measured approximately 1.5 x 1.0 m, and the burnt soil terminated at 40 cmbs.



Figure 63. Exposed ECO-FX-B.



Figure 64. ECO-FX-D.



Figure 65. Profile of ECO-FX-D bisection.



Figure 66. ECO-FX-I1.

number of charred lotebush seeds ($n = 236$), were noted in the sample. The presence of charred lotebush seeds suggests that it was the buckthorn species in question. Although vitrification of charcoal has been attributed to burning at high temperature and/or burning of green wood, the process of vitrification is not completely understood. Experimental studies and reflectance measurements on archaeological charcoal suggest that vitrification can occur at low temperatures. McParland and her associates (2010) were unable to produce vitrification during experimental high-temperature burning or by burning green wood. They suggest that vitrification is associated with postdepositional factors, however, the occurrence of charred seeds and twigs suggests greenwood may have been utilized. A single charred termite fecal pellet was also present in the sample, indicating that termite-infested wood was burned. Only a few uncharred insect fragments and worm castings were noted in the sample.

The high frequency of lotebush seeds indicates that lotebush (also known as wild plum) may have been the target species for the feature. However, lotebush seeds were not known ethnographically to have been roasted. Traditionally, lotebush seeds were treated in ways very similar to acorns: the outer fruit is either eaten fresh or dried, and the seed is dried, ground, leached to remove bitterness/toxins, and then boiled into cakes (Bean and Saubel 1972; Spier 1923; Wilken 2012). The presence of seeds indicates either that a large number of whole lotebush branches with fruits were used as fuel or that in the past there was an alternative method for processing lotebush seeds that required roasting.

ECO-FX-N: This thermal feature, likely an earth oven, consisted of more than 350 quartz, basalt, and granitic fire-affected rocks (Figure 68). The shape was roughly circular, measuring approximately 1.5 x 1.5 m, with a termination depth of approximately 30 cmbs. The sediments inside the feature were dark brown/black burnt compact soil surrounded by dark brown soil and fire-affected rock, ultimately surrounded by the light brown silty sand natural to the area. One interior quartz flake was recovered.



Figure 68. ECO-FX-N.

ECO-FX-O: This thermal feature was a large circular configuration consisting of more than 350 quartz, granitic, and basalt fire-affected rocks (Figure 69). ECO-FX-O measured approximately 2.0 x 2.0 m, with a termination at 50 cmbs (Figure 70). This feature was found in relatively good condition, with only trenching having disturbed a portion of the feature on the northern side. Two volcanic interior flakes, a unidirectional volcanic core, and a volcanic scraper were collected inside and adjacent to the feature. Sediments within the feature were a black silty soil surrounded by the light brown sandy silt and granitic gravel of the drainage channels.



Figure 69. ECO-FX-O.



Figure 70. Profile of ECO-FX-O.

Charcoal from the feature was radiocarbon dated (Beta-370076) within a two-sigma calibrated date range of A.D. 670 to 850.

The soil sample was dominated by sunflower family pollen and contained a smaller quantity of juniper and pine pollen. The cheno-am and grass pollen frequencies were slightly elevated in this sample, suggesting the possibility that seeds from a plant either group may have been processed. Recovery of moderately small to small quantities of sagebrush, plants in the ragweed/cocklebur portion of the sunflower family, chamise, a member of the bindweed family, two species of ephedra or Mormon tea, and wild buckwheat indicated local growth of those species. Although this sample exhibited a larger quantity of microscopic charcoal than did several other features, this sample had a total pollen concentration of nearly 6,700 pollen grains per cm³ of sediment. This high total pollen concentration suggests more recent intrusion of pollen that boosted the total pollen concentration.

Numerous charred yucca vascular bundle fragments were noted, suggesting the possibility that yucca leaves were used. One charred Malvaceae seed recovered in this sample represented a member of the mallow family. A few uncharred juniper seed fragments and a few roots/rootlets also were present in the sample. Charcoal was dominated by juniper, including juniper twigs. Several charcoal fragments of a woody buckthorn family species, likely hollyleaf redberry or lotebush, were also present, and charred termite fecal pellets were recovered in small quantities. Numerous uncharred worm castings were identified, indicating impact by bioturbation on ECO-FX-O.

ECO-FX-P: This thermal feature, likely an earth oven, was identified in the same drainage channel and to the east of Feature-15 and Feature-16. ECO-FX-P consisted of approximately 102 granitic and quartz fire-affected rocks and measured approximately 1.5 x 1.0 m, with a termination depth of 20 cmbs (Figure 71). Sediments in the feature consisted of dark brown and black soil, with small amounts of charcoal dispersed throughout. Light brown silty sand with granitic gravel surrounded the feature. No artifacts were recovered.



Figure 71. ECO-FX-P.

ECO-FX-W: This thermal feature was rather isolated from other features and recorded artifacts; only a piece of debitage and three potsherds were identified within 20 m of this location. ECO-FX-W was a small circular feature with approximately 28 quartz and granitic fire-affected rocks in a dense cluster (Figure 72). The feature measured approximately 1.0 x 1.0 m, with a termination depth of 20 cmbs (Figure 73). No artifacts were recorded during the excavation.



Figure 72. ECO-FX-W.



Figure 73. Profile of ECO-FX-W bisection.

ECO-FX-BB: This thermal feature, likely a washed-out earth oven, consisted of approximately 90 quartz and granitic fire-affected rocks (Figure 74). The central portion of ECO-FX-BB measured approximately 2.0 x 1.0 m, with a termination depth of 10 cmbs (Figure 75). A gray, ashy layer was observed in this central portion and trailed downslope, with displaced fire-affected rock increasing the area to 2.5 x 2.0 m. Some charcoal was present, but no burnt soil was apparent. The soil below the feature was heavily oxidized. The ash and high subsoil oxidation suggest that the feature burned hot and may have been left open while fired. No artifacts were recorded.



Figure 74 ECO-FX-BB.



Figure 75. Profile of ECO-FX-BB bisection.

ECO-FX-BE: This thermal feature included four basalt, 80 granitic, and one quartz fire-affected rocks (Figure 76). The feature measured 1.5 x 1.5 m, with a termination depth of 20 cmbs. ECO-FX-BE was circular in shape, with the majority of the eastern side intact. The feature contained an ash layer and charcoal throughout. A concentrated burn layer was observed in the center, and some fire-affected rock was displaced by construction disturbance. No artifacts were recorded.



Figure 76. Overview drawing of ECO-FX-BE.

ECO-FX-BG: This thermal feature, a large earth oven, consisted of a dense, roughly circular conglomeration of more than 400 quartz and granitic fire-affected rocks (Figure 77). ECO-FX-BG measured approximately 1.5 x 1.0 m, with a termination depth of 20 cmbs (Figure 78). The fire-affected rocks were densely packed, heavily burnt, and black, representing a neatly preserved earth oven. One artifact, a volcanic core, was collected.

ECO-FX-BI: This thermal feature consisted of a semicircular earth oven feature containing approximately 90 granitic and quartz fire-affected rocks with burnt soil and charcoal (Figure 79). The feature measured approximately 2.5 x 1.5 m, with a termination depth of 15 cmbs (Figure 80). Three samples of charcoal were collected from the feature, as it contained large chunks of in situ carbon. One volcanic secondary flake was collected.

Charcoal from the feature was radiocarbon dated (Beta-370075) within a two-sigma calibrated date range of A.D. 1520 to the present.



Figure 77. ECO-FX-BG.



Figure 78. Profile of ECO-FX-BG.



Figure 79. ECO-FX-BI.



Figure 80. Profile of ECO-FX-BI bisection.

The pollen record was dominated by high-spine Asteraceae, reflecting plants in the sunflower family. Smaller quantities of juniper, pine, and oak tree pollen that probably grew locally. Small quantities of sagebrush, a member of the chicory tribe of the sunflower family, chamise, saltbush or a related plant, two species of ephedra or Mormon tea, wild buckwheat, spurge, grasses, and sumac pollen indicate that local growth of those species. The fuel level sample yielded a large quantity of microscopic charcoal and a total pollen concentration, moderately high, at more than 3,000 pollen grains per cm³ of sediment.

The macrofloral record contained a moderate amount of charred *Yucca* sp. vascular bundle fragments, suggesting the processing of yucca leaves or possibly their inclusion as part of the fuel. Uncharred floral remains consisted of two sandmat seeds, one cholla (*Cylindropuntia*) seed fragment, one storksbill (*Erodium*) seed, and a juniper leaf fragment and seed. A few roots and moderate quantities of rootlets from postdepositional incursion suggest only a moderate amount bioturbation in the feature.

Analysis of charcoal yielded mostly juniper charcoal and twig fragments, with fewer buckthorn family charcoal fragments, indicating the burning of wood from those families. The presence of several charred juniper leaf fragments and charred juniper twigs may indicate the use of small dry twigs as a tinder. Numerous charred termite fecal pellets recovered in this sample reflect the burning of wood that was infested with termites.

ECO-FX-BJ: This thermal feature consisted of 36 large granitic fire-affected rocks in a semicircular arrangement. Recent spill-out from the feature was observed to the east and uphill, which was likely due to project construction activities. The feature measured approximately 1.0 x 0.5 m. Sediments were an ashy gray lens surrounding a concentrated burn layer near the center of the feature, with charcoal fragments throughout. No artifacts were recorded.

FX-BW-18: This feature was identified approximately 30 cm below original surface. It consisted of 18 embedded quartz and granitic fire-affected rocks with a large amount of charcoal and burnt soil (Figure 81). The feature measured 1.25 x 1.0 m with a thickness of 20 cm (Figure 82).



Figure 81. FX-BW-18.



Figure 82. Profile of FX-BW-18.

FX-CL-02: This thermal feature consisted of more than 400 granitic fire-affected rocks (most of them highly fragmented by grading activity) and very little charcoal (Figure 83). A volcanic scraper was identified on an exposed Anza Formation knoll immediately adjacent to the feature (within 5 m).

FX-CL-23: This thermal feature was identified approximately 35 m east of FX-CL-22 and in the same drainage system. Thirteen quartz fire-affected rocks, burnt soil, and charcoal covered an area roughly 90 x 60 cm and to a depth of 20 cmbs.

FX-CL-24: This thermal feature was identified adjacent to and stratigraphically above FX-BW-19 and FX-KM-113. The feature consisted of 30 quartz fire-affected rocks surrounded by burnt soil and covered an area approximately 1.4 x 1.1 m.

FX-CL-25: This thermal feature consisted of 70 granitic fire-affected rocks surrounded by burnt soil and a minimal amount of charcoal. The feature measured approximately 1.0 x 1.0 m.

FX-CL-29: This thermal feature consisted of 64 granitic fire-affected rocks and dark ashen sandy soil with charcoal dispersed throughout. The feature covered an area of approximately 1.5 x 1.5 m.

FX-CL-83: This thermal feature contained approximately 40 granitic fire-affected rocks, burnt soil, and charcoal, covering an area of approximately 1.0 x 0.9 m and to a depth of 35 cmbs (Figure 84).

FX-DC-132: This thermal feature (also labeled KM-55) was identified approximately 6 m below the ground surface (Figure 85). FX-DC-132 was heavily disturbed and showed a roughly circular fire-affected rock pattern measuring 1.1 x 1.1 m, with some in situ charcoal bits. Sixty-one granitic and four quartz fire-affected rocks were present. The feature appeared to have been excavated into the New Alluvium deposits and was observed at the bottom of a channel in the Anza Formation atop a thin layer of Older Alluvium.



Figure 83. Profile of FX-CL-02 bisection.



Figure 84. Profile of FX-CL-83, bisection created by grading activity.

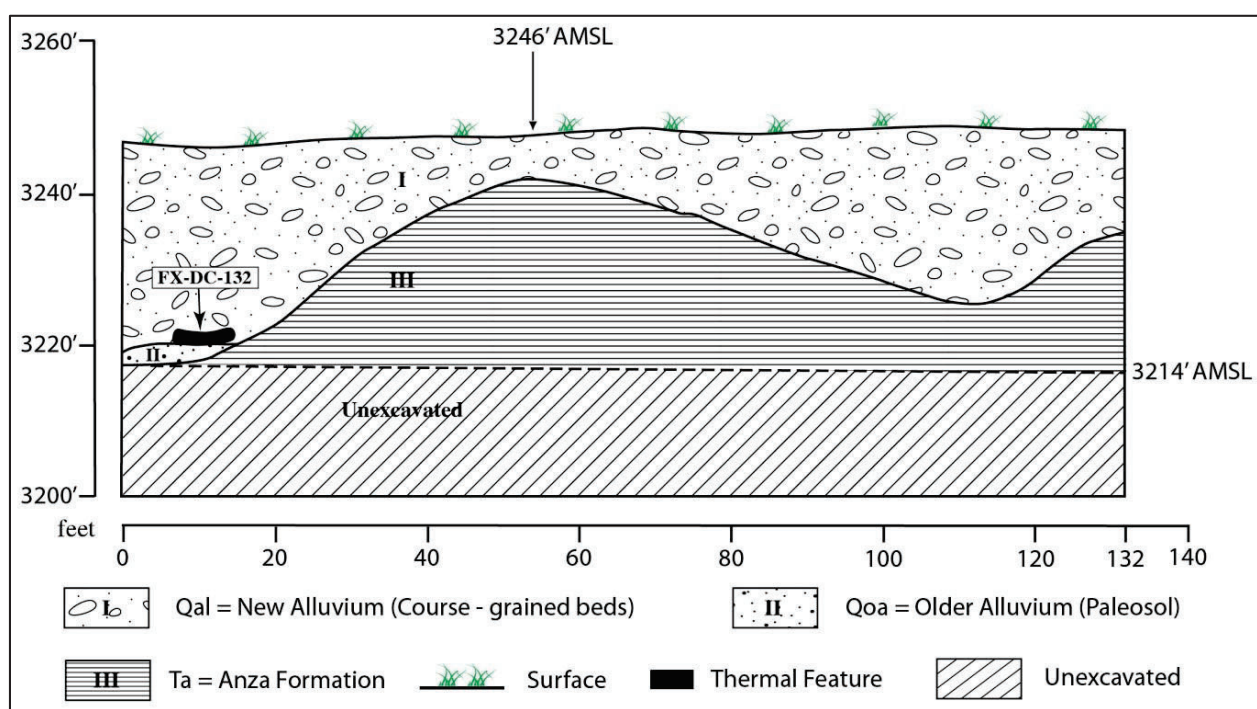


Figure 85. Stratigraphic profile of the vicinity of FX-DC-132 (drawn by Brad Riney, San Diego Natural History Museum).

Charcoal from the feature was radiocarbon dated (Beta-357180) within a two-sigma calibrated date range of 6690 to 6530 B.C.

FX-HS-11: This thermal feature included approximately 40 fire-affected rocks surrounded by a matrix of dark black, loose ashy soil (Figure 86). It covered an area of approximately 1.0 x 1.0 m to a depth of 10 cmbs.

FX-HS-20: This thermal feature was identified roughly 1.7 m below the modern ground surface and consisted of approximately 50 fire-affected rocks, burnt soil, and charcoal covering an area of roughly 1.0 x 1.0 m.

FX-IC-37: This feature, likely an earth oven, was found to the east and slightly upslope in the same drainage in which FX-IC-36 was observed, 3.6 m below original ground surface. The feature, roughly 1.0 m. in diameter, consisted of fire-affected rock, bits of charcoal, and a fuel floor (Figures 87 and 88). The fire-affected rock was made up of granitic (n = 40) and quartz (n = 3) rock, and the feature was sitting on top of a level of granitic gravel. The two stones on top appeared to be coping stones. Only the northwest portion of the feature appeared to have been impacted by tractor tire treads.

Charcoal from the feature was radiocarbon dated (Beta-357178) within a two-sigma calibrated date range of 7140 to 7040 B.C.

The recovered samples yielded only three pollen grains, all identified as high-spine Asteraceae. An estimated 1,350,000 pieces of microscopic charcoal occupied the volume that would have been required to find approximately 100 pollen grains. The charcoal yield was approximately the same as was identified in FX-TRT-56. As these are the two oldest thermal features identified at SDI-7074, it is an interesting similarity. Total pollen concentration was calculated at slightly more than 200 pollen grains per cm³.



Figure 86. FX-HS-11.

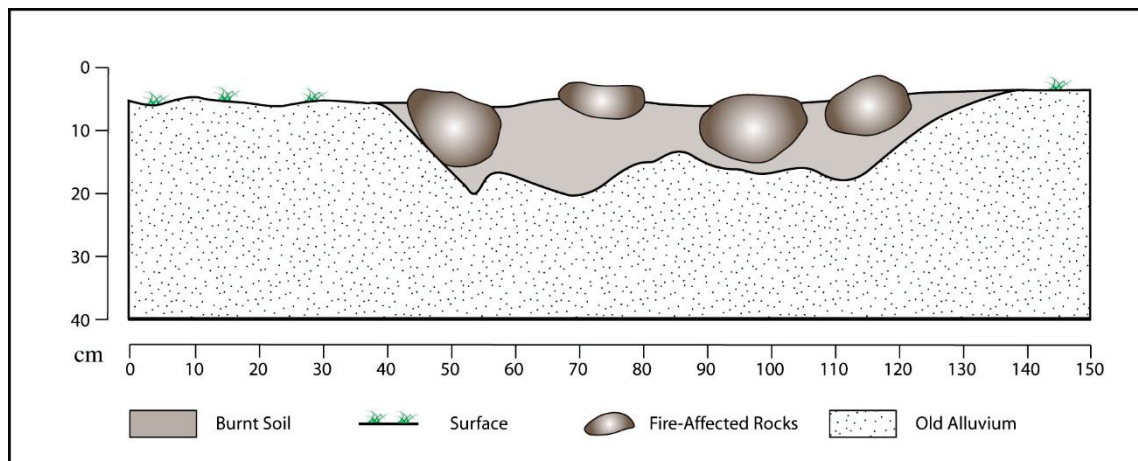


Figure 87. Profile view of FX-IC-37.



Figure 88. FX-IC-37 exposed (top view).

The macrofloral record included juniper charcoal fragments, reflecting use of the wood as a fuel. Numerous charred termite fecal pellets indicated that wood used as fuel was infested with termites.

FX-IC-53: This thermal feature was circular and consisted of approximately 20 quartz and granitic fire-affected rocks, burnt soil, and charcoal covering an area roughly 1.0 x 1.0 m, to a depth of 15 cmbs.

FX-KM-01: This thermal feature was identified near Concentration 6, a quartz debitage scatter. The feature contained 40 fire-affected rocks and dark soil with no observable charcoal over an area of roughly 1.2 x 0.8 m and to a depth of 10 cmbs.

FX-KM-95: This thermal feature consisted of 22 quartz fire-affected rocks with burnt soil and charcoal, over an area of approximately 80 x 60 cm and to a depth of 15 cmbs. The feature appeared to have undergone postdepositional impacts from root systems that had carried newer, darker charcoal into the older burnt soil lens. An approximately 4-cm-diameter track of this incursion was observed in the unburnt soil adjacent to the feature.

FX-KM-113: This thermal feature was approximately 2.5-3 m below the modern surface and roughly circular (3.0 x 2.7 m), with a fuel floor approximately 30 cm thick at the deepest point (Figures 89 and 90). Due to its size and the depth of the fuel level, this deep feature is presumed to be an earth oven. More than 200 pieces of fire-affected rock and two fire-affected milling slab fragments (M-CAT-272 and M-CAT-386) were observed.



Figure 89. Exposed feature FX-KM-113.



Figure 90. Profile of feature FX-KM-113 with in situ charcoal deposits.

Some intrusive modern small animal bones and 16 pieces of debitage (15 volcanic and one quartz) were recovered from FX-KM-113. Most of the volcanic material is porphyritic. The flakes are interior, with the exception of one secondary flake. The two largest flakes and the smaller flakes that are technologically identifiable are from core reduction. The volcanic flakes vary in their material, and it appears that few groups of two to three flakes were struck from any single core.

Charcoal from the feature was radiocarbon dated (Beta-357181) within a two-sigma calibrated date range of 7560 and 7380 B.C.

The two milling slab fragments are unifacial, made from granitic rock, and do not refit. M-CAT-272 measures 27.8 x 18.5 x 11.5 cm and weighs 4,762.8 g. The milled surface is broken laterally and the remaining element has no rough spots, being completely polished, and measures approximately 17.5 x 18.0 cm, with no depth and covers an entire face. The second milling slab fragment, M-CAT-386, measures 25.2 x 16.5 x 10.3 cm and weighs 3,629.0 g. The milled surface takes up roughly two-thirds of one face, has several rough patches, and is broken along three margins. The surviving portion of the milled surface measures approximately 15.0 x 14.5 cm, with less than 1.0 cm of depth. Both slabs show signs of having been burned on all sides, with the darkest char marks on the milled surfaces, suggesting that the milled surfaces faced toward the hotter portions of the feature. The incorporation of the fragmentary milling slabs into the feature's floor suggests that they were repurposed for use as hot rocks. As discussed above, the repurposing of milling slab fragments into feature structures was seen in nine other features at SDI-7074: however, FX-KM-113 is the only early feature to show this practice.

This pollen analysis yielded nearly equal quantities of the sunflower family and cheno-am, saltbush and related plants. Recovery of moderately small to small quantities of juniper, pine, and oak pollen reflected local tree growth. Recovery of moderate to small quantities of sagebrush, ragweed/cocklebur-type plants in the sunflower family, members of the chicory tribe of the sunflower family, chamise, ephedra or Mormon tea, wild buckwheat, and grass pollen represented local plants of those varieties. Total pollen concentration was slightly more than 2,650 pollen grains per cm³ of sediment.

The charred macrofloral assemblage represented various wood taxa, including buckthorn family, juniper, vitrified mesquite (*Prosopis*), and saltbush, reflecting that members of those varieties were used as a fuel source. Numerous charred termite fecal pellets suggest that some of the wood burned contained termites. A few uncharred worm castings were observed, indicating a minimal bioturbation affect.

FX-LT-33: This thermal feature consisted of approximately 66 granitic fire-affected rocks with burnt soil and charcoal, covering an area of roughly 1.1 x 0.9 m and extending to a depth of 20 cmbs (Figure 91). Many of the fire-affected rocks were broken or crushed from grading activities.

FX-LT-46: This thermal feature contained 102 granitic and quartz fire-affected rocks arranged in a circular, densely packed mosaic pattern roughly 50 cm in diameter (Figures 92 and 93). Charcoal remains were moderate and localized within the burnt soil deposits.

FX-MS-07: This semi-intact thermal feature consisted of dark, charcoal-rich sandy soil and 37 medium-sized and seven large (over-20-cm-diameter) fire-affected rocks. Overall diameter of the feature was approximately 1.3 m. Artifacts from the upper 10 cm of the feature include 14 pieces of volcanic debitage, a quartz interior flake, and a volcanic scraper. Much of the thermal feature had been removed by grading activities and smeared over an area extending approximately 10 m to the west.

FX-MS-13: This large thermal feature, likely an earth oven, contained more than 200 fire-affected rocks with burnt soil, measuring approximately 4.5 m in diameter.



Figure 91. FX-LT-33.

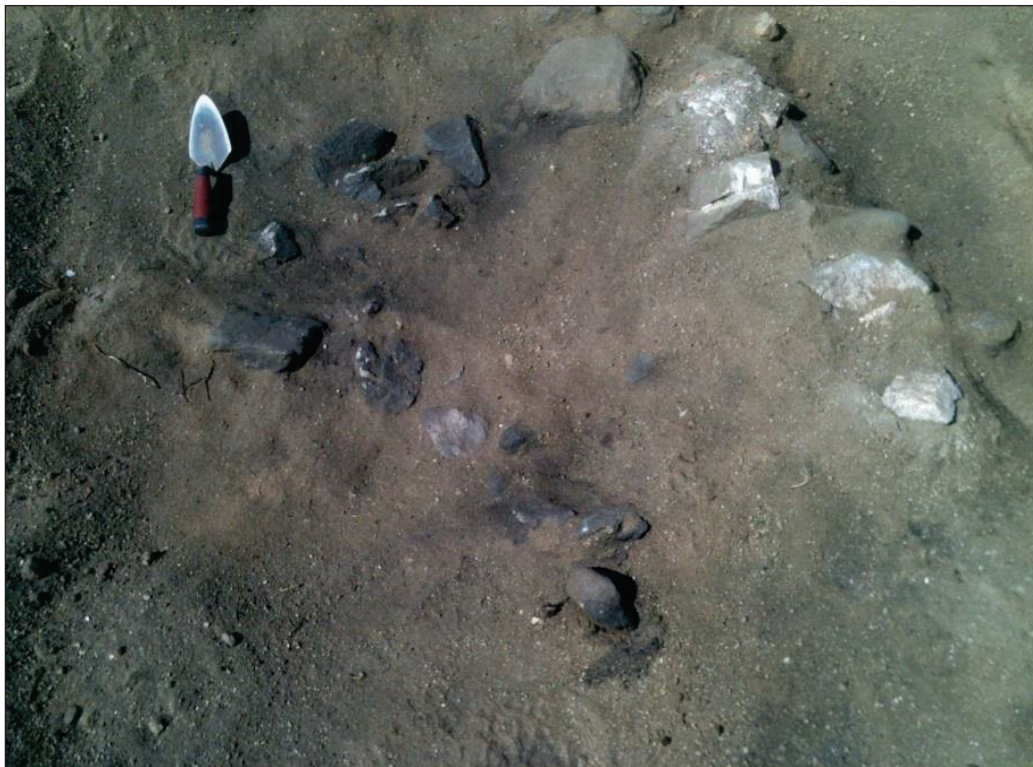


Figure 92. FX-LT-46.



Figure 93. FX-LT-46 with a mosaic floor.

FX-TRT-33: This large thermal feature was identified in the same drainage channel as and to the east of FX-KC-08 and FX-KM-14. More than 120 fire-affected rocks with burnt soil were recorded over an area measuring approximately 3 m in diameter.

FX-TRT-100: This thermal feature was observed in the same drainage channel as and to the west of FX-CL-16. The feature contained more than 100 fire-affected rocks, with a surrounding dark, sandy soil, covering an area of approximately 2.0 x 2.0 m (Figure 94).

FX-TRT-108: This thermal feature was relatively isolated. The feature consisted of more than 45 fire-affected rocks and burnt soil covering an area of approximately 1.0 x 0.8 m, and extending to a depth of 10 cmbs. No artifacts were observed.

ECO-SWPL-2: This thermal feature remnant was mostly washed out and only slightly intact, with 32 granitic and quartz fire-affected rock (22 of them embedded), a thin burn layer, and some intact charcoal deposits (Figure 95).

Oblong Oven Features with Rock Floors

Feature-12: This thermal feature remnant was in the same drainage channel as Feature-13 and Feature-41, and located in between them. Feature-12 consisted of 12 granitic fire-affected rocks in a tight cluster near the center of a burn layer only 2 cm thick (Figure 96). No charcoal was present, and the feature was identified directly atop old alluvium soils.



Figure 94. FX-TRT-100

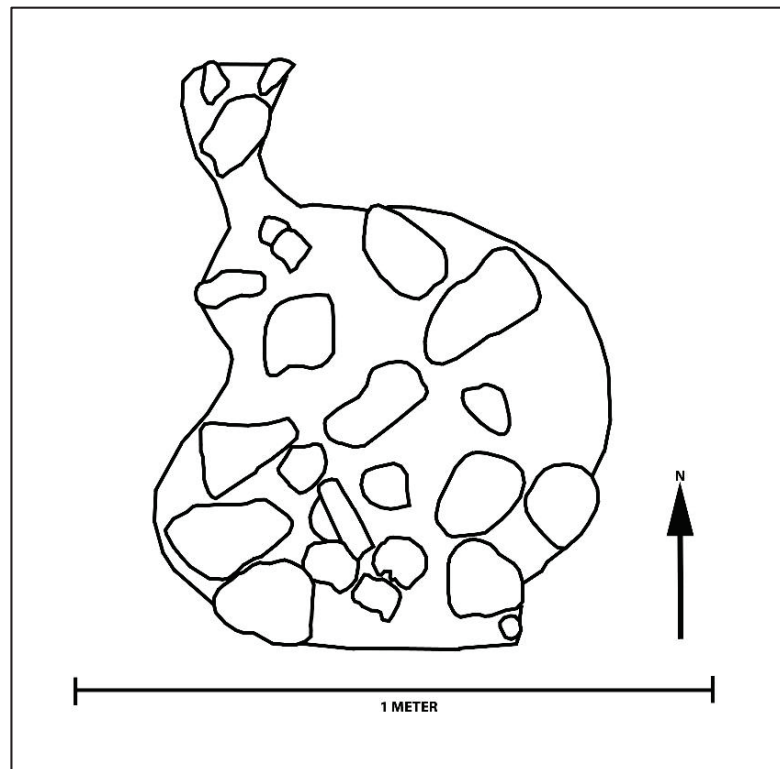


Figure 95. Overview drawing of ECO-SWPL-2.



Figure 96. Feature-12.

Radiocarbon results (Beta-340136) dated the feature within a two-sigma calibrated date range of A.D. 600 to 660.

The pollen record is co-dominated by members of the sunflower family and grasses, indicating local growth of those species. Small quantities of pines and oak pollen indicate that grew in the region. Other herbaceous and shrubby vegetation is represented by wild buckwheat and chamise. The sample contained a few algal spores, indicating that the feature probably held water at least after a rain subsequent to its abandonment. The large quantity of microscopic charcoal noted in this sample indicates that the sample was collected from an area that contained burned fuel. Although the total pollen concentration was nearly 1,550 pollen grains per cm³ of sediment, the large quantity of microscopic charcoal made separating pollen extremely difficult.

The charcoal sample contained one fragment of juniper charcoal, indicating use of juniper wood as fuel.

Feature-18: This thermal feature was found amid an area that may represent an historic-period or modern camp. Feature-18 contained more than 80 granitic fire-affected rocks with little burnt soil and charcoal to a depth of 24 cmbs (Figure 97). A metal hinge labeled “TMC 1847” was recovered from the feature, and the immediate area around this location contained a wood-burning stove, a dispersed pile of sawed wood, and a mix of prehistoric and historical artifacts.

Feature-42: This thermal feature consisted of 105 granitic, basalt, and quartz fire-affected rocks with burnt soil and charcoal in a loose, oblong arrangement measuring approximately 1.3 x 0.8 m, to a maximum depth of 17 cmbs (Figure 98). The feature sloped slightly to the northeast, into the drainage channel, and had been impacted by a woody shrub observed in the eastern portion of the deposit. Thirteen pieces of quartz shatter were recovered at this feature.



Figure 97. Feature-18.



Figure 98. Overview drawing of Feature-42.

Radiocarbon results (Beta-340137) date the feature within a two-sigma calibrated range of A.D. 690 to 880.

Pollen identified from Feature-42 was dominated by members of the sunflower family, indicating that they were abundant in the area. Recovery of small quantities of juniper, pine, and oak pollen indicates that all three grew in the region. Small quantities of sagebrush, members of the ragweed/cocklebur portion of the sunflower family, saltbush and related plants, ephedra or Mormon tea, wild buckwheat, members of the spurge family, legumes, prickly pear cactus (*Opuntia*), grasses, members of the rose family including chamise, and globe mallow represent local growth of those species. It is possible that the elevated quantity of grass pollen, which was accompanied by aggregates (clumps of a single type of pollen), and the small quantity of prickly pear cactus pollen reflect the possible use or processing of grasses, perhaps the seeds, and prickly pear cactus in this feature. It is also possible that either or both of these taxa may have been used as part of a buffering plant layer. Recovery of a large quantity of microscopic charcoal fragments and pollen in a poor state of preservation is consistent with burning in this feature. Total pollen concentration was more than 3,400 pollen grains per cm³ of sediment.

Macrofloral analysis on charcoal recovered from the feature showed two fragments of juniper charcoal were present, evidently as a result of burning juniper wood as fuel.

ECO-FX-E: This thermal feature consisted of a loose grouping of 93 basalt, granitic, and quartz fire-affected rocks and one concentration of charcoal (Figures 99 and 100). The sediments around the feature consisted of naturally occurring light brown silty sand and granitic gravel. ECO-FX-E was oblong and measured approximately 2.5 x 2.0 m. No artifacts were recovered from this feature.



Figure 99. ECO-FX-E.



Figure 100. Detail of charcoal concentration within feature ECO-FX-E.

ECO-FX-J: This thermal feature, likely an oven, was a loose collection of approximately 221 pieces of basalt, granitic, and quartz fire-affected rock (Figure 101). As mentioned above, the feature sat in line with ECO-FX-I2, Feature-24, and Feature-25 within the same drainage. ECO-FX-J was slightly oblong, measured approximately 3.5 x 2.0 m, and terminated at approximately 30 cmbs (Figure 102). One charcoal sample was taken in situ at 20 cmbs. The surrounding matrix consisted of light brown sandy silt with granitic gravel, while the sediments in the feature included dark black soil that was burnt immediately around the fire-affected rock. The original center of the feature appeared in the northern section, and the fire-affected rock scattered to the south appeared to be remnants of a toss pile from opening the oven. No charcoal was observed in the southern portion. One charred granitic milling slab fragment (M-CAT-314) was recovered and had been incorporated into the feature's mosaic floor.

Charcoal from the center of the feature was radiocarbon dated (Beta-370074) within a two-sigma calibrated date range of A.D. 900 to 1020.

Samples removed from ECO-FX-J were submitted for pollen, macrofloral, and FTIR analysis. Pollen analysis indicated dominance by high-spine Asteraceae pollen, reflecting an abundance of plants from the sunflower family in the local vegetation. Small quantities of juniper, pine, sagebrush, members of the ragweed/cocklebur portion of the sunflower family, plants in the chicory tribe of the sunflower family, chamise, saltbush and related plants, members of the bindweed family, ephedra or Mormon tea, wild buckwheat, prickly pear cactus, and grass pollen indicating the local vegetation. Total pollen concentration was slightly more than 1,000 pollen grains per cm³ of sediment.



Figure 101. ECO-FX-J.



Figure 102. Profile of ECO-FX-J bisection.

Several charred yucca (likely Mojave yucca) vascular bundle fragments were recovered in the macrofloral portion of the sample. Modern plants were represented by an abundance of roots and rootlets. Juniper charcoal, including fragments from a twig, dominated the charcoal record, which was completed with two buckthorn (likely hollyleaf redberry or lotebush) charcoal fragments. A few charred termite fecal pellets indicated burning of wood that contained termites. Only a few uncharred insect chitin fragments and worm castings reflect limited disturbance from insect and worm activity.

FX-BW-19: This feature was identified 3.4 m below the original ground surface. It was in the same buried drainage channel as FX-KM-113. Fifty-five embedded granitic fire-affected rocks, with numerous pieces of charcoal and burnt soil, were recorded in a single course with a roughly circular shape measuring 1.3 x 1.4 m and terminating at 24 cmbs (Figures 103 and 104). Micro-stratigraphic observations showed that FX-BW-19 sat atop the older alluvium and had at least two episodes of silt intrusion and intermixing with the uppermost fuel level prior to the stabilization of the deposit (Brad Riney, personal communication 2013). Each layer of silt was less than 2 cm thick and appeared to have filled in the uneven surfaces of what was then the exposed feature. Evidently the feature had been inundated by more than a single hydrological event.

Charcoal from the feature was radiocarbon dated (Beta-370077) within a two-sigma calibrated date range of 4460 to 4350 B.C.

Only one pollen grain (wild buckwheat) was recorded, with a total pollen concentration calculated at approximately 372 pollen grains per cm³ of sediment. Microscopic charcoal overwhelmed the record, and it was calculated that approximately 920,000 pieces of charcoal would be present in the space required to find 100 pollen grains.



Figure 103. FX-BW-19.



Figure 104. Profile of FX-BW-19.

The macrofloral sample yielded one charred hedgehog cactus (*Echinocereus*) seed fragment, one charred juniper seed fragment, and a single charred yucca leaf fragment, suggesting preparation of hedgehog cactus fruits and juniper berries, and processing of yucca leaves or their use as kindling. Wood taxa used as fuel included saltbush, juniper, a member of the buckthorn family (possibly hollyleaf redberry or lotebush), and a member of the rose family (possibly chamise). The Rosaceae charcoal recovered was vitrified.

FX-CL-90: This thermal feature consisted of 16 granitic fire-affected rocks surrounded by a dark black and brown, burnt soil matrix in an area measuring approximately 2.1 x 0.9 m, to a depth of 25 cmbs.

FX-DC-137: This thermal feature, likely an earth oven, was identified in line with and between ECO-FX-T and FX-CL-25. The feature consisted of approximately 78 pieces of fire-affected rock, surrounded by a gray ashen sandy soil. The feature covered an area of approximately 3.5 x 1.3 m, at a depth of 15 cmbs.

FX-DC-138: This thermal feature was identified adjacent to and south of ECO-FX-T. It covered an area of approximately 8.0 x 4.0 m, with a depth 30 cmbs. The fire-affected rock ($n = 24$) was loosely consolidated at the center of the feature with a dark black/burnt sandy soil and surrounded by additional, largely dispersed arrangement of fire-affected rocks representing either washout from the feature or toss piles created by removal of lid stones. No charcoal was observed in the scatter, so the second interpretation is more likely.

FX-DC-144: This thermal feature was identified in the same drainage as and to the northeast of FX-CL-29. It consisted of mottled dark sandy soil and 25 fire affected-rocks covering an area of approximately 2.0 x 1.0 m, at a depth of approximately 15 cmbs.

FX-HS-23: This thermal feature was identified roughly 30 cm below the modern ground surface and consisted of approximately 45 fire-affected rocks surrounded by a dark black/brown loose soil matrix covering an area of approximately 2.75 x 1.5 m with a thickness of 10 cm.

FX-KC-08: This thermal feature was identified adjacent to FX-KM-14 and in the same drainage as and to the west of FX-TRT-33 (Figure 105). Some embedded fire-affected rock was observed, and four volcanic interior flakes, one volcanic primary flake, and one piece of volcanic shatter were recovered from the surrounding soils (Figures 106 and 107). The three pieces of debitage broadly indicate that late stage lithic reduction may have been conducted here. Two burnt milling slab fragments (M-CAT-271 and M-CAT-313) were recovered and had been incorporated into the feature's structure.



Figure 105. Profile in sidewall of FX-KC-08 upon identification.



Figure 106. FX-KC-08.



Figure 107. Profile of FX-KC-08 bisection.

Soil from FX-KC-08 was analyzed for pollen and macrofloral remains. The soil sample was marked by an overwhelming dominance by pollen in the sunflower family. Moderately small to small quantities of included sagebrush, plants in the ragweed/cocklebur portion of the sunflower family, chamise, saltbush or related plants, ephedra or Mormon tea, wild buckwheat, spurge, and grasses indicating local vegetation. Total pollen concentration was high, at more than 4,700 pollen grains per cm^3 of sediment. The quantity of microscopic charcoal was also high, at more than 31,000 pieces estimated for the volume required to count 100 pollen grains. The higher total pollen count may reflect recent or relatively modern pollen that had intruded into the sediments, as older pollen would have been proportionately more thoroughly destroyed by the firing of the feature.

The charcoal record, dominated by buckthorn family fragments, also included one juniper fragment. This reflected burning primarily of wood from a shrubby plant in the buckthorn family and a small amount of juniper. Recovery of a few charred termite fecal pellets suggested that some of the wood that was burned contained termites. A few uncharred roots/rootlets and moderate quantities of uncharred worm castings were also noted in the sample, indicating some bioturbation within the feature, which possibly accounts for the high pollen count.

FX-TRT-56: This thermal feature, likely an earth oven, was identified at a depth of 6.4 m (Figure 108). FX-TRT-56 had an oblong structure, approximately 2.5 m long and in the east wall of a grading cut (Figure 157). The fuel floor is approximately 36 cm thick at the center and black with a large amount of in situ charcoal (Figures 109, 110 and 111, center of feature not pictured). Twenty to 25 fire-affected granitic and quartz rocks were counted. (The edge of the feature was partially impacted by the grader, and an exact fire-affected rock count could not be made.) Artifacts recovered included a quartz core, seven pieces of quartz shatter, and 48 pieces of volcanic debitage (one primary flake, four secondary flakes, 16 interior flakes, and 27 pieces of shatter). Many of the pieces of volcanic debitage refitted and showed an intentional rather than natural break pattern (Figure 112). In addition, the edges of the flakes were still fairly sharp, and smaller protrusions that would typically have broken off in alluvial environments were intact (Figure 113), indicating a very rapid deposition of the artifacts or that the flakes were in situ and had not been redeposited alluvially. FX-TRT-56 sat just above the old alluvium.

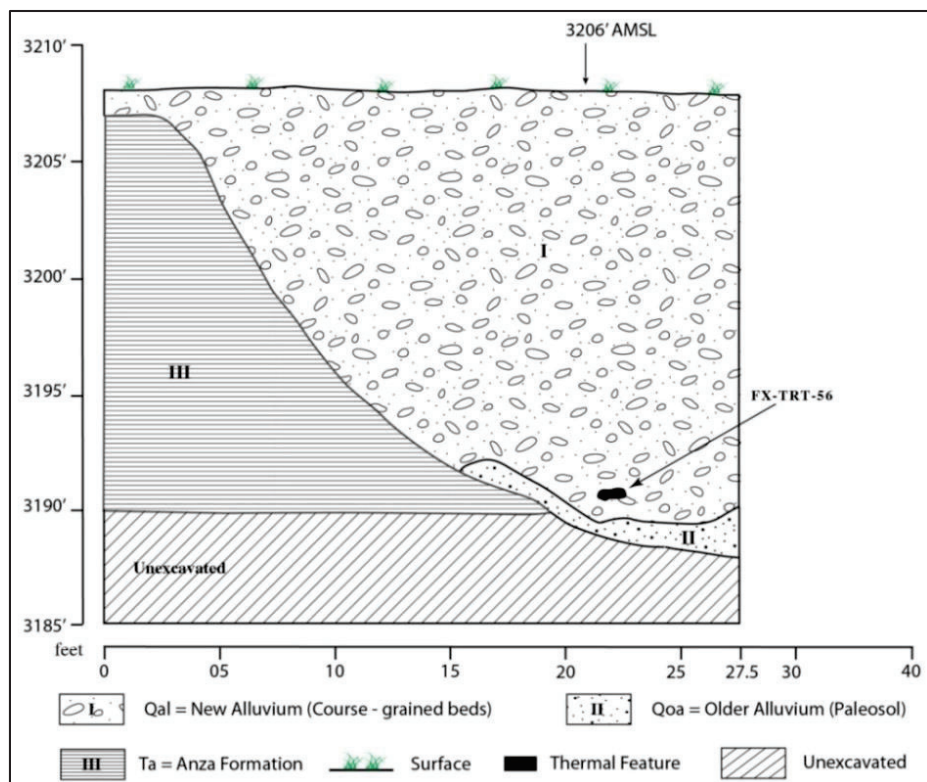


Figure 108. Stratigraphic profile of the vicinity of FX-TRT-56 (by Brad Riney, San Diego Natural History Museum).

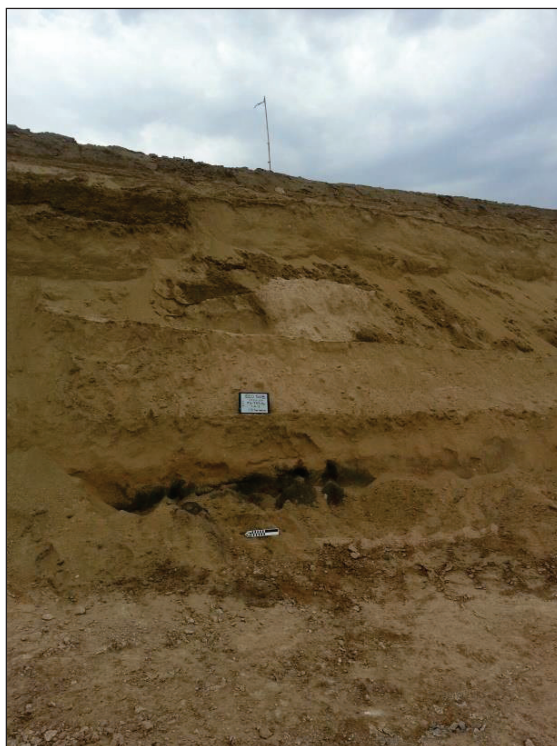


Figure 109. Profile of feature FX-TRT-56 exposed in excavation cut.



Figure 110. Detail of Feature FX-TRT-56 and in situ fuel floor.



Figure 111. Detail of Feature FX-TRT-56 and in situ fuel floor.



Figure 112. Refit of volcanic debitage recovered from Feature FX-TRT-56.

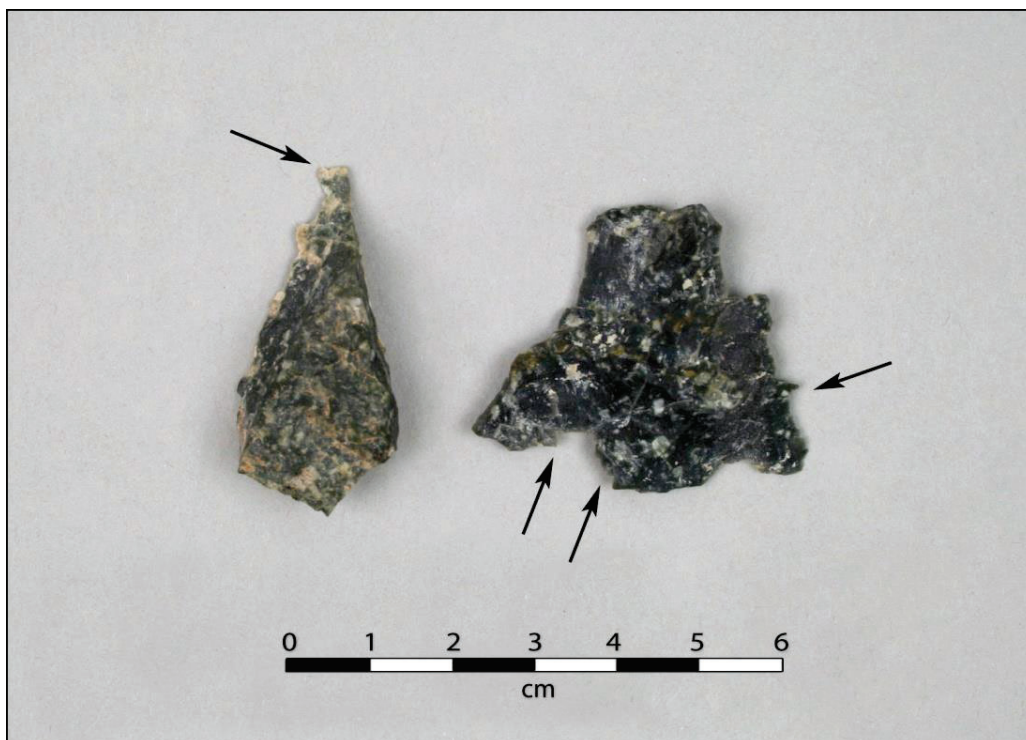


Figure 113. Fragile protrusions that would typically have broken off in erosional contexts, indicating minimal postdepositional movement.

Charcoal from the feature was radiocarbon dated (Beta-357179) within a two-sigma calibrated date range of 7780 to 7590 B.C.

Only two pollen grains were observed in the sediment sample that was heavily dominated by microscopic charcoal. An estimated 1,420,000 pieces of microscopic charcoal would have occupied the space necessary to count 100 pollen grains. This reflected a calculated 372 pollen grains per cm³ of sediment.

Nine charred juniper seed fragments were recovered, suggesting either processing of juniper berries or burning of whole juniper branches or twigs with berries attached. Buckthorn family charcoal was most abundant, followed by juniper. Other wood taxa identified in the charcoal record included cholla and California laurel (*Umbellularia californica*). A few charred termite fecal pellets were observed, indicating use of wood infested with termites for fuel. A few uncharred worm castings and uncharred roots/rootlets also were noted, suggesting limited bioturbation.

Oblong Ringed Oven Features

Feature-15: This thermal feature was identified in the same drainage channel as Feature-16 and to the west of it. Feature-15 was an elliptical arrangement of 47 embedded granitic fire-affected rocks, with dark and ashy soil mottled throughout with the light brown silty sand and granitic gravel of the drainage (Figure 114). Charred juniper seeds (n = 33) were recovered, but no charcoal was observed. A number of uncharred seeds and roots were present. Feature-15 was one of the few examples of a rock ring rather than the typical mosaic rock floor feature at SDI-7074, and resembles the construction of earth ovens identified near the town of Ocotillo at IMP-12,027. A volcanic interior flake was recovered.

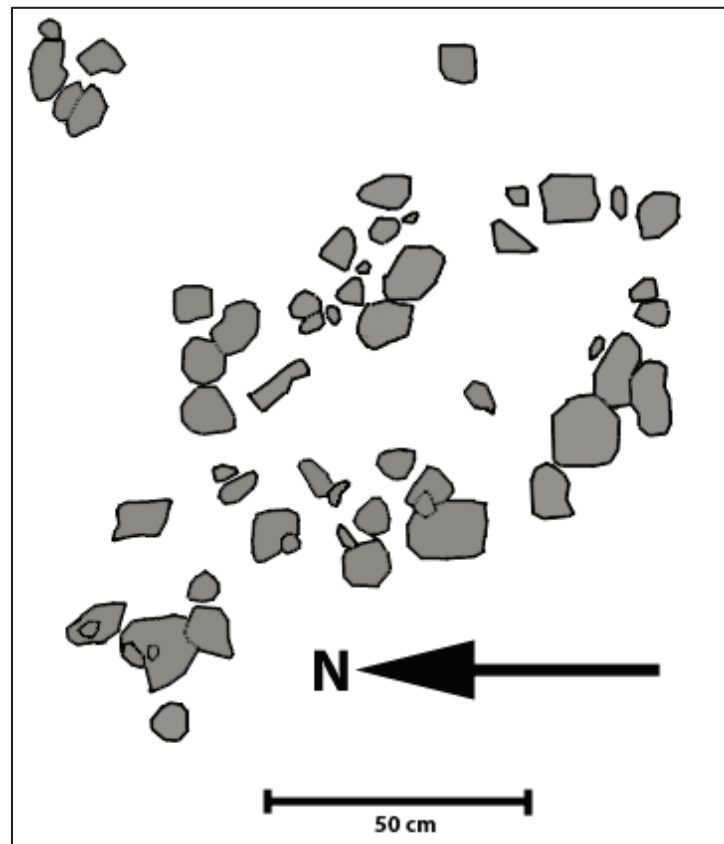


Figure 114. Plan drawing of Feature-15 showing rock ring construction.

Feature-44: This thermal feature was identified approximately 10 cmbs among a cluster of features that included Feature-17, Feature-18, and Feature-43. The feature consisted of 79 granitic and quartz fire-affected rocks, most of which were loosely arranged on the surface, with 27 embedded in a ringed arrangement (Figure 115). No blackened fuel level or charcoal were present, only an ashy lens at the center of the feature. One charred lotebush seed was identified, indicating either processing of lotebush seeds or (more likely given the low count) whole branches were used as fuel. Two pieces of quartz shatter, a volcanic interior flake, a volcanic secondary flake, and a fragmented *Argopecten* sp. shell (DR-CAT-301) were recovered.

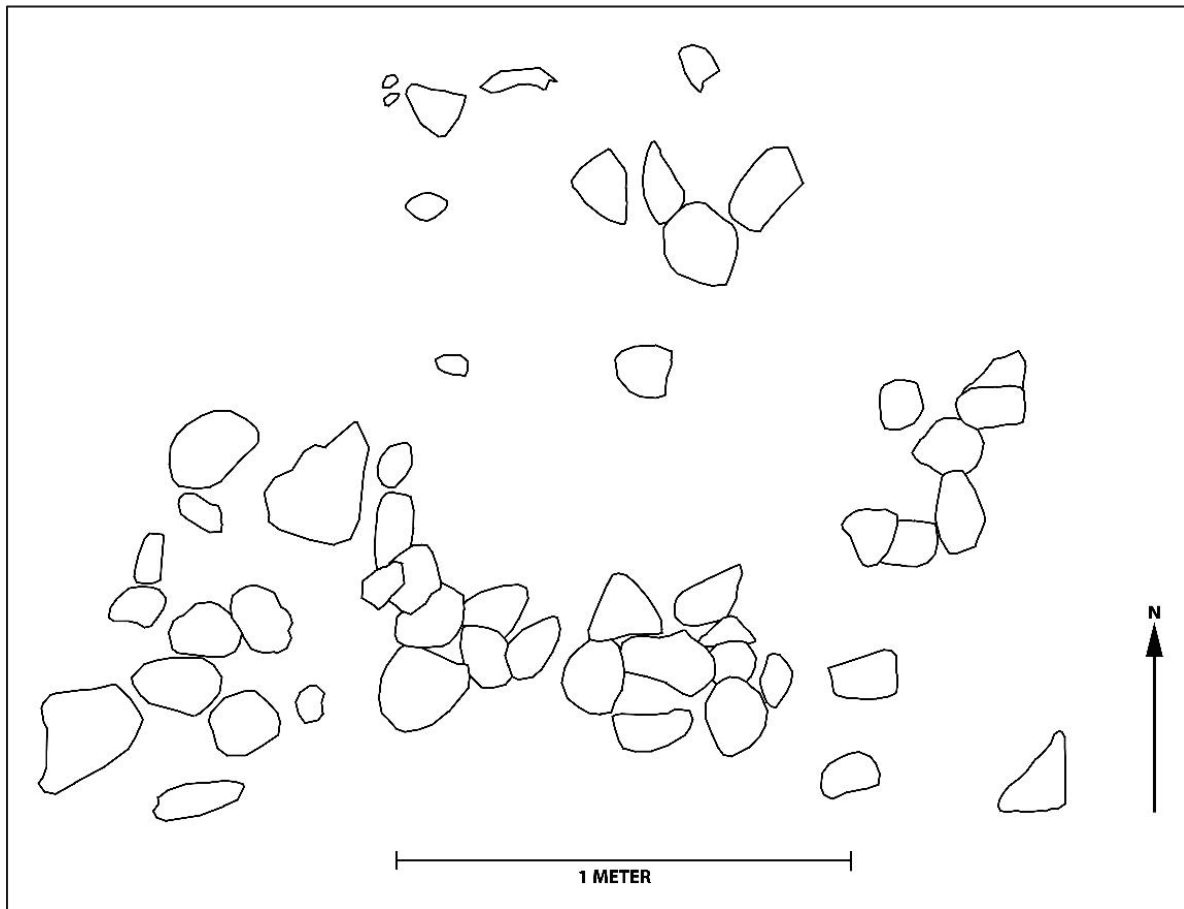


Figure 115. Overview drawing of Feature-44.

Amorphous Earth Oven Features

Feature-33: This thermal feature, likely an earth oven, was identified just below the surface and was relatively isolated from the other identified features. The feature consisted of more than 450 granitic and quartz fire-affected rocks, mostly spalls and small fragments, in an amorphous configuration similar to Feature-59 and ECO-FX-F, with burnt soil and charcoal covering an area approximately 3.0 x 2.5 m and to a depth of 30 cmbs in places (Figure 116). The floor was the characteristic mosaic arrangement, but the fuel level and outlying margin of rocks had been moderately impacted by bioturbation and water erosion, so that the original shape of the feature had been slightly distorted. One volcanic interior flake and three quartz interior flakes were recovered.



Figure 116. Feature-33.

Radiocarbon results (Beta-340142) date the feature within a two-sigma calibrated date range of A.D. 1440 to 1620.

A soil sample collected from the feature were dominated by members of the sunflower family. Small quantities of juniper, pine, and oak pollen were noted. The remainder of the record included sagebrush, members of the ragweed/cocklebur portion of the sunflower family, members of the mustard family, chenopods, ephedra or Mormon tea, wild buckwheat, legumes, grasses, and chamise pollen reflecting local growth of those species. Very little microscopic charcoal was observed in this sample. A small quantity of algal spores was noted, suggesting the possibility of postdepositional ponding of water in the feature. Total pollen concentration was high, with more than 12,000 pollen grains per cm³ of sediment.

Macrofloral analysis identified six lotebush seeds, indicating either processing of lotebush seeds or (more likely given the low count) that whole branches were used as fuel.

Feature-59: This thermal feature, likely an earth oven, was identified just below the surface. The feature consisted of 164 embedded granitic, quartz, and basalt fire-affected rocks with some additional loose fire-affected rocks surrounding it (Figure 117). The feature was amorphous in shape (similar to Feature-33 and ECO-FX-F), with a relatively level fuel deposit that extended from 14 to 20 cmbs across the feature and was mottled in places by the light brown sandy silt and granitic gravel of the drainage channel (Figure 118). Feature-59 sat directly atop the old alluvium formation, and a desert apricot tree was growing out of the western edge of the feature, compromising its integrity in that section.



Figure 117. Feature-59.



Figure 118. Profile of Feature-59 bisection.

Pollen analysis was found to contain more moderate quantities of pollen that have typically been identified in other features. Sunflower family pollen still dominated. The juniper pollen frequency was moderately elevated in this sample and was accompanied by small quantities of pine and oak pollen. Moderately small quantities of sagebrush, members of the ragweed/cocklebur portion of the sunflower family, and grass pollen reflect the presence of these species in the local vegetation community. In addition, recovery of small quantities of cheno-ams, ephedra or Mormon tea, wild buckwheat, and chamise pollen indicate that those varieties were present. A total pollen concentration of more than 37,000 pollen grains per cm³ of sediment suggests accumulation of pollen postdepositionally.

ECO-FX-F: This thermal feature measured approximately 3.0 x 2.0 m and consisted of an amorphous arrangement of granitic, basalt, and quartz fire-affected rocks and black ashy soil with a thin ash layer (Figure 119). No artifacts were recovered.

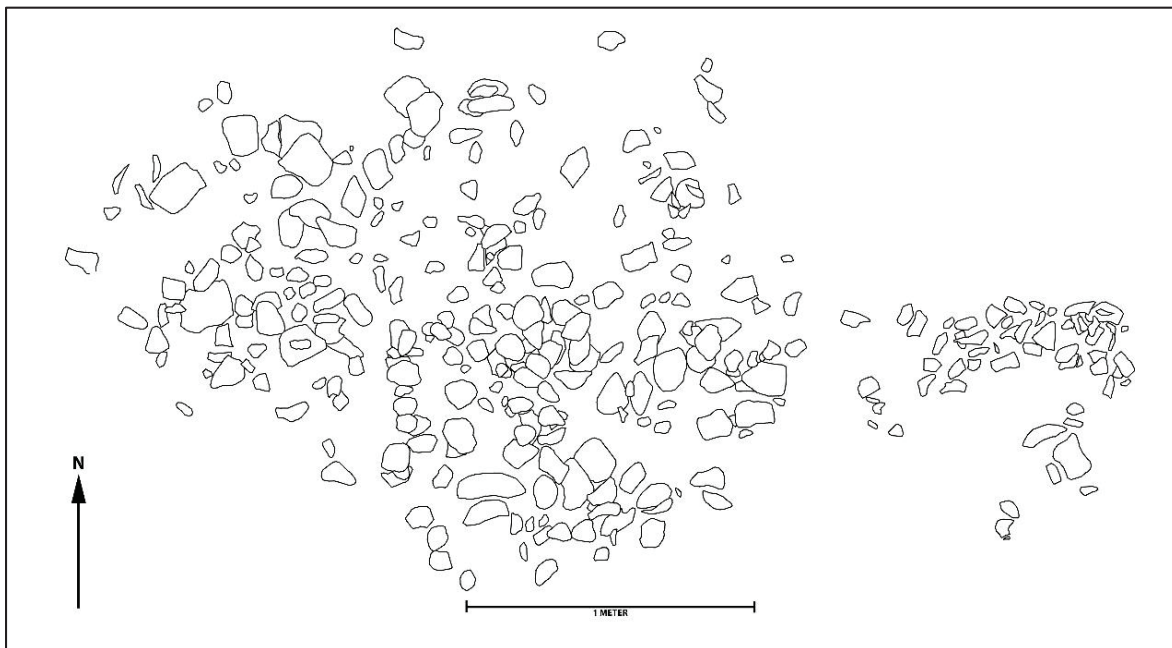


Figure 119. Overview drawing of ECO-FX-F.

Threshing Floor Features

Feature-66: This thermal feature was identified just below the surface. A piece of obsidian shatter and a brown ware sherd were recovered from the 0–10-cm level of the feature. The feature consisted of 90 granitic fire-affected rocks, loosely arranged over an area roughly 1.3 x 1.0 m, with no observable intact fuel level, only light brown silty sand with granitic gravel (Figure 120). Scattered charcoal bits were identified around the fire-affected rocks, outside the presumed center of the feature. Given the lack of fuel but the presence of fire-affected rock and charcoal bits, it is possible that the feature represents a threshing floor that was created to flash burn wood and leaf structures so that over the remaining seeds and fruits could be collected. A volcanic primary flake, five quartz interior flakes, one piece of quartz shatter, one obsidian interior flake, and a pottery sherd were recovered.

Feature-69: This thermal feature was identified just below the surface. It consisted of a loose scatter of granitic fire-affected rocks ($n = 158$), with no discernible fuel level or soil change from the light brown sandy silt and granitic gravel of the drainage (Figure 121). Bits of charcoal were identified around and through the feature, so it is possible that this location was used for threshing.

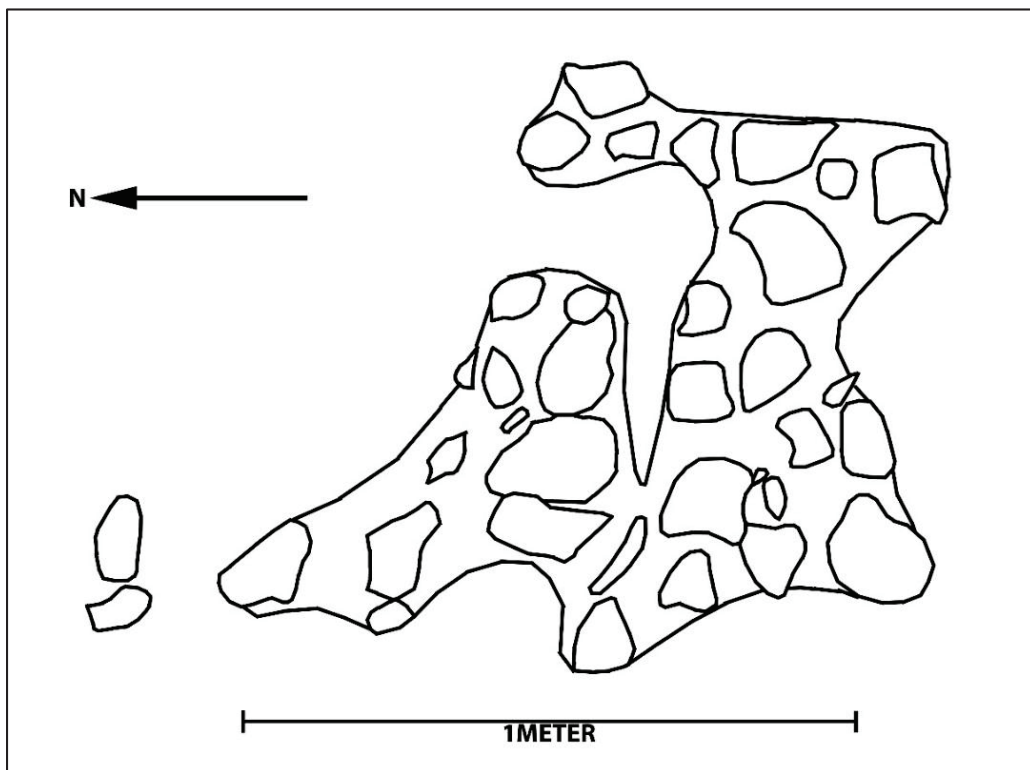


Figure 120. Overview drawing of Feature-66.



Figure 121. Feature-69.

Feature-71: This thermal feature, identified just below the surface, consisted of more than 470 granitic fire-affected rocks, creating a roughly mosaic floor 3.0 x 2.0 m in area (Figure 122). No burnt soil was identified in the feature, only the light brown sandy silt and granitic gravel of the drainages. However, like Feature-66 and Feature-69, charcoal bits were found throughout and around the feature, indicating that it may have been used for threshing. Unlike those two features, though, the fire-affected rocks appear embedded in the soil and a relatively high concentration of charred juniper seeds ($n = 48$) was recovered, indicating that juniper may have been the target species for threshing. Five charred lotebush seeds were also collected, indicating multiple species may have been fired and harvested together. The seeds of both plant species are known ethnographically to have been dried rather than cooked (Bean and Saubel 1972; Spier 1923; Wilken 2012) so the charred seeds are likely the product of burning off the woody portions rather than evidence of preparation.



Figure 122. Feature-71.

Historic-period Thermal Feature

Feature-64: This thermal feature was identified immediately adjacent to a road, and charcoal on the surface of the feature still appeared fresh. This feature was made up of 22 granitic and quartz fire-affected rocks aligned in a tight circle. It was likely a modern construction (Figure 123).

Undefined Thermal Features

Feature-14: This thermal feature remnant was identified near the surface. It had no discernible shape, just being a loose grouping of 13 granitic fire-affected rocks, with mottled burnt soil and some charcoal bits (Figure 124).



Figure 123. Feature-64.



Figure 124. Feature-14.

Feature-41: This thermal feature was identified in the same drainage to the east of Feature-12 and Feature-13 (Figure 125). Fifteen embedded granitic fire-affected rocks were recorded in a semicircular arrangement with some burnt soil and charcoal (Figures 126 and 127). However, it appeared that much of the feature had been impacted and washed out. A volcanic secondary flake and a piece of volcanic shatter were recovered. A granitic milling slab fragment was recovered from within the mosaic floor.



Figure 125. Drainage with Feature-41, Feature-12, and Feature-13 facing west.



Figure 126. Feature-41.



Figure 127. Profile of Feature-41 bisection.

Feature-43: This thermal feature remnant was identified just below the surface among a cluster of features, including Feature-17, Feature-18, and Feature-44. The feature consisted of 33 granitic and quartz fire-affected rocks, only nine of which were observed to be embedded; the remainder were loosely arranged on the surface (Figure 128). A very thin fuel layer and some bits of charcoal remained immediately around the embedded rock but was missing from the rest of the feature. A single quartz interior flake, a large number of uncharred seeds, and a bullet slug were collected.



Figure 128. Feature-43.

Feature-48: This thermal feature remnant was identified near the surface. The feature appeared mostly washed out, with 11 basalt and granitic fire-affected rocks and a mottled burnt soil matrix with bits of charcoal that extended to a maximum depth of 17 cmbs (Figure 129). A volcanic interior flake and 11 pieces of volcanic debitage were recovered.



Figure 129. Feature-48.

Feature-49: This thermal feature remnant included 12 granitic rocks loosely arranged in a mottled burnt soil matrix with some bits of charcoal (Figure 130). There was no discernible shape or use determined for this feature.

Radiocarbon results (Beta-340143) date the feature within a two-sigma calibrated date range of A.D. 1440 to 1630.

Charcoal collected from Feature-49 yielded fragments of juniper wood.

ECO-FX-K: This marginal thermal feature consisted of two separate groups of quartz and granite fire-affected rocks. The first group measured approximately 50 x 20 cm and had three fire-affected rocks. The second group measured approximately 25 x 10 cm, with two fire-affected rocks. Thirty to 40 displaced fire-affected rocks surrounded the presumed center of the feature, but its true shape and construction could not be determined from the remains. The sediments in the feature were an ashy silty sand with only two pieces of charcoal. No artifacts were recovered.



Figure 130. Feature-49.

ECO-FX-T: This thermal feature, possibly an earth oven remnant, consisted of approximately 16 granitic, quartz, and basalt fire-affected rock fragments (Figure 131). The feature was only slightly intact, with sparse fire-affected rock in a loose conglomeration with no discernable pattern. The soil was medium brown, with darker soil around the extant fire-affected rock. There was no discrete fuel lens, and soil discolorations surrounding the feature were very subtle. ECO-FX-T measured approximately 1.5 x 1.0 m, with a termination at 20 cmbs. No artifacts were collected.

ECO-FX-V/AA: This thermal feature consisted of a sparse semicircular arrangement of 15 quartz and granitic fire-affected rocks in situ and approximately 200 quartz, granitic, and basalt fire-affected rocks scattered by grading activity throughout the surrounding area (Figure 132). The remnants of the fuel floor measured approximately 1.5 x 1.0 m, with a termination depth of 20 cmbs. No artifacts were observed.

ECO-FX-AC: A lithic concentration with pieces of quartz debitage, predominately interior flakes, and pottery was identified immediately adjacent to the location of this thermal feature. Excavation of ECO-FX-AC uncovered only a slightly intact feature consisting of approximately 15 quartz and granitic in situ fire-affected rocks (Figure 133). Soils within the feature were a dark brown and black color, with burnt soil remaining around the embedded fire-affected rocks. The feature was surrounded by light brown silty sand and granitic gravel of the drainage channels. The feature remnant measured approximately 1.0 x 0.5 m, with a termination depth of 10 cmbs. No artifacts were observed within the feature.



Figure 131. ECO-FX-T.



Figure 132. ECO-FX-V/AA.



Figure 133. ECO-FX-AC.

FX-CL-16: This thermal feature was identified in the same drainage channel as FX-TRT-100. The feature consisted of 40 fire-affected rocks with burnt, ashy soil and some charcoal.

FX-CL-22: This thermal feature was exposed by a grading cut and consisted of burnt soils with eight quartz and three granitic embedded fire-affected rocks. No charcoal was present. The feature measured roughly 70 x 40 cm, with a thickness of 7 cm.

FX-CL-36: This thermal feature consisted of in situ fire-affected rock surrounded by black soil. FX-CL-36 was observed to the east of and in the same drainage channel as ECO-FX-M and Feature-48.

FX-CL-39: This thermal feature was observed adjacent to FX-CL-36 and consisted of seven quartz and one granitic fire-affected rocks. The matrix was a black ashy soil covering an area of approximately 70 x 80 cm and to a depth of 8 cmbs.

FX-CL-54: This thermal feature contained 15 quartz fire-affected rocks surrounded by a matrix of burnt soil with some charcoal. The entire exposure covered an area approximately 1.1 x 0.9 m to a depth of 5 cmbs.

FX-CL-70: This thermal feature consisted of 12 granitic fire-affected rocks surrounded by a burnt soil matrix with a small amount of charcoal. The feature measured approximately 1.0 x 1.0 m, to a depth of 15 cmbs.

FX-CL-80: This thermal feature remnant contained 29 embedded granitic fire-affected rocks, burnt soil, and charcoal, and measured approximately 1.0 x 0.5 m (Figure 134).



Figure 134. FX-CL-80.

FX-CL-87: This marginal thermal feature consisted of four quartz and granitic fire-affected rocks, burnt soil, and charcoal over an area of approximately 60 x 60 cm, to a depth of 10 cmbs.

FX-IC-01: This thermal feature was only slightly intact. Three fire-affected rocks, burnt soil, and charcoal remain. A quartz percussion tool was identified.

FX-IC-36: This possible feature was identified at a depth of 5.4 m. FX-IC-36 is roughly circular, 80 x 90 cm in area, and made up of burnt soil with some charcoal bits (Figure 135). The burnt soil extends approximately 10 cm in thickness, the margins are poorly defined, and no fire-affected rock was observed (Figure 136). An oxidation rind was observed on the silty sand and granitic gravel under the burnt soil, indicating a high heat in the fire. The lack of fire-affected rock and structure in this feature, however, indicate that it may be the result of natural rather than cultural burning.

Charcoal from the feature was radiocarbon dated (Beta-357180) within a two-sigma calibrated date range of 7750 to 7590 B.C.

FX-IC-43: This feature was only slightly intact, with three embedded fire-affected rocks and some burnt soil and charcoal. One volcanic retouched flake was recovered from the soil surrounding the feature.

FX-JH-07: This thermal feature was identified on the eastern side of a cluster of approximately 10 observed features. It was only very slightly intact, consisting of a thin black soil stain with a few embedded fire-affected rocks.



Figure 135. Possible feature FX-IC-36 exposed.



Figure 136. Profile of possible feature FX-IC-36.

FX-JH-13: This thermal feature remnant was identified in line with and to the west of FX-DC-142. The marginal remains consisted of a thin black soil stain with a few embedded fire-affected rocks. A hand stone fragment was collected from the soil around the feature.

FX-KC-03: This thermal feature contained 15 fire-affected rocks and burnt soil to a depth of approximately 5 cmbs, and it covered an area roughly 30 cm in diameter.

FX-KC-37: This thermal feature was observed approximately 1.4 m below the surface. The remnant included seven fire-affected rocks and a broken granitic milling slab that was burnt on both sides.

FX-KC-38: This thermal feature was identified near FX-KC-37 but approximately 4.5 m below the ground surface. The feature contained approximately 19 fire-affected rocks with an ashy soil matrix and charcoal bits.

FX-KC-60: This thermal feature consisted of approximately 15 embedded fire-affected rocks, surrounded by an ashy soil matrix and charcoal.

FX-KM-07: This thermal feature was identified in the same drainage as and to the west of FX-TRT-21 and FX-TRT-22. The feature was very marginal and included only a single embedded fire-affected rock and burnt soil dispersed over an area of 90 x 90 cm, to a depth of roughly 20 cmbs.

FX-KM-14: This feature was identified in the same drainage channel as and between FX-KC-08 and FX-TRT-33. Some burnt soil and 10 fire-affected rocks were present.

FX-KM-26: This thermal feature included more than 13 fire-affected rocks and burnt soil.

FX-KM-27: This thermal feature was very marginal and included three fire-affected rocks and a 4-cm-thick layer of burnt soil with no charcoal.

FX-KM-30: This thermal feature was comprised of a large volume of burnt soil and charcoal with fire-affected rock. A fire-affected volcanic scraper was recovered from the feature.

FX-KM-49: This marginal thermal feature contained four granitic fire-affected rocks, burnt soil, and charcoal covering an area roughly 1.7 x 1.5 m to a depth of 20 cmbs. A volcanic secondary flake was recovered from outside the burnt soil matrix.

FX-KM-51: This thermal feature was identified among a cluster of approximately 10 other features. It consisted of five quartz fire-affected rocks and burnt soil over an area of roughly 1.1 x 0.7 m and to a depth of 15 cmbs.

FX-KM-53: This thermal feature was identified among a cluster of approximately 10 other features. It consisted of 28 quartz fire-affected rocks and burnt soil over an area of roughly 80 x 70 cm and to a depth of 20 cmbs.

FX-KM-54: This thermal feature was identified among a cluster of approximately 10 other features and consisted three quartz and granitic fire-affected rocks with burnt soil, covering an area of roughly 0.6 x 0.6 m and to a depth of 10 cmbs.

FX-KM-96: This thermal feature consisted of 14 quartz and six granitic fire-affected rocks with burnt soil covering an area of roughly 1.1 x 0.7 m and to a depth of 10 cmbs.

FX-KM-97: This thermal feature consisted of one quartz and nine granitic fire-affected rocks, surrounded by a dark burnt soil matrix with a small amount of charcoal.

FX-KM-115: This thermal feature contained 15 fire-affected rocks with dark, ashy soil covering an area approximately 80 x 60 cm.

FX-KM-117: This thermal feature contained approximately 44 granitic and quartz fire-affected rocks with a burnt soil matrix covering approximately 1.0 x 1.4 m (Figure 137).



Figure 137. FX-KM-117.

FX-KM-118: This thermal feature remnant contained three fire-affected rocks surrounded by dark sandy soil matrix within an area of approximately 1.0 x 0.8 m, to a depth of 10 cmbs.

FX-TRT-21: This thermal feature was observed across the same drainage channel from FX-TRT-22. Burnt soil with some fire-affected rock was observed extending within an area of approximately 1.4 x 1.0 m and a thickness of 5 cm. No artifacts were identified.

FX-TRT-22: This thermal feature was observed across the same drainage channel from FX-TRT-21. Black sandy soil with four small fire-affected rocks was recorded within an area of approximately 1.3 x 1.0 m, with a maximum depth of the fuel at 10 cmbs, and which point light brown sandy silt and granitic gravel were encountered.

FX-TRT-46: This thermal feature remnant was observed in the southwest corner of the ECO 230kV pad and contained five small fire-affected rocks and burnt soil covering an area of 1.0 x 0.8 m, with a depth of 10 cmbs.

FX-TRT-92: This thermal feature contained nine quartz fire-affected rocks within a surrounding matrix of burnt soil and charcoal, covering an area of approximately 1.0 x 0.6 m, to a depth of 15 cmbs.

FX-TRT-93: This thermal feature contained approximately 32 fire-affected rocks within the surrounding soil matrix of dark black soil and charcoal.

FX-TRT-109: This thermal feature contained seven fire-affected rocks with burnt, ashy soil, covering an area of approximately 80 cm in diameter, to a depth of 5 cmbs. No charcoal was present.

ECO-SWPL-1: This thermal feature remnant was mostly washed out and only slightly intact, with 21 granitic fire-affected rock, 14 of which were embedded, as well as a thin burn layer and some intact charcoal deposits (Figure 138). One quartz flake was also recovered from the feature.



Figure 138. ECO-SWPL-1.

FTIR Analysis

FTIR organic residue analysis of 11 feature fill samples contributed three separate environmental signatures. Samples 1 (ECO-FX-A) and 2 (ECO-FX-M) reflect signatures typical of raw *Calandrinia ciliata* (red maids) seed. Samples 2 (ECO-FX-M) and 3 (ECO-FX-J) yielded a moderate match with raw *Triteleia laxa* corms, suggesting the possibility that Ithuriel's spear grew in the disturbed sediments filling these features after they were abandoned. Samples 4–11 (ECO-FX-BI, ECO-FX-O, ECO-KC-08, ECO-TRT-56, ECO-KM-113, ECO-IC-37 (two samples), and ECO-BW-19, respectively) yielded signatures typical of calcium carbonate from alkaline sediments, suggesting leeching into the feature fill from the surrounding natural matrix. Samples 4 (ECO-FX-BI), 6 (ECO-KC-08), and 11 (ECO-BW-19) additionally demonstrated contributions from wood used as fuel. Both *Calandrinia* and *Triteleia* were matched to raw, unprocessed, substances precluding any cultural use and suggesting local growth of these plants. Detailed results can be found in Appendix F.

Feature Composition and Structure Comparison

SDI-7074 had five general categories of thermal feature composition and structure. All of the identified thermal features were constructed in the silty sand and granitic gravel of the New Alluvium drainage channels that crisscross the gullied landscape from east to west. There is some variability in whether the features were dug down to the underlying Old Alluvium or Anza Formation materials or whether they were excavated down just far enough into the soft sediments so that the feature could be constructed; however, the former is far more common and seems to have been the preference. It also appears that energy was not wasted in digging to create level features, as many feature floors followed the sloped contours of the drainage channels, angling slightly downslope with the drainages.

The thermal features were constructed with up to three locally available stone materials: granitic rock, basalt, and quartz. Granitic materials were either collected from the nearby slopes of Nopal Peak, a large granite batholith creating the eastern slopes to the Jacumba Valley, or from the washes leading from those outcrops into SDI-7074. Tabular basalt could have been found naturally around the base of Jade Peak, which borders the northern perimeter of the project area. Quartz veins are exposed across this eastern edge of the Jacumba Valley. With the exception of a few recycled milling slabs ($n = 12$), the fire-affected rocks in the features ranged from fist-sized to just over head-sized and were not worked before they were used in the features. All three rock types, but particularly granite, provided non-combustible, high-density material that was able to efficiently capture and retain heat. Granite was by far the dominant material used, likely because it absorbs and stores heat and releases it over a longer period of time than basalt (Eerkens and Rosenthal 2002). This heat retention capability enabled the prolonged baking in earth ovens of foods, like geophytes, that require cooking times in excess of 24 hours to render them nutritious and readily digestible (Thoms 2009:576).

Fuel levels in the thermal features varied from less than 1 cm to nearly 30 cm in thickness, and many of the features showed evidence of the fuel lying underneath the fire-affected rock, suggesting that the fuel may have been lit prior to placement of the rock floors. The macrofloral analysis has shown that juniper (*Juniperus*) and a woody member of the buckthorn family were the most common hardwood sources used for fuel throughout the entire period of the site's occupation, being identified at 19 and 10 features, respectively. Numerous juniper twigs and berries were recovered as well, indicating that juniper branches may have been burned whole. The most common buckthorn family species found currently at SDI-7074 are lotebush and hollyleaf redberry, although the nearby chaparral community also contains mountain mahogany (*Cercocarpus* sp.) and ceanothus (*Ceanothus* sp.). Lotebush and hollyleaf redberry are the two most abundant hardwood varieties in the immediate area, so their use is not surprising, but it shows that hardwoods were not typically brought in from a distance to construct the features.

Ten of the 20 macrofloral samples contained charred termite pellets, indicating either termite-infested wood was preferred for burning or that the occurrence of termites in the local hardwood was high. All 10 samples are from presumed earth oven features. Termite-infested wood could provide two benefits when preparing these thermal features: methane-imbued wood and combustion channeling effects. Termites produce large quantities of methane as a byproduct of wood consumption (Grieco et al. 2013; Ho et al. 2013; Jamali et al. 2013). While the majority of studies on methane production by termites has focused on mound populations in Australia, South America, and Africa, the local termite populations of the Jacumba area are drywood species, *Margitermes hubbardi* and *Incisitermes minor* (Baker and Marchosky 2005), meaning that they live entirely within their food source, which consists of dead trees or dead branches on living trees. Termite nesting creates a methane-rich environment within the plant, increasing its combustibility. The second benefit from termite-affected wood is the combustion channeling effect, which occurs where voids are found in wood particles. Combustion channeling creates spaces for air and gas to travel, allowing for faster ignition propagation through the channels and results in hot spots (Ryu et al. 2006). The speed of fuel ignition also effects the proportion of mass loss during ignition, meaning the remaining char layer is thicker (Ryu et al. 2006:1043). Consequently, the thicker a char layer the slower the overall mass loss and burn rate for the material (Ryu et al. 2006:1043). The channeling effects and methane produced by termite infestation would create a faster ignition period and subsequent increased char layer ideal for the slow burn preferred in earth ovens. The use for termite-infested wood does not appear to have changed over time, having been identified in three of the oldest features: FX-IC-37 (7140–7380 B.C.), FX-KM-113 (7560–7380 B.C.), and FX-TRT-56 (7780–7590 B.C.); as well as three of the more recent constructions: ECO-FX-O (A.D. 670–850), ECO-FX-M (A.D. 1470–1650) and ECO-FX-A (A.D. 1650–present).

Two features contained saltbush (*Atriplex*) charcoal, which is readily available on site and was likely used for kindling. It is interesting to note that the two features with saltbush were among the oldest recorded at the site: ECO-BW-19 (4460–4350 B.C.) and ECO-KM-113 (7560–7380 B.C.). A single charcoal sample each of the hardwood portion of the Mojave yucca, two cholla (*Cylindropuntia*) buds, California laurel (*Umbellularia californica*), mesquite (*Prosopis*), and a member of the Rosaceae were also identified. Mojave yucca charcoal was also identified within an excavated feature of an adjacent site, SDI-7073 (Williams and Whitley 2012), and, ethnographically, Mojave yucca was the preferred hardwood for use in pottery kilns in this area (Rogers 1936). The Rosaceae family plant is likely desert apricot, which is very common at this location, or possibly chamise, which is found sporadically on site and increasingly so farther west in the valley. With the exception of California laurel, all these taxa were found on site or in the nearby drainages. The California laurel sample was recovered from the oldest feature at the site, so its presence may indicate that plant was readily available at this location in the Early Holocene.

Six of the thermal features showed traces of charred yucca leaves. The only yucca species at the site is Mojave yucca. It is possible that the leaves were used for kindling or as a buffer within features used to bake foods, or that they were charred for future processing. The collection of desert agave to use as cordage has been documented ethnographically in this portion of the Jacumba Valley (Almstedt 1968:2). However, Mojave yucca leaves were utilized in a similar manner, so the features may represent the preparation of the leaves for making cordage. Asparagaceae family plants, including desert agave and Mojave yucca, are known to have been used both as buffers and for cordage (Balls 1970; Bean and Saubel 1972; Hedges 1967; Wilken 2012). To serve as buffers, the leaves were placed over or under the item to be baked to avoid exposing the item to direct heat. When the oven was opened, the food and leaves were removed, the pulp of the leaves was pounded out, and the stringy fibers were dried for use in cordage. The identification of a volcanic hammer stone with yucca protein residue indicates that this activity may have taken place on site.

Grass (Poaceae) pollen was identified in nearly every sampled feature, but it was particularly prominent in seven of the features: Feature-12, Feature-16, Feature-17, Feature-42, Feature-62, ECO-FX-J, and ECO-FX-O. Grass beds, like yucca and agave leaves, are known from the ethnographic accounts to be used as buffers between cooked food and combustible fuels. While the elevated counts may indicate the presence

of grass beds within features, the seven features were also radiocarbon dated to similar ranges between A.D. 580 and 1280. The increased grass pollen, then, may also suggest changed climatic conditions during this period. In other regions, natural increases in grass pollen counts have been shown to correlate with higher precipitation, lower wind, and high maximum heat (Davies and Smith 1974; Smart et al. 1979) though no studies of local grass populations have been identified. An interesting correlation is the occurrence of algal spores in three of these same features: Feature-12 (A.D. 600 to 660), Feature-16 (A.D. 710 to 890), and Feature-17 (A.D. 580 to 660). Only one other feature, Feature-33 (A.D. 1440 to 1620), had algal spores identified. The presence of algal spores indicates postdepositional pooling of water within those features. That only these features contain the spores may indicate increased precipitation during this period, as discussed further in Section 7.1.

Nine of the thermal features appear to be prehistoric hearths: Feature-11, Feature-13, ECO-FX-AC, ECO-FX-BD, ECO-FX-C, ECO-FX-I2, FX-CL-71, FX-KM-137, and FX-KM-138. At least three of these (Feature-11, Feature-13, and FX-KM-137) appear to have direct links to nearby oven features, and two showed evidence of the excavation of small pits for their construction. While the features' exact use is unknown (e.g., for production of coping stones, discussed further below, or for light or direct-fire cooking), it is possible that these hearths were created solely for warmth or perhaps to perform other tasks, such as parching, while food in the ovens was being cooked.

Three features revealed only fire-affected rock, with no discernible fuel level or bits of charcoal among the rocks and surrounding the feature. It is possible that these represent threshing platforms. The threshing technique involved burning whole plant limbs and twigs from fruit/seed-bearing flora in order to burn off the woody portions and collect the remaining foodstuffs. Generally this was done with plants like buckwheat, for which harvesting individual seeds would be very labor-intensive. Plants would be placed on the rock floor and fired, so that the burned wood bits would be scattered around the feature after use. Seeds collected after scorching would not need further parching and could be ground immediately.

The remainder of the intact thermal features at SDI-7074 either resembled the earth ovens of ethnographic accounts (e.g., Balls 1970; Bean and Saubel 1972; Chase 1919; Shackley 1984) or else they were only slightly intact and the reasons for their construction could not be determined. The most common shape for the presumed earth ovens was circular and around 1.5 m in diameter (e.g., ECO-FX-M, ECO-FX-N, ECO-IC-37, and Feature-20), with a smaller frequency of elliptical/oblong features (e.g., Feature-15, ECO-FX-J, ECO-BW-19, and ECO-TRT-56) and a few amorphous features (e.g., Feature-33 and Feature-59). Both the circular and oblong morphologies were identified in the examples of the earliest features at SDI-7074 (ECO-IC-37 and ECO-TRT-56 respectively), which is not surprising as circular and oblong oven constructions are seen worldwide and across many time periods (see Thoms 2009:575). All three feature shapes were accomplished using either interlocking mosaics of rocks or by lining the margins of a pit with rocks and burning fuel directly on the substrate. Construction of all these feature types utilized the natural contours of the drainage channels, angling slightly downslope rather than creating level platforms. Some of the pit floors were flat (e.g., Feature-33) while the majority showed basin forms with patterns of stepped excavation for the preparation of the feature.

A few of the identified thermal features were rather large and amorphous, measuring over 2.0 m on an axis. Thoms (1989:328-337) argued that larger ovens facilitated bulk cooking in a fuel-poor region. While some hardwoods were present in the vicinity, they were mostly shrubs or dwarf varieties, not ideal for efficient cooking practices. Two possible explanations may be suggested for the use of these larger ovens. The first is that a change in the local environment created less combustible fuel for consumption and required the use of larger, more fuel-efficient ovens. The environmental analysis for this study, as well as others in the region (Townsend 1986), did not show a drastic change in the plant community over the past 9,000 years. It appears possible that the Holocene Climatic Optimum (Altithermal) and the Medieval Climatic Anomaly may have had little effect on the makeup of the plant community, even while decreasing the amount of

available resources. The second scenario involves an increased population size that would need to consume more food with the same amount of fuel. The larger ovens would allow more resources to be cooked using a given amount of fuel.

A number of other variables differed from feature to feature at the site. The first was the presence of toss piles at a few feature locations, implying the use of cap stones in the ovens. Toss piles are discrete areas where accumulations of fire-affected rocks occur on one or more sides of the primary cooking platform (Eerkens and Rosenthal 2002:23). The majority of the fire-affected rock in these toss piles was heavily burned, indicating that these features may have used two fires. In this method, a fire would be set on the floor of the feature, and then the food stuff would be laid down, possibly also with a buffer atop it. This would be followed by another buffer and/or a second layer of rocks. A second fire would then be started in the upper level of rocks and allowed to burn down before the feature was covered with soil and the food was allowed to bake. The two fires enclosing the food being cooked prevented excessive heat from escaping (Chase 1919; Shackley 1984:132). Of the 130 features analyzed, 5 percent ($n = 6$) showed evidence of toss piles, implying that either the use of cap stones in ovens was not a prevalent practice at SDI-7074 or that toss piles are less likely to be preserved in archaeological deposits as they were exposed to erosion and redeposition downstream. The amount of isolated fire-affected rock scattered across the site may reflect the latter process.

It is possible that the toss piles may also represent the incidental removal of floor stones from a previous thermal feature and as such are evidence of feature reuse. As only four of the 130 thermal features showed any evidence of this potential for reuse, SDI-7074 follows the majority of patterns identified ethnographically and archaeologically with these types of sites in the region (for examples, see Laylander 2014; Lee 1928; May 1980; Schaefer et al. 2014; Shackley 1984). If there was a tendency to avoid reusing earth ovens, this may reflect decision making based on an ideological rather than utilitarian basis. Following Levi-Strauss's (1963:89) distinction between foods being *good to eat* and being *good to think*, this may reflect a cultural mechanism to curb overexploitation of a resource, or it may exemplify the predominant ethnographic attitude toward the deceased and/or property. Overexploitation of geophyte resources may have destroyed whole stands of potential crops in only a few years or decades. Avoidance of the dead has been suggested to tie into a mechanism for avoiding contagious diseases, biological and chemical contaminants and other subtle environmental hazards. Finally, there is some archaeological and ethnographic basis for establishment of territorial communities that influenced a trend toward ownership rather than sharing of land, resources and possessions. An ideological sanctioning and reinforcement of ownership rights to earth ovens may have been observed (Laylander 2014:336).

The inclusion of ground stone in several of the features reflects a practice of artifact recycling, suggesting that the original ground stone artifacts were either unintentionally broken or perhaps that a reuse taboo prevented their continued use for grinding and, as such, they were discarded then later scavenged with other local stone material to construct the thermal features. Neither the amount of features (7 percent) nor the overall percentage of ground stone fragments within features at the site (15 percent) suggest that ground stone artifact recycling was a common practice. One of the early features, FX-KM-113 (7560 and 7380 B.C.), had two broken milling stones incorporated into the feature floor, indicating the practice of recycling milling slabs had a long history in the region, although it was a relatively rare occurrence.

Several of the features also contained possible coping stones. Coping stones as defined by Shackley (1984:132) were added to contain thermal energy within the oven. These components would show up as fire-affected rocks with only one burned surface, the side that faced the feature's fuel level. Coping stones were generally fired in a hearth adjacent to the earth oven and then added after the fuel had been fired and reduced to char. This practice may also account for the number of hearths identified adjacent to oven features like Feature-10 and Feature-11, discussed further below.

Unfortunately, the studies conducted on the soil samples taken from the thermal features did not conclusively identify what items were being cooked in the features. Results of the protein residue studies showed deer, bighorn sheep, rat, and yucca/agave plants were processed to some extent on site. While it has been presumed on the basis of ethnographic evidence and by previous archaeological studies in the region (Christenson 1980; May 1980; Shackley 1981, 1984) that these features are likely ovens for desert agave, no evidence of that assumption was found in the present study. Yucca, lily bulbs, cactus buds, bladder pods, and mesquite blossoms have also been recorded as being roasted in the region (Bean and Saubel 1972).

THERMAL FEATURE DISTRIBUTION ANALYSIS

Finding a direct relationship between individual thermal features was fairly tentative given the broad date ranges and homogenous stratigraphy of the New Alluvium deposits. As mentioned earlier, Feature-10 (circular earth oven) and Feature-11 (hearth) were identified on the same stable upland so are likely contemporary. A similar association (hearth adjacent to earth oven) was observed between ECO-FX-I2 (hearth) and ECO-FX-J (an oblong earth oven), as well as ECO-KM-137 (conjoined hearth and earth oven). The relationship may indicate pre-firing of elements prior to inclusion in the earth oven, similar to Shackley's (1984) observation of the use of coping stones. It is also possible that the hearths are indicative of overnight camps. As the ethnographic evidence describes one to three days of cooking needed for baking geophytes, these hearths may have been set up next to oven features. The associations of Concentrations 1 and 12 may also suggest this practice.

Fourteen locations contained at least two thermal features within the same drainage channel and in proximity (within 30 m) to one another: (1) Feature-12/Feature-13/Feature-41, (2) Feature-15/Feature-16/ECO-FX-P, Feature-17/Feature-18/Feature-43/Feature-44/ECO-FX-BE, (3) Feature-19/Feature-20, (4) Feature-24/Feature-25, (5) Feature-61/Feature-62, (6) ECO-FX-A/ECO-FX-B, (7) FX-BW-19/FX-KM-113, (8) FX-CL-16/FX-TRT-100, (9) FX-DC-142/FX-JH-13, (10) FX-DC-144/FX-CL-29, (11) FX-IC-36/FX-IC-37, (12) FX-KC-08/FX-KM-14/FX-TRT-33, (13) FX-KC-37/FX-KC-38, and (14) FX-KM-07/FX-TRT-21/FX-TRT-22 (see Figures 27 through 32). Several of these features were indeterminate as to their morphology. Radiocarbon dates from two groups Feature-12 (A.D. 600 to 660) with Feature-13 (A.D. 440 to 600) and Feature-19 (A.D. 1440 to 1620) with Feature-20 (A.D. 1440 to 1660) have overlapping date ranges, while FX-IC-36 (7750-7590 B.C.) and FX-IC-37 (7140-7040 B.C.) are within a margin of error. The only feature association that does not support this claim is FX-BW-19 (4460 to 4350 B.C.) and FX-KM-113 (7560 to 7380 BC). These last two features were also separated vertically by almost 30 cm of depth.

RESEARCH QUESTIONS

When was agriculture introduced to Jacumba?

No residues from domesticated crops were identified in the protein studies, and no pollen from domesticated plants was detected in the soil studies. There was also no evidence of irrigation uncovered. This absence of domesticate pollens or other remains in the dated contacts tends to support the argument that agriculture was not present in the Jacumba Valley prior to the nineteenth century.

How strong were the prehistoric trade and travel links between the Jacumba Valley and surrounding regions, and how widely did they extend?

The majority of lithic materials found on site, including the chert and silicified wood, were locally available. The high occurrence of western Colorado Desert pottery suggests a strong trade link with that region, and the occurrence of Tumco/Hedges buff suggests that it continued up to the ethnohistoric period. The single

piece of obsidian shatter could not be sourced. Both of the shellfish remains, *Olivella* sp. and *Argopecten* sp., could indicate a connection with either the Pacific Ocean or Gulf of California. As only two remains were identified, the link does not appear very strong to either location. Elko points have been identified throughout most of California and have been dated as early as 2000 B.C. – A.D. 1100. A number of sites in the immediate region (see the work of McDonald [1992] at Indian Hill and Williams [2013a] at SDI-7030 in Jacumba) also showed adaptation of this technology to local stone varieties. While the Elko point was distinguished originally in the Great Basin (Heizer and Baumhoff 1961), coastal San Diego sites also contained Elko point series projectile points.

What was the availability and occurrence of biotic resources over the past 10,000 years, and are any dietary changes recognizable over time?

These questions are addressed by the results of the pollen and macrofloral analyses conducted on soil samples from the thermal features at which there are also radiocarbon dates to provide chronological contexts. The results suggest that over the last 9,000 or so years, the environment at SDI-7074 has not changed dramatically. The only plant species identified in the earlier features that is not present in the vicinity today is California laurel, which is known to have a dwarf variety in this region, but the macrofloral analysis was not precise enough to determine if the specimen is of the dwarf variety. Otherwise, the site appears to have consistently remained a juniper woodland with desert transitional plant varieties throughout the Holocene. However, there are two gaps in time not represented by the archaeological evidence from this site, so it unclear whether significant environmental changes may have occurred during those periods. The first gap is between 6530 and 4460 B.C., and the second is between 4350 B.C. and A.D. 240.

The period from A.D. 240 to the present day contains the majority of the radiocarbon dated thermal features (n = 20). There are several potential explanations for increases in the frequency of thermal features that may include (a) intensification, (b) regional population growth, perhaps without changes in subsistence costs, or (c) higher survival and/or discovery for more recent thermal features.

The advantages of decreased mobility are fairly obvious when considered in terms of travel costs and the care of children, pregnant women, and the elderly. If early groups could have maintained the same subsistence costs while becoming less mobile, they likely would have done so early on. The downside to adopting decreased mobility (either voluntarily or under pressure) was that (barring technological innovations) it required some form of intensification to meet subsistence needs.

Thoms (2008, 2009) argued that high concentrations of hot rock technology features within specific time periods are a good measure of land-use intensification, often in response to higher population densities and reduced mobility. In this way, a marked increase in the use of previously available but unused or under-used foods would be indicative of land use intensification (Thoms 2008:123). Indirect cooking of foods by first heating rocks for earth ovens requires more fuel than direct cooking over a fire, not to mention more labor to construct the ovens; these are all measures involving intensification. Of the 28 thermal features dated during the study on Torrey Pines State Natural Reserve, a similar distribution was observed with 24 features dated between 260 and 1900 A.D., two older than 3000 B.C. and two younger than 100 years old (Gamble and Mattingly 2012:266). The similarities suggest that either cultural or environmental changes were occurring in different parts of San Diego County during roughly the same time periods.

Do the early Holocene features at SDI-7074 represent the same type of hot-rock cookery for agave hearts as represented by late Holocene features at the site? What were the target species of these features?

These questions have not been answered. The signatures indicating inulin, produced by baking agave, do not last in the archaeological record; even given good preservation, inulin is not typically represented in any visible diagnostic form. Agave tends to produce only calcium oxalate phytoliths that are easily degraded

and destroyed, rather than opal or glass phytoliths that would be more resistant to weathering. Additionally, agave did not show up in any pollen records, so it cannot be confirmed that the plant was actually available in the early Holocene. Agave pollen grains are known to survive under certain conditions and in archaeological contexts but are rare in most sedimentary and airborne samples (Gentry 1982). The sole argument supporting the cooking of agave in the deep features is that, if it was locally available, it is one of a few regional plants that require long baking periods for consumption.

Residues indicating the plant or animal foodstuffs that may have been cooked in any of the features were limited to a few burnt seeds, but these may represent intrusion of local plant varieties or the use of whole branches when firing, rather than processing for consumption. Yucca vascular bundles indicating the processing of yucca leaves were identified in ECO-BW-19 and suggest that yucca leaves were being fired for cordage production as early as 4460 B.C. The absence of floral remains does not mean that the features were not used for geophyte processing. In fact, the absence of significant amounts of burnt seeds or faunal remains in most of the features suggests that either the features' users were quite efficient at removing cooked items from oven features or else, more likely, the targeted species were ones, such as geophytes, that do not preserve well in archaeological deposits.

Are the deep features comparable in morphology to later features, or is there evidence of systematic change over time?

The identified thermal features at the site fall into roughly six construction patterns: (1) hearth features, (2) circular oven features with rock floors, (3) oblong oven features with rock floors, (4) oblong ringed oven features, (5) amorphous earth oven features, and (6) threshing floor features. Among the five deep features identified in this study, only the circular and oblong variety of feature with mosaic rock floors were present (Table 4). FX-TRT-56 and FX-BW-19, were oblong oven features with mosaic floor arrangements excavated into basin-shaped pits. Neither the rock material types (granitic and quartz) nor features' sizes (2.5 m and 1.4 m in length, respectively) are outside the maximum ranges for the later features identified on site (see Table 3). FX-DC-132, FX-IC-37, and FX-KM-113 are all roughly circular earth oven arrangements with mosaic rock floors that were excavated into pits and that also resemble other of the later configurations at the site. For example, FX-IC-37 (with a calibrated radiocarbon date range between 7140 and 7040 B.C.) closely resembled Feature-20 (with a calibrated radiocarbon date range between A.D. 1510 and 1600) and ECO-FX-M (with a calibrated radiocarbon date range between A.D. 1470 and 1650) (Figures 139, 140, and 141). FX-IC-37 also utilized coping stones, which were seen in five of the late features at the site, and FX-KM-113 showed signs of recycling of fragmented ground stone artifacts into feature design, a practice observed in nine other features on site: Feature-16, Feature-20, Feature-41, Feature-55, Feature-62, ECO-FX-J, FX-KC-08, FX-KM-137 and FX-KM-138.

Table 4. Occurrence of Feature Structure Types

Date Range	Structure Type					
	Hearth	Circular Oven with Rock Floor	Oblong Oven with Rock Floor	Oblong Ringed Oven	Amorphous Oven	Threshing Floor
A.D. 240 – Post 1950	8 (2)*	51 (13)	11 (3)	2 (0)	3 (1)	3 (0)
B.C. 7780 - 4350	0	3	2	0	0	0

(#) is count of total with radiocarbon dates



Figure 139. FX-IC-37 exposed (top view).



Figure 140. Feature-20 excavated during data recovery phase.



Figure 141. ECO-FX-M excavated during construction monitoring.

These results may simply be attributable to the fact that the archaeological remains of thermal feature technology are not very complex. To properly bake an item, a hole is dug and lined with rocks, fuel and resources are added, and the fire is lit. Some of the earliest hot-rock features in Europe, for example, (ca. 31,100-30,000 B.C.) are basin-shaped, about 1.5 m in diameter, and filled with heat-fractured river cobbles (Thoms 2009:575). However, there are two possible additions to the feature morphology since the early Holocene. The first addition is construction of the large, flat, amorphous features (Feature-33, Feature-59, and ECO-FX-F). No such feature was identified in the earlier finds. If these amorphous features indicate response to intensification or reduced mobility, they may not have been required in the early Holocene when populations were likely smaller and more mobile.

The second addition to the morphological record was the identification of toss piles in the more recent features (Feature-67, ECO-FX-A, ECO-FX-J, and ECO-DC-138) that were not witnessed in the deep features. As mentioned above, toss piles suggest use of a second layer of fuel, above the food being cooked, that would have needed to be removed prior to extraction of the cooked resource. The addition of a second fuel layer may indicate a greater amount of food stuffs, requiring more heat, cooked within the features. It should be noted that this may be entirely due to the number of samples sent for analysis. Juniper wood was found in all four macrofloral samples from the deep features, and buckthorn (likely lotebush or hollyleaf redberry) was identified in three of the four features (excluding FX-IC-37). These two species are the dominant hardwood sources currently found in the vicinity of the site, and their identification in the older features suggests this has also been the case throughout the site's use. The only wood fuel source identified in the later features that was not observed in the deep features was Mojave yucca (Feature-52), while the deep features contained four additional charred wood species: saltbush (ECO-BW-19 and ECO-KM-113), rose family (ECO-BW-19), mesquite (ECO-KM-113), and laurel (ECO-TRT-56). The discontinued use of saltbush, rose wood, mesquite, and laurel may indicate these resources became less available through time or that juniper and buckthorn became more prevalent.

As the earlier technological components of the deep features (e.g., coping stones, burning green wood, local stone exploitation, etc.) are still present in the adaptive patterns of the Late Prehistoric ones, this suggests a continuity of land use strategy between the Archaic and Late Prehistoric periods. The continuity in adaptive patterns (e.g., creation of thermal features remote from habitation sites for flora/fauna processing) that is seen from the earliest Holocene period suggests that the cultural and technological hallmarks of this practice were established early in the Archaic period. This general concept of in-field exploitation of biotic resources and the technology of earth oven construction appear to have spread throughout North America around the same period, as other early remains of rock-filled earth ovens date between 7000 to 6000 B.C. (Thoms 2008:122). Additionally, if the observed increase in thermal feature numbers found in the current study is a reflection of intensification, it would fit reports of similar responses on the continent between 2000 B.C. and A.D. 1 (Thoms 2008:121). If, for sake of argument, Thoms's dates are taken to be firm, then the inhabitants of Jacumba were some of the earliest adaptors of earth oven technology in North America, but also some of the latest to increase their reliance on the practice.

Do the results of the study shed light on questions regarding human adaptation in periods of increased aridity, particularly during the Holocene Climatic Optimum or Altithermal (between 5000 and 3000 B.C.) and the Medieval Climatic Anomaly (MCA) (between A.D. 800 and 1300) in prehistoric California?

The results from the deep features indirectly address this question. With five features dating between 6780 and 4300 B.C., it is interesting that no subsequent intact features were encountered until approximately A.D. 290. There is a good possibility that this may be due to sampling bias. However, it is possible that the effects of the Altithermal period were initially felt less in this landscape due to its aridity but that after several centuries of its stresses a change may have taken place. If the Altithermal removed a significant proportion of the ground cover in this area, it may have destabilized the landscape and contributed to increased erosion and deposition, deeply burying the early features. As no pollen records were captured for

the period between 4300 B.C. and A.D. 290, it is unclear whether the area became more barren or was even changed by the Altithermal. The lack of thermal features seems to suggest that some kind of environmental change may have occurred. It is possible, but very unclear, that key local plant varieties died out and did not start returning to the area until roughly 2,000 years ago.

The MCA is generally understood as the period between A.D. 800 and 1300 in many regions worldwide but consisted of complex climatic phenomena that were expressed differently in different region (Dean 1994). In North America, it seems to have involved an overall increase in temperature and higher aridity, including several severe multi-decade drought periods (Cook et al. 2004; Meko et al. 2007; Stine 1994). In California, the most severe drought periods occurred between A.D. 1020 and 1070 and between A.D. 1250 and 1330 (Jones and Schwitalla 2008). In the Great Basin, the period is associated with marginally habitable sites falling into disuse with decreased use of the Mojave and compact settlement units (habitations) (Hogan 2013; Jones and Schwitalla 2008). True (1990) argued that the end of the MCA set off the Late Prehistoric Period and may reflect the concentration of these previously disposed populations on a few reliable water sources.

At SDI-7074, five thermal features, all presumed earth ovens, had radiocarbon dates in the range of the MCA period: Feature-16, Feature-42, Feature-62, ECO-FX-J, and ECO-FX-O. Their presence indicates that the area maintained a reliable food source and was not abandoned. The pollen analyses for these features seems to show that the local plant community, considered to be drought resistant in most respects, was unchanged during the MCA (Table 5). In fact, the pollen analyses revealed an elevated occurrence of grass and arboreal species leading up to and during the MCA. Elevated levels of grass and arboreal pollen are generally associated with high levels of precipitation (Beggs 2004; Davies and Smith 1974; Smart et al. 1979). Increased grass pollen counts were identified in three of the five features dated to this period (Feature-16, Feature-42, and ECO-FX-O), and the only other thermal features, also presumed oven features, at SDI-7074 that contained elevated grass pollen counts date from the period immediately prior to the proposed MCA period: Feature-12 (A.D. 600 to 660) and Feature-17 (A.D. 580 to 660). Feature-62 (A.D. 1220 to 1280), with a radiocarbon date that overlaps one of the severe drought periods, showed elevated levels of arboreal pollen (juniper, pine, and oak). Additionally, algal spores identified in Feature-16 and the two features with high grass pollen counts that predate the MCA (Feature-12 and Feature-17) indicate that the period leading up to the MCA may have seen an increase in rainfall. Increased rainfall while raising the grass and arboreal pollen rates would also have recharged basins that fed local springs (LaMoreaux and Tanner 2001:34). Jacumba does not have standing above-ground water sources and is reliant on the scattered springs that feed the valley. Groundwater also tends to maintain a relatively long-term average temperature similar to its aquifer, so is less susceptible to rises in temperature and surface evaporation, unlike open-air reservoirs, meaning water sources in Jacumba are less susceptible to long periods of high heat that cause increased evaporation rates (LaMoreaux and Tanner 2001:34). Recharged catch basins may have continued to discharge water throughout the MCA and created a stable environment for the local inhabitants.

Table 5. Pollen Analysis from MCA Period Features

Feature No.	Type	2-Sigma Date Range	Pollen Analysis Results
Feature-16	Circular Earth Oven	A.D. 710 to 890	Sunflower family, juniper, pine, oak, sagebrush, ragweed/door/cocklebur, chicory, cheno-am, ephedra, wild buckwheat, spurge, prairie clover, sumac, rose family, chamise, local grasses, and algal spores
Feature-42	Oblong Earth Oven	A.D. 690 to 880	Sunflower family, juniper, pine, oak, sagebrush, ragweed/cocklebur, saltbush, ephedra, wild buckwheat, spurge family, legumes, prickly pear cactus, grasses, rose family, globe mallow, and grasses

Feature No.	Type	2-Sigma Date Range	Pollen Analysis Results
Feature-62	Circular Earth Oven	A.D. 1220 to 1280	Sunflower family, juniper, pine, oak, chicory, mustard family, pink families, saltbush, bindweed, ephedra, wild buckwheat, legumes, local grasses, and rose family
ECO-FX-J	Oblong Earth Oven	A.D. 900 to 1020	Sunflower family, juniper, pine, sagebrush, ragweed/cocklebur, chicory, chamise, saltbush, bindweed family, ephedra, wild buckwheat, prickly pear cactus, and local grasses
ECO-FX-O	Circular Earth Oven	A.D. 670 to 850	Sunflower family, juniper, pine, cheno-am, local grasses, sagebrush, bindweed family, two species of ephedra, and wild buckwheat

GIS-BASED SYNTHESIS OF PREHISTORIC LANDSCAPES IN THE JACUMBA/MCCAIN VALLEY REGION

by Don Laylander and Jerry Schaefer

In addition to site-specific studies for the East County Substation Project, a synthesis of information on prehistoric archaeological landscapes in the surrounding region was mandated for this project, along with other concurrent projects. A prehistoric archaeological landscape consists of the spatial patterning of the material remains from prehistoric activity in relation to each other and to the natural environment, including topography, hydrology, soils, geology, fauna, and flora. Two closely related synthetic reports are in preparation for the Jacumba/McCain Valley region and the Ocotillo region (Laylander et al. 2014a, 2014b; see also Schaefer and Laylander 2014). This section presents the results from the first of those syntheses that were derived from the creation and analysis of a geographical information system (GIS) database. All of that information remains confidential.

GEOGRAPHICAL SCOPE

The boundaries defined for the Jacumba/McCain Valley region generally correspond to the boundaries for the western half of the area addressed by the Yuha-Jacumba corridor mountain-to-desert landscape historic context study (Noah 2012), which is also the contextual foundation for this project (Figure 142). Areas south of the U.S./Mexico international border have been excluded because fully comparable information from those areas is not available. The use of this southern border limits but does not bias the statistical sample, since the other boundaries of the region are also largely arbitrary ones. An expanded database may be available in the future, however, as there have been ongoing discussion between BLM and the Instituto Nacional de Antrología e Historia (INAH) to share information. In the eastern half of the Yuha-Jacumba corridor, areas within an 8-km (5-mi.) buffer west of prehistoric Lake Cahuilla's 12-m-elevation (40-ft.) maximum shoreline have also been excluded; those areas more properly pertain to an ongoing Lake Cahuilla regional synthesis. The eastern boundary of the Jacumba/McCain Valley study area has been established at the 1,500-ft. elevation contour.

DATA SOURCES

This synthesis is based on existing GIS data sets and archaeological site records, which were generally those that were available as of January 1, 2014. Several major GIS data sets relating to aspects of the modern natural environment have been used for analysis of the modern natural environment. These data sets contain information on the region's topography, bedrock geology, soils, hydrology and vegetation.

The National Elevation Dataset (NED; <http://ned.usgs.gov/index.asp#>) has been used to characterize the region's topography. Produced by the U.S. Geological Survey (USGS), the NED is the primary elevation dataset for the United States. The resolution available for the study area is $1/9$ arc-second, or about 3 m.

For geological units, two sources have been used. Mapping of San Diego County, correlated with Rudolph G. Strand's (1962) "San Diego/El Centro Sheet" of the Geologic Map of California, was previously digitized by the San Diego Association of Governments (SANDAG). This was combined with mapping based on Paul K. Morton's (1977) *Geology and Mineral Resources of Imperial County, California* that has been digitized for the present project.

For soils units, digitized mapping based on Roy H. Bowman's (1973) *Soil Survey, San Diego Area, California* has been used. This mapping is only available for a portion of the Jacumba/McCain Valley region, excluding the portions in Anza-Borrego Desert State Park and in Imperial County.

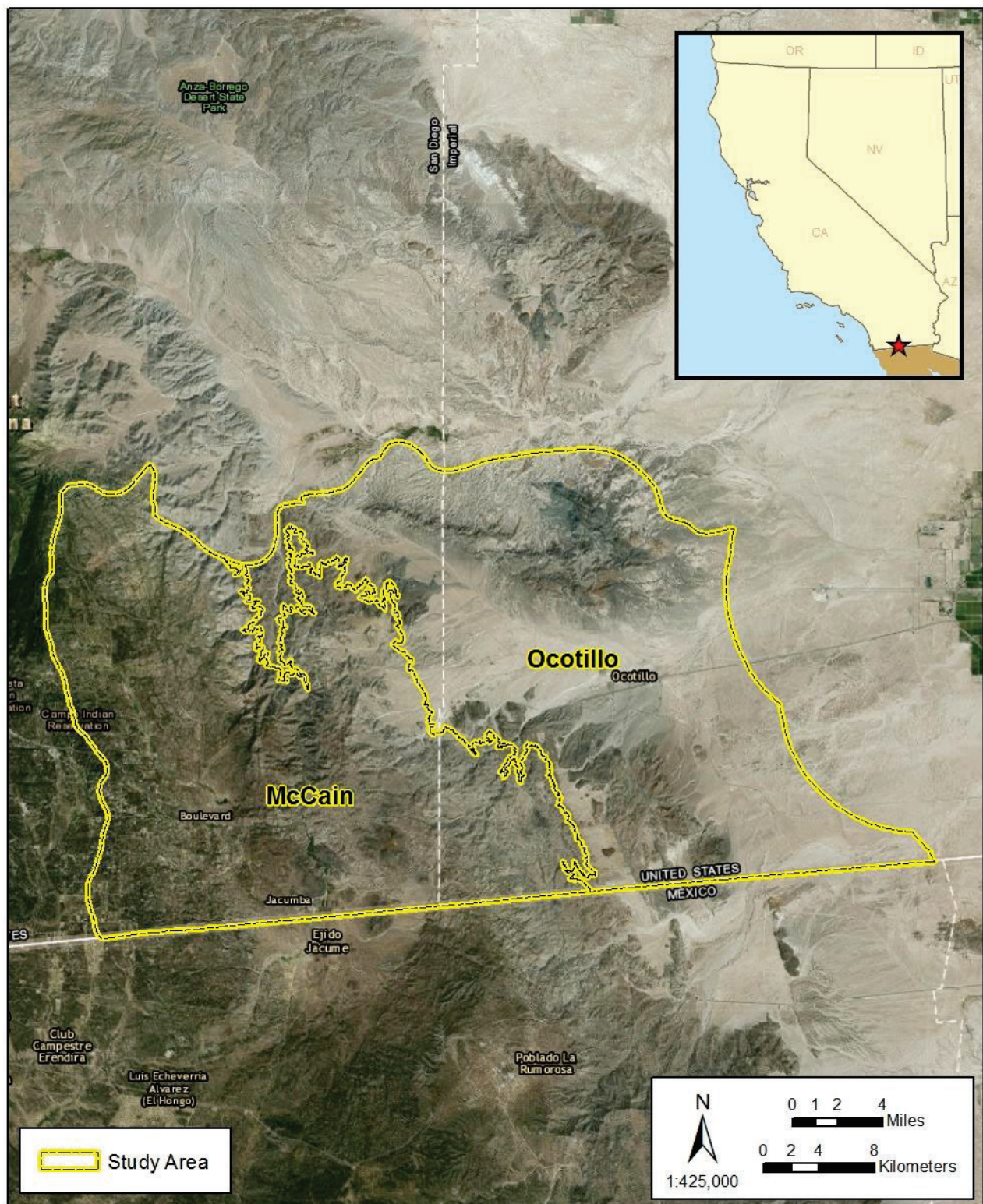


Figure 142. Map showing the Jacumba/McCain Valley and Ocotillo regions.

The National Hydrographic Dataset (NHD; <http://nhd.usgs.gov/data.html>), which was also produced by the USGS, has been used. This includes perennial streams, intermittent drainages, and springs, corresponding to those features as shown on the USGS's 7.5-minute topographic maps.

For vegetation, sources of mapping data included the U.S. Forest Service (2014) and the California Department of Fish and Wildlife (2014).

Archaeological layers for the GIS database have been created on the basis of data obtained from the California Historical Resources Information System's (CHRIS) South Coastal Information Center (SCIC), housed at San Diego State University. In addition to locational data, the GIS incorporates information from the records for archaeological sites and isolates based on the attribute and type categories that are discussed below. Sites and isolates that have only historic-period components have been excluded from the present database, as have some locations that have assigned site numbers but that lack any information suggesting that prehistoric sites are known to be present. The latter include records such as those for "rock shelters" that lack any associated artifacts or midden, as well as some arrays of desert pavement clearings that are more likely the products of natural processes rather than cultural activity.

National Archaeological Database (NADB) records on file at the SCIC have been used to identify the extents of areas within the region that were addressed by previous archaeological studies. Records indicating documents that may not include archaeological inventory information, such as planning and management documents, have been excluded, as have documents relating exclusively to studies of historic-period resources.

THEORETICAL CONTEXT

Prehistoric archaeologists have sometimes been accused with being excessively preoccupied with the concept of the individual archaeological site and with the prehistoric creation and abandonment of features, artifacts, and waste products, at the expense of giving attention to sites' larger contexts and to more varied dimensions of prehistoric lifeways. There are elements of truth in these criticisms, particularly as applied to archaeology that has been carried out under the mandate of cultural resource management (CRM) regulations rather than as academic research projects. Even CRM studies of relatively large blocks of land that contain numerous sites have sometimes been mere agglomerations of many individual site reports.

The preparation of a regional synthesis, based on the concept of *prehistoric archaeological landscapes*, offers an opportunity to offset some of the limitations of routine CRM investigations. It provides a chance to look at archaeological sites, features, and other remains within wider spatial contexts, in relation to each other and in relation to their settings within the natural landscape. Archaeological landscapes can encompass something closer to full life contexts, to the extent that those can be inferred from archaeological evidence, rather than the more limited suite of activities and cultural choices that are likely to be represented within an individual site.

At the same time, the limitations of studies such as this one need to be clearly recognized. One limitation is the largely arbitrary geographical delimitation of the study region. Except perhaps in the case of some isolated oceanic islands, archaeological regions can never be expected to constitute complete, fully self-contained cultural worlds. Some of the people who lived primarily within the region will have crossed beyond its borders during their lifetimes, and some outsiders will have occasionally entered into the region. Raw materials, finished products, and cultural ideas will have flowed into and out from the region. The arbitrariness of a delimited region is even more pronounced in the case of those prehistoric regions, such as the present one, that were occupied by mobile hunter-gatherers rather than more sedentary agriculturalists.

An effort has been made to minimize the arbitrariness of the present region's definition. The western and northern boundaries have been delineated, where possible, to include or exclude valleys as wholes rather than to cut across those areas. On the east, an elevation contour has generally been adopted as a boundary, falling within the relatively abrupt descent from the Peninsular Range to the low Colorado Desert. The problem of the eastern boundary is also somewhat mitigated by the close integration of the present study with a parallel landscape synthesis for the adjacent Ocotillo region. However, the two areas, considered together as a single region, still clearly constitute a fairly arbitrary segment of the landscape rather than a self-sufficient cultural universe. On the south, the arbitrariness of the U.S./Mexico international border is patent, but it has been used as a practical boundary because of difficulties with the comparability and accessibility of archaeological information beyond that boundary.

Another limitation to the study arises from its CRM context. In academic studies, it is sometimes possible for a team of researchers to carry out an integrated program of investigations extending over a decade or longer, implementing a standardized methodology to address specific, well-defined research goals. In contrast, the present study is based on existing archaeological data that have been collected by a variety of independent investigators. The data were recorded with limited comparability, and the investigations were not specifically focused on recovering the data that would be most desired to meet the research objectives discussed in this synthesis. This is a significant limitation, but not a crippling one. Comparability and relevance are always imperfect in large projects, even within the most rigorous investigations, and the presently available data are adequate to address important issues with reasonable reliability.

An important distinction may be drawn between a "prehistoric archaeological landscape" and a "cultural landscape," at least as the latter term is sometimes defined. A cultural landscape may refer to the ways in which a modern group relates to and interacts with a traditional natural and cultural context. As such, it is closely related to the concept of a traditional cultural property. Archaeological sites are important elements in cultural landscapes, but their importance lies within the minds and practices of cultural descendants, not in their scientific information value. The delineation and investigation of such cultural landscapes lies in the province of the ethnographer, not the archaeologist.

A related distinction exists between "emic" and "etic" ways of understanding cultural phenomena. Emic information refers to the subjective ways in which things are understood by the participants within a culture. Etic information refers to outsider, scientific, "objective" understanding. It has sometimes been suggested that etic understanding is an imperfect and probably ethnocentric attempt to arrive at emic understanding, but this is incorrect. An etic understanding of cultural phenomena can address significant dimensions of culture that lie entirely beyond the understanding of the participants in the culture, such as systems of long-term cultural change and the functional origins of institutions. Prehistoric archaeological landscape studies should ideally address both emic and etic understandings, to the extent that they may be recoverable from the archaeological record as manifestations of patterned human behavior.

In the present study, several approaches to regional synthesis have been applied, but the primary method is the statistical analysis of spatial patterning through the use of the GIS (Conolly and Lake 2006). The analysis attempts to identify and offer explanations for the nonrandom distribution of various categories of prehistoric cultural residues with respect to each other and with respect to aspects of the inferred prehistoric natural landscape. However, as noted above, problems with the comparability and accuracy of the received archaeological data may exist and might sometimes create false statistical patterning. On the other hand, the limited size of the archaeological sample and the complex interaction of the variables involved likely means that some genuine patterning has not been recognizable and awaits future analysis.

In proposing explanations for the archaeological patterning that has been discovered, materialist interpretations have been favored here over idealist interpretations (Harris 1979). Materialist interpretations have been integrated under a variety of labels, such as cultural materialism, cultural ecology, and behavioral ecology. At their best, these systems offer falsifiable predictions about the observed phenomena, which

idealist interpretations (such as structuralism and post-processualism) commonly do not offer. However, cultural phenomena are clearly the products of both material and ideological imperatives, and when the prioritized materialist explanations are insufficient, idealist explanations must also be considered.

Explanatory models have been partly drawn from the local ethnographic record, partly from comparative worldwide ethnographic records (e.g., Kelly 1995), and partly from theoretical models based on such factors as economic maximization and evolutionary efficiency (e.g., Bettinger 1991). The use of the local ethnographic record does not mean that the limitations of that record are overlooked. The ethnographic record was inevitably collected incompletely and imperfectly, generally after more than a century of intensive cultural change had elapsed subsequent to the end of the prehistoric period, not to speak of the centuries and millennia of prehistoric change that had separated the “ethnographic present” from earlier periods. The worldwide ethnographic record provides a valuable comparative database, particularly with respect to cultures that share elements in common with the study region with respect to environmental settings, economies, and social organization. Purely theoretical models, when they are falsifiable, provide invaluable hypotheses, but inevitably they involve severe simplifications.

GEOGRAPHICAL CONTEXTS

Archaeological landscapes must be understood within the context of natural landscapes, both within the study area and in the adjacent regions to which the study area’s prehistoric inhabitants travelled or with which they had connections. To a degree, the modern natural landscape may be taken as an approximation of the prehistoric natural landscape. This is a fairly valid simplification for the relatively stable dimensions of physiography, geology, and soils, but it becomes less so in the cases of climate, hydrology, and biota. It must also be recognized that none of these dimensions remained entirely constant throughout the course of more than 12 millennia of prehistory.

In the analysis of the archaeological landscape in subsequent sections, statistical sampling will be used to look for distinguishing characteristics in the locations within the study region that were selected for various prehistoric uses. To compare the characteristics of the archaeological site locations with the general characteristics of potential site locations within the study region, a systematic GIS sample of 6,045 points, spaced in a grid at 300-m intervals, has drawn (Figure 143). The characteristics of that sample are discussed in this section.

Only portions of the study region have been systematically examined for the presence or absence of archaeological remains. Consequently, a statistical comparison between the characteristics of site locations and of locations within the region as a whole is potentially biased by characteristics that have directed archaeological investigations toward particular types of areas. This bias is primarily in favor of areas that have been selected for some form of modern development, and that consequently have been addressed by cultural resource management studies.

To reduce this bias, the systematically sampled locations have been distinguished as falling either within or outside of areas addressed in NADB documents at the SCIC. One thousand three hundred and seventy-eight (1,378) of the sample points, or approximately 22.8 percent of the study region, fall within areas that have been addressed by NADB documents. These NADB areas are taken as an approximate estimate of areas that have been systematically inventoried for archaeological resources, to the extent that most major studies were registered with NADB. However, it is clear that the equation between NADB areas and areas of archaeological inventory is only very roughly valid. NADB areas probably include some areas that were not surveyed archaeologically, for instance because of steep slopes or overlaying modern development. More importantly, many non-NADB areas have been examined archaeologically. This is confirmed by the fact that 37.4 percent of the prehistoric sites and isolates that have been reported within the Jacumba/McCain Valley study region are located outside of the NADB areas. In this section, the statistical characteristics of both the study region as a whole and of NADB areas within it are discussed.

Physiography

The Jacumba/McCain Valley region lies on the eastern margin of a portion of the Peninsular Range. The range's crests mark the drainage divide between the Pacific Coast to the west and the Salton Basin and the Gulf of California to the east. The Peninsular Range extends, albeit brokenly, from San Geronimo Pass and the San Jacinto Mountains in Riverside County to the north of the study region, south through most of the length of the Baja California peninsula, a total distance of over 800 km. While the western approaches to the Peninsular Range are generally fairly gradual, through foothills and valleys, the eastern margin of the range tends to be more precipitous, only occasionally offering valleys of any great extent at intermediate elevations. The range's highest peaks exceed 3,000 m (10,000 ft.) in elevation at Mount San Jacinto in Riverside County and Picacho del Diablo in northern Baja California. However, the range would not have constituted a serious barrier to prehistoric east/west communications. Instead, higher elevations, with their greater rainfall and economically significant biota, including preferred sources of acorns and pinyon nuts, often served as magnets for visitors, at least seasonally coming from both east and west (cf. Laylander and Christenson 1988). Major occupations focused on these and other resources in the Mt. Laguna and Cuyamaca areas to the northwest of McCain Valley (Graham 1981; True 1970). San Diego Bay and the open Pacific Coast lie about 75 km to the west of the Jacumba/McCain Valley region. The Gulf of California lies about 175 km to the southeast. The maximum shoreline of prehistoric Lake Cahuilla, during periods when the lake was present, lay as little as 20 km to the east.

In the portion of the study region that lies north of Interstate 8, the western border of the region is roughly defined by the mountains of the Tecate Divide. Farther to the east, running approximately north/south through the study region, are the In-Ko-Pah Mountains. The relatively broad expanse of McCain Valley occupies the area between those two ranges. Farther east again are the Jacumba Mountains. Between the In-Ko-Pah and Jacumba ranges is the narrow, steep canyon of Carrizo Gorge. To the east of the Jacumba Mountains, at elevations still above the arbitrarily defined 1,500-ft.-elevation boundary of the study region, the land is predominantly open, relatively level desert.

The southern boundary of the study region is the geographically arbitrary U.S./Mexico international border. Between the border and the community of Boulevard is the relatively small Jewell Valley. Farther east, and only incompletely cut off from it by the southern end of the In-Ko-Pah Mountains, is the larger Jacumba Valley, which spans both sides of the international border. Devil's Canyon and In-Ko-Pah Gorge descend to the northeast from Jacumba Valley toward the low desert. East of In-Ko-Pah Gorge but west of Davies Valley (which lies within the Ocotillo study area), an irregular extension of the In-Ko-Pah Mountains, containing the relatively small Myers Valley and Pinto Canyon, continues south, becoming northern Baja California's Sierra de Juárez.

Three physiographic dimensions have been used to characterize the study region statistically for use in the analysis of archaeological site locations. These dimensions are elevation, slope, and aspect. Data frequencies for the three dimensions are summarized in Figures 144 through 146, comparing the representation from NADB study areas with the project area as a whole.

Elevations in the regional point sample range between 1,495 ft. (456 m) and 5,349 ft. (1,630 m) (Figures 144 and 145). The median elevation among the sample points is 3,329 ft. Grouping the data into 100-ft.-interval ranges, there is a mode in the 3,400-3,900-ft. ranges, and a secondary mode in the 1,500-2,100-ft. ranges. The elevation frequencies in NADB areas differ somewhat from these. The median NADB-area elevation is 3,643 ft. The secondary (1,500-2,100-ft.) mode is less well represented in the NADB areas, and the primary mode lies at somewhat higher elevations, between 3,900 and 4,100 ft. The underrepresentation of relatively low elevations in the NADB areas is explained by fewer CRM projects having taken place along the eastern escarpment of the Peninsular Range, with the exception of In-Ko-Pah Gorge.

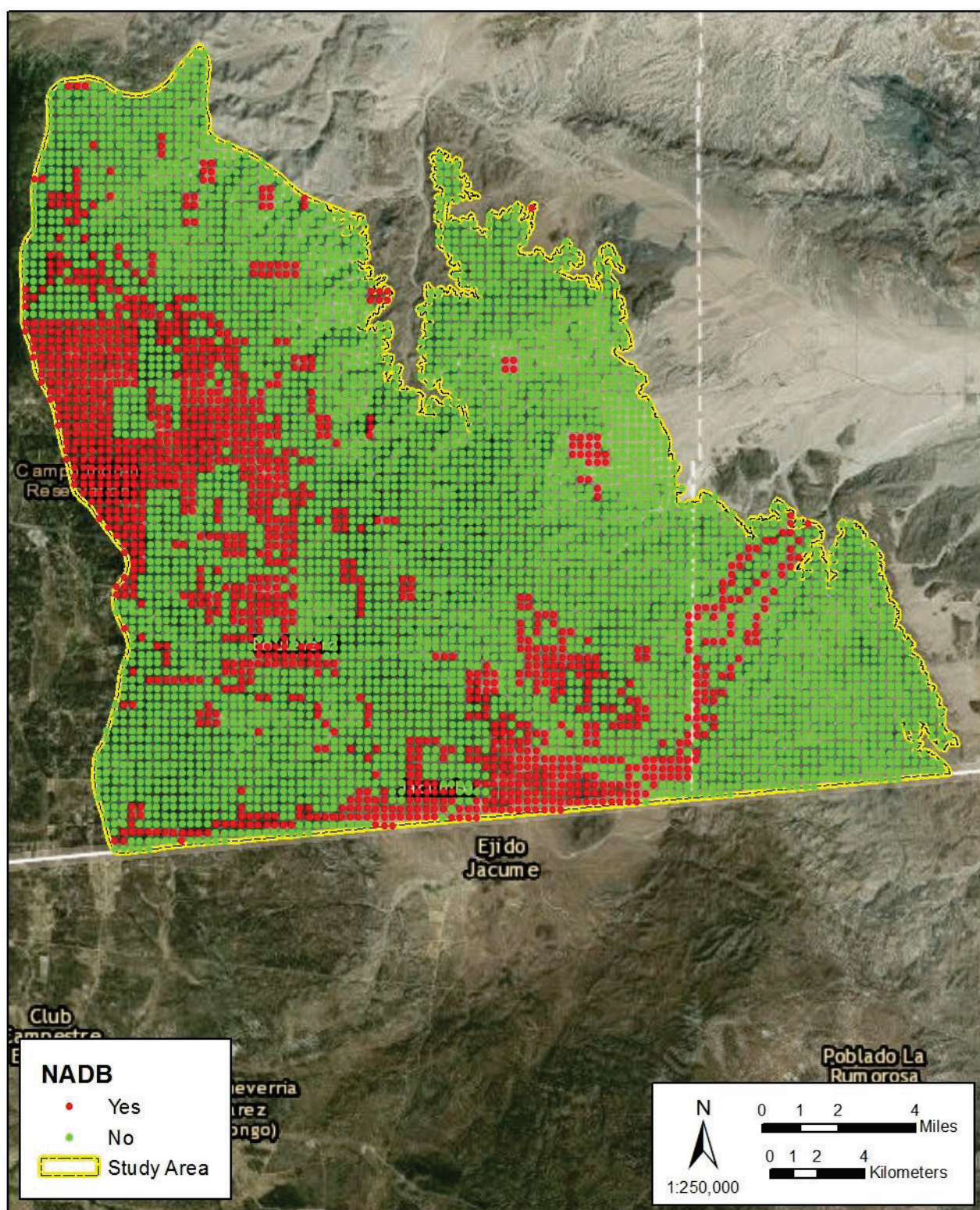


Figure 143. Map showing regional samples points in the Jacumba/McCain Valley region, including areas within and outside of NADB areas.

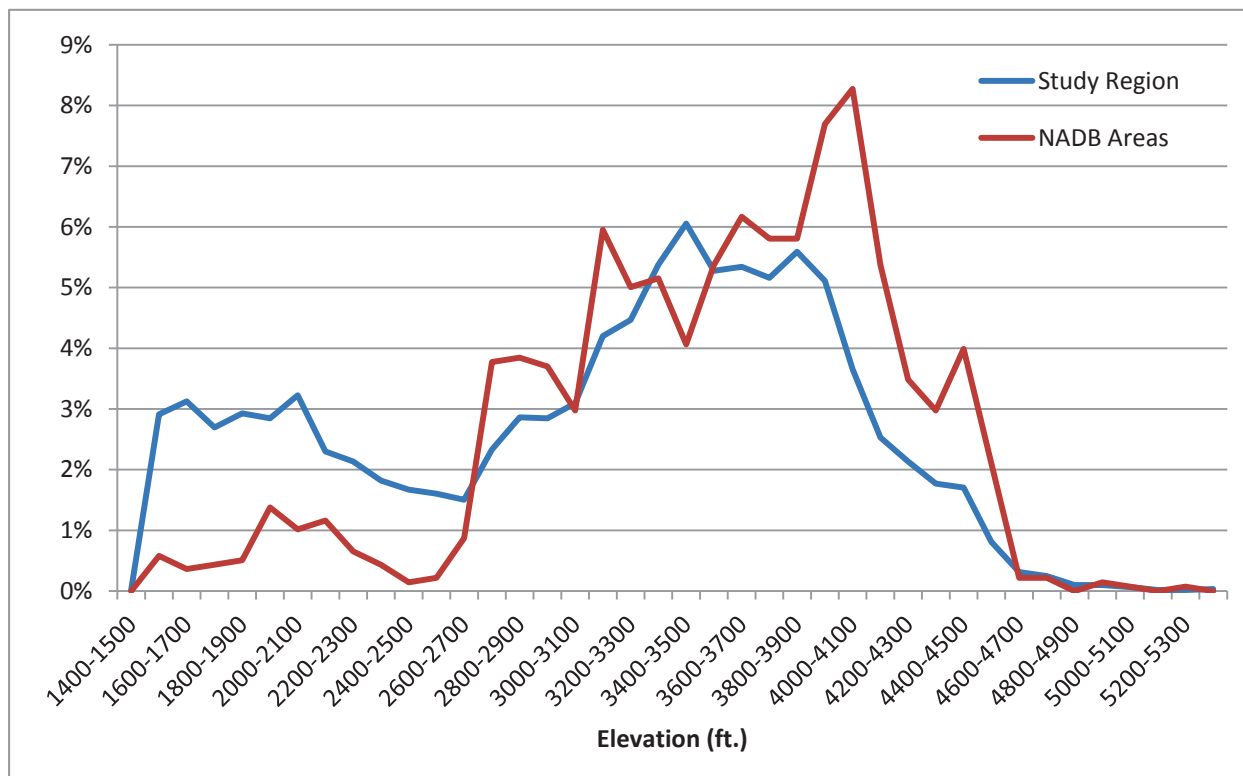


Figure 144. Relative frequencies of elevations within the Jacumba/McCain Valley region and NADB areas.

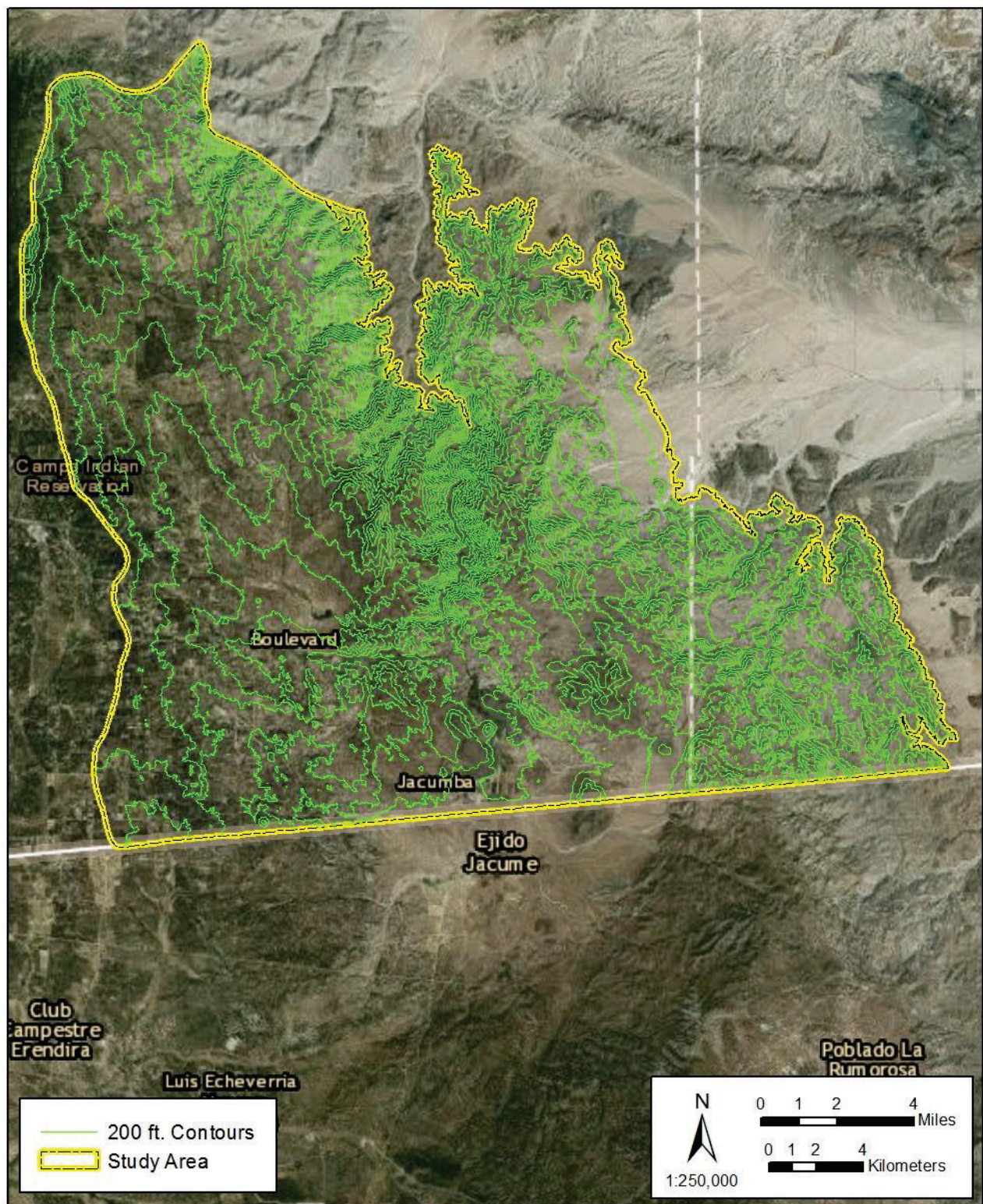


Figure 145. Relative frequencies of slopes within the Jacumba/McCain Valley region and NADB areas.

The slope of the land at the sample of points within the study region ranges from 0° to 85° (see Figure 146). Slopes of 10° or less account for only 14.8 percent of the region, compared with 39.7 percent of the Ocotillo study region to the east. Slopes greater than 45° make up 35.6 percent of the Jacumba/McCain study region. As might be expected, NADB areas disproportionately represent flatter portions of the study region, with slopes of 10° or less accounting for 24.8 percent of the areas, and slope greater than 45° accounting for only 19.2 percent.

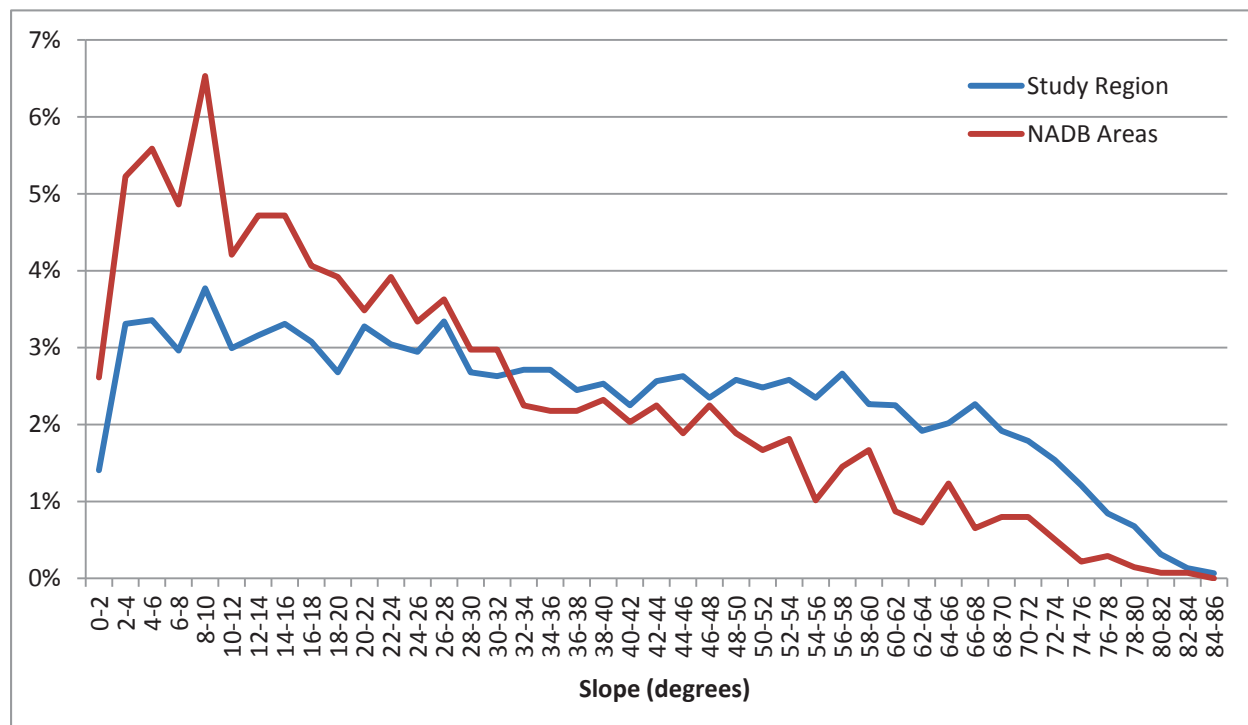


Figure 146. Relative frequencies of aspects within the Jacumba/McCain Valley region and NADB areas.

Aspect refers to the direction faced by the downward slope in the immediate vicinity of a geographical point. Because the region lies on the eastern margin of the Peninsular Range, which generally trends north-northwest and south-southeast, it is predictable that northeastern and eastern aspects would be disproportionately represented in the point sample, and this is the case, with that quadrant of aspects representing 35.7 percent of the study region (see Figure 147). The aspects for NADB areas are similar to those for the study region as a whole, but include a higher proportion of southern aspects.

In general, the region's physiography may be considered to have been nearly constant from the present back to its earliest human prehistory. Erosion, sedimentation, and modern development have altered landforms, but only on a fairly localized basis. In surrounding regions, one significant change has been in shorelines, in response to the post-Pleistocene rise of sea level. The world's oceans rose perhaps 80 m between 12,000 B.C. and 4000 B.C., after which the rate of sea-level rise has been fairly low (Masters and Aiello 2007:37).

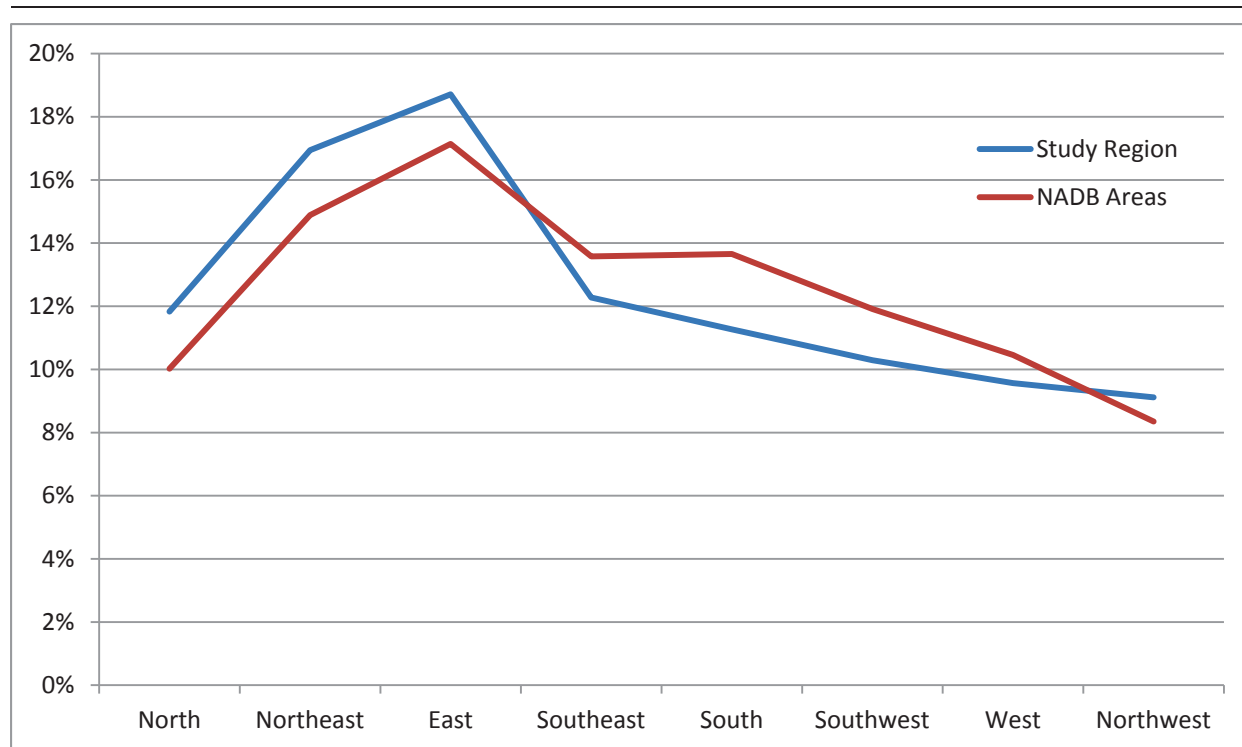


Figure 147. Map showing elevations within the Jacumba/McCain Valley region, in 200-ft. intervals.

Geology

Two sets of GIS data on the generalized geology of the study region were used (Figure 148). The GIS mapping for San Diego County was created by the San Diego County Association of Governments (SANDAG), and it corresponds, to a considerable extent, with the geological mapping on the San Diego-El Centro Sheet of the California Division of Mines and Geology's *Geologic Map of California* (Strand 1962). The mapping for Imperial County was digitized for the present study from Paul K. Morton's (1977) *Geology and Mineral Resources of Imperial County, California*. The two data sets do not perfectly match in terms of the mapping units used. In addition, some of the distinctions that were made between different-aged sedimentary rock formations, while significant for geological chronology, are generally not likely to be significant for the analysis of prehistoric archaeological landscapes. Table 6 summarizes the manner in which the two data sets were reconciled for present mapping and analytical purposes.

Table 6. Concordance of Mapped Geological Units

Present Study	San Diego County (SANDAG)	Imperial County (Morton 1977)
Metamorphic Rock	Pre-Cretaceous Metasedimentary	Metamorphic Rocks
		Marble
Granitic Rock	Cretaceous Plutonic	Granitic Rocks
Miocene Volcanic Rock	Miocene Volcanics	Alverson Andesite and Jacumba Pyroclastics

Present Study	San Diego County (SANDAG)	Imperial County (Morton 1977)
Miocene Sedimentary Rock	Miocene Nonmarine	Split Mountain Formation
Plio-Pleistocene Sedimentary Rock	Pliocene Marine	Imperial Formation
	Plio-Pleistocene Fluvial and Plio-Pleistocene Fluvio-Lacustrine	Palm Springs Formation and Canebrake Conglomerate
Older Quaternary Alluvium	Older Quaternary Alluvium, Terraces, and Fonglomerates	Older Alluvium
Younger Quaternary Alluvium	Quaternary Alluvium	Alluvium

Figure 149 summarizes the relative frequencies of the geologic units within the study region and within NADB areas. More than 90 percent of the study region is underlain by Cretaceous granitic rocks of the Southern California Batholith (72.5 percent) and associated pre-Cretaceous metamorphic rocks (17.9 percent). Miocene volcanic rocks account for 1.6 percent of the study region's area, and Miocene sedimentary formations make up 1.6 percent. (Plio-Pleistocene sedimentary rocks are present in the adjacent Ocotillo study region but are not represented in the Jacumba/McCain Valley region.) Younger Quaternary alluvium accounts for 4.9 percent of the region, while older Quaternary alluvium represents another 1.5 percent. NADB areas show higher proportions of granitic rock (80.9 percent), Miocene volcanic rock (2.8 percent), Miocene sedimentary rock (2.8 percent), and younger alluvium (7.3 percent); a much lower proportion of metamorphic rock (4.4 percent), reflecting the minimal archaeological work done in the Carrizo Gorge area; and a similar proportion of older Quaternary alluvium (1.7 percent).

The geologic units have various potential implications concerning the archaeological record. Granitic rocks provided optimal materials for portable milling tools as well as bedrock or boulder platforms for milling features. Quartz dikes within granitic areas provided a widely used although probably not optimal material for flaked lithic tools. Prehistorically significant varieties of metamorphic rock included gneiss, schist, quartzite, and soapstone. Gneiss and schist were commonly used for milling tools and milling platforms. Quartzite provided another source of flaked lithic tools. Locations with soapstone, including the Jacumba area (Parkman 1985; Treganza 1942), offered a comparatively rare material that was valued for its softness and thermal properties. It was used for cooking vessels, heating stones, arrowshaft straighteners, sucking tubes, smoking pipes, ornaments, effigies, body powder, body paint, and ground paintings. Some volcanic rocks offered a preferred material for flaked lithic tools, while other volcanics might be used as milling implements. Sedimentary rocks were generally less valued; however, sandstone was used for milling, and conglomerate might contain cobbles that were suitable for flaking. Areas of alluvium were significant with respect to the preservation or destruction of archaeological evidence. Older alluvial surfaces provided the most likely settings for the preservation of prehistoric trails and cleared circle features. Younger alluvium might represent areas where archaeological deposits would have been eroded or buried.

Significant geologic aspects of the study region's prehistoric archaeological landscape were not limited to areas within the study region itself, but also included resources located in other regions. Obsidian was a highly valued material for flaked lithic tools, particularly bifaces and projectile points. Significant obsidian sources included Obsidian Butte, located 65 km northeast of the study region near the present-day Salton Sea (Hughes and True 1985); San Felipe and other sources in northeastern Baja California, on the order of 240 km south of the study region (Panich et al. 2012); and Coso Volcanic Fields, 370 km to the north in the northern Mojave Desert (Gilreath and Hildebrandt 1997).

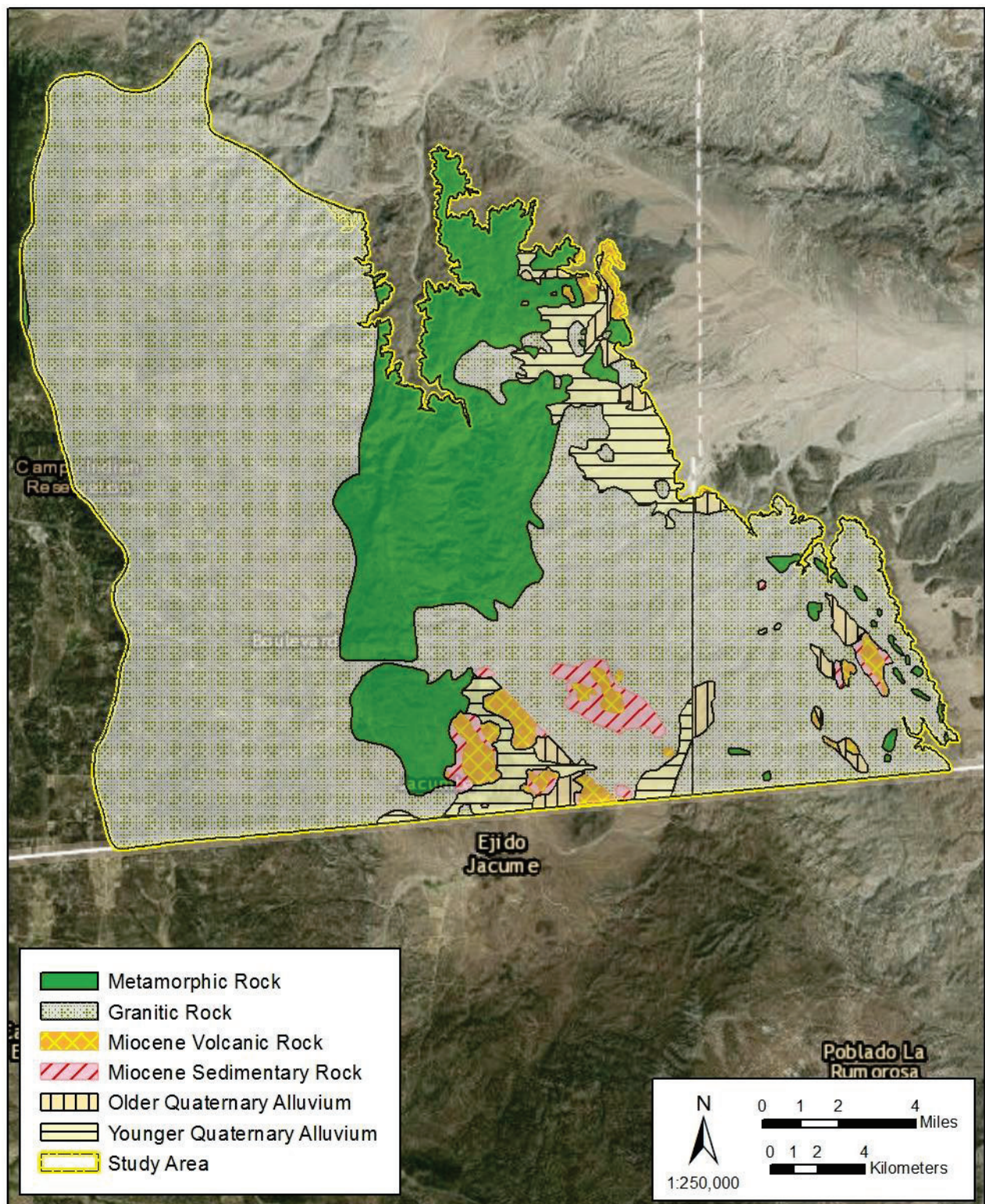


Figure 148. Generalized geologic map of the Jacumba/McCain Valley study region.

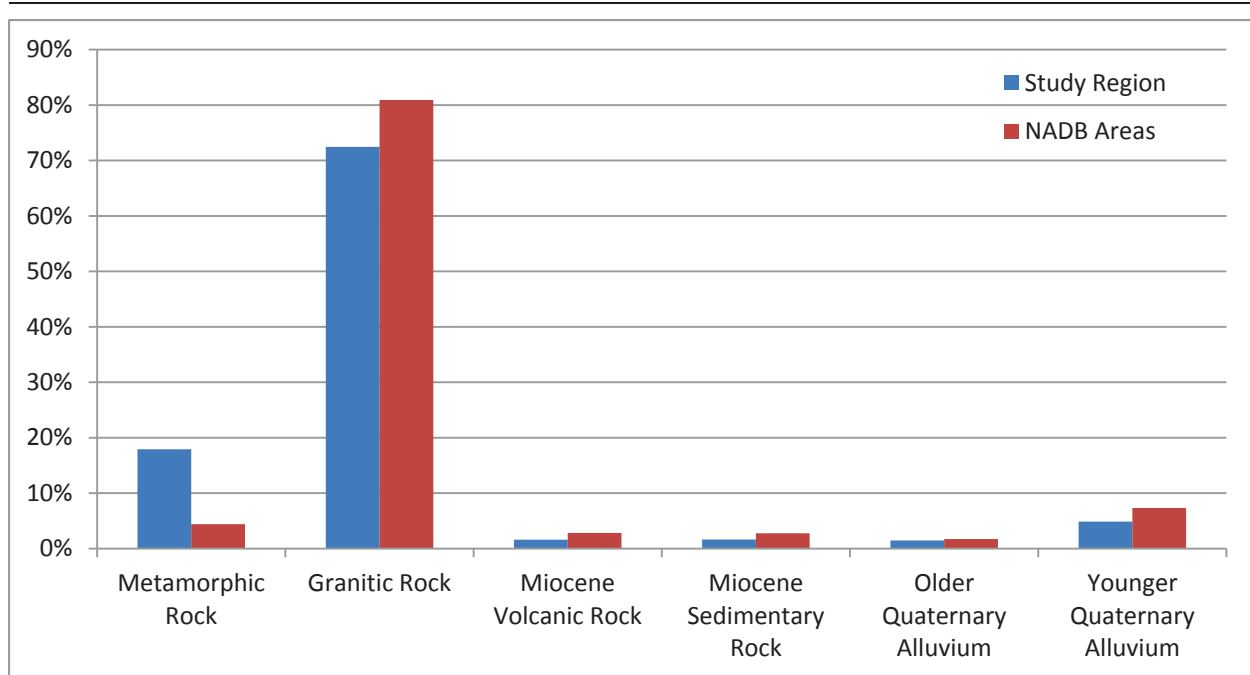


Figure 149. Relative frequencies of geologic units within the Jacumba/McCain Valley study region and in NADB areas.

Cryptocrystalline silica (chert, chalcedony, jasper, etc.) was another material that was highly valued for use in flaked stone tools. Diverse source areas for this material have been identified, including wonderstone sources at Rainbow Rock, 35 km to the north of the study region, and Cerro Colorado, about 10 km to the east (Pignuolo 1992, 1995). Metavolcanic rock from the Santiago Peak Formation in western San Diego County probably reached the study region.

Although largely constant, the geologic landscape did undergo at least a few changes during and after the prehistoric period. Areas of younger Quaternary alluvium were subject to significant erosion and deposition, changing the suitability of particular site locations and destroying or burying earlier deposits. The Obsidian Butte lithic source was periodically inaccessible when Lake Cahuilla was present, as discussed below. A recent suggestion is that Obsidian Butte may have formed as recently as 3,000-2,000 years ago (Schmitt et al. 2013). It is possible that some lithic resources may have been significantly depleted during the course of prehistoric exploitation, although no evidence to confirm this hypothesis has been obtained in the study region and adjacent areas (Norwood 1980).

Soils

Soil characteristics are unlikely to have been important as direct factors in the land-use decisions of the region's prehistoric occupants. However, soils are indirectly important for interpreting archaeological landscapes. Differences in soils reflect differences in the likelihood that archaeological deposits have been eroded away, buried, or preserved. Soil types also affect the types of vegetation that will successfully grow from them, and the soil types are more stable and less subject than the observed plant communities themselves to the shorter-term fluctuations related to fire history, succession, and climate change. With more detailed data and more intensive analysis than are available for the present study, soils may provide additional clues to the likely distributions of prehistoric vegetation communities. Although specific clay sources used for pottery have not been identified ethnographically or archaeologically in the study region, it is likely that sources exist where granitic rocks, water sources, and depositional basins all converge, such as in the Jacumba and McCain valleys.

Detailed GIS soils mapping is only available for about 60 percent of the study region, excluding Imperial County in the southeast and Anza-Borrego Desert State Park in the northeast (Figure 150) (Bowman 1973). Thirty-six soil types have been mapped within the study region, but for purposes of the present analysis, these have been collapsed into six categories (Table 7; Figure 151).

Table 7. Concordance of Mapped Soil Units

Analyzed Category	Included Mapped Units
Bedrock	AcG – acid igneous rock land
	MrG – metamorphic rock land
	RuG – rough broken land
	SvE – stony land
Bedrock Soils	KcC, KcD2 – Kitchen Creek loamy coarse sand
	LaE2, LaE3, LcE2 – La Posta loamy coarse sand
	LdE, LdG – La Posta-Sheephead complex
	LeE2 – Las Flores loamy fine sand
	SpG2 – Sheephead rocky fine sandy loam
	ToE2, ToG – Tollhouse rocky coarse sandy loam
Alluvial Soils	CaB, CaC, CaC2, CaD2 – Calpine coarse sandy loam
	CeC – Carrizo very gravelly sand
	GoA – Grangeville fine sandy loam
	InA, InB, IoA – Indio silt loam
	MnB – Mecca coarse sandy loam
	MvC, MvD – Mottsville loamy coarse sand
	RaC, RaD2 – Ramona sandy loam
	RkA – Reiff fine sandy loam
	RsA, RsC – Rositas loamy coarse sand
Gullied Land	SrD – gullied land
Riverwash	Rm – riverwash
Water	W – water

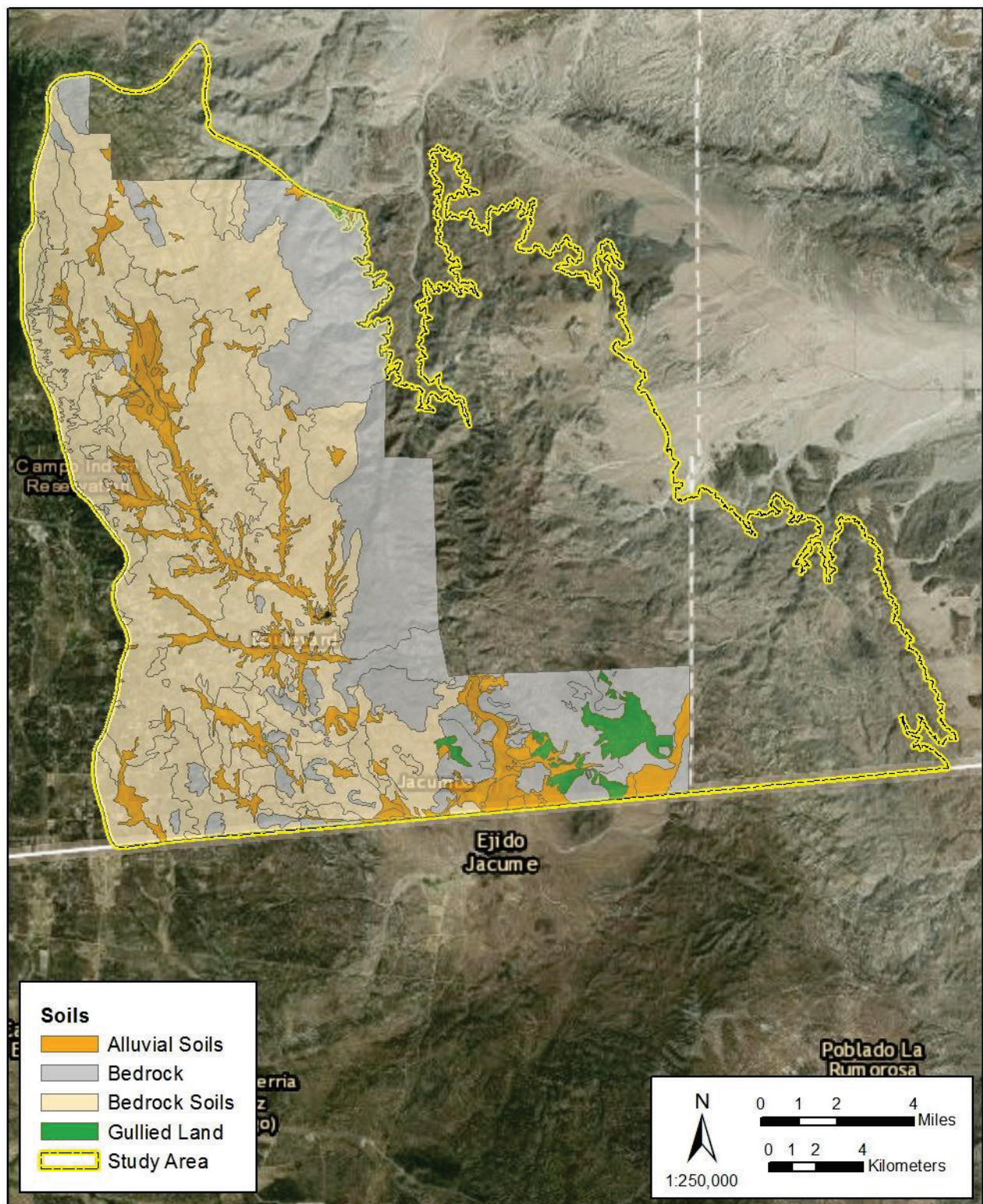


Figure 150. Generalized soils map of a portion of the Jacumba/McCain Valley study region.

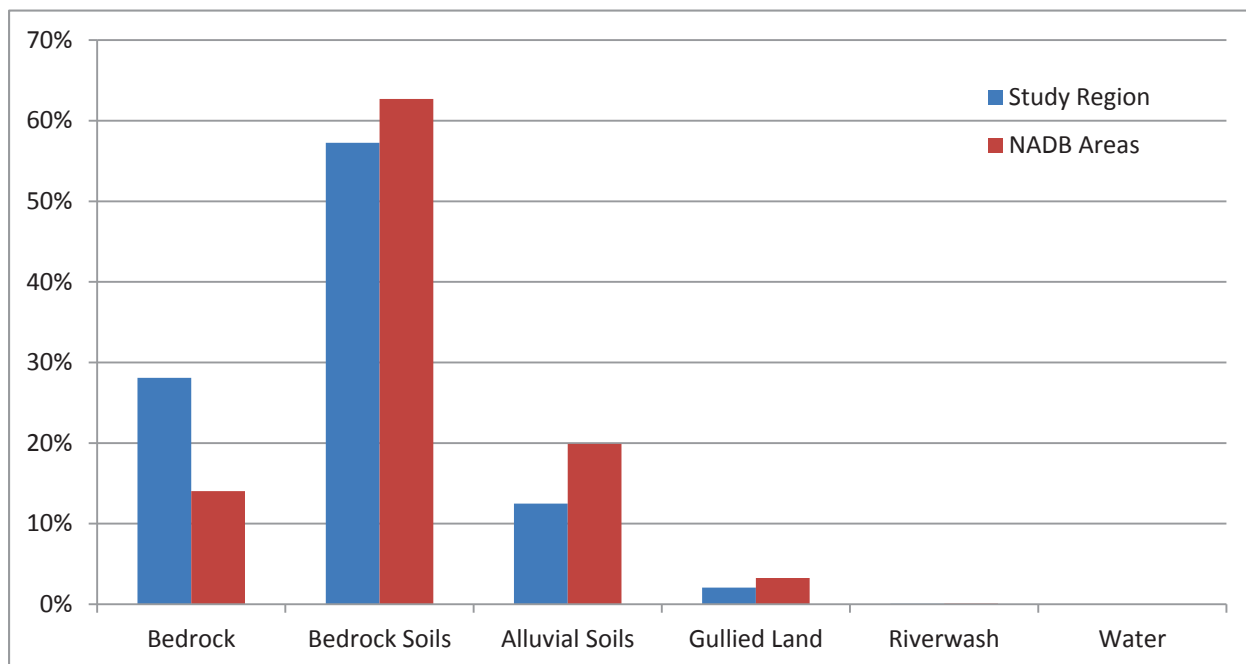


Figure 151. Relative frequencies of soils types within the mapped portions of the Jacumba/McCain Valley study region and in NADB areas (excluding Anza-Borrego Desert State Park and Imperial County).

Bedrock areas largely lack any substantial soil. Vegetation is likely to be very sparse. Archaeological materials, if they have not been eroded away, are likely to be exposed on the surface. These areas might also have been used for bedrock milling and for storage in granaries.

Bedrock soils are comparatively shallow, formed from the weathering of the underlying bedrock. Archaeological materials deposited on the surface in these areas may have become incompletely mixed downward into the soil through bioturbation, for instance as a result of rodent burrowing.

Areas of alluvial soils have very deep soils that have formed in alluvially deposited sediments. In some but not all cases, alluvial action may have continued into the prehistoric period, eroding or stratigraphically burying cultural deposits. Some postdepositional mixing of archaeological materials, both upward and downward, through bioturbation is also likely.

In gullied land, archaeological deposits might be extensively disturbed by erosion, but deeper cultural deposits might also be exposed. If the gullying occurred prehistorically, these areas are unlikely to have attracted prehistoric settlement.

Areas of riverwash might have attracted prehistoric use seasonally as providing sources of water and of cobbles for tool-making. However, archaeological evidence is unlikely to have been preserved, except in the case of milling features on boulders.

Areas mapped as “water” include locations where water has been historically impounded to form lakes or ponds. Although prehistoric archaeological sites may have been present in these areas and may be preserved under water, they are normally undetected and inaccessible.

In the portion of the study region in which soils have been mapped, they are predominantly derived from the underlying granitic or metamorphic bedrock. Significant additional areas have exposed bedrock or soils formed in alluvium, while traces of gullied land are present. NADB areas show higher proportions of alluvial and bedrock-derived soils but a substantially lower proportion of exposed bedrock.

Hydrology

Water was a critical resource for prehistoric groups, particularly in arid or semi-arid areas such as the Jacumba/McCain Valley region. Potential sources of water in the region included perennial creeks, intermittent seasonal drainages, springs, shallow wells, and *tinajas* (natural tanks). Modern mapping may be used to suggest the distribution of such sources, although historic-period land-use has likely altered those patterns to a degree.

The USGS 7.5-minute topographic quadrangles show only four creeks in the study region as having segments with perennial flows: Tule Creek in McCain Valley, Boundary Creek in Jewell Valley, and Boulder and Myer creeks in In-Ko-Pah Gorge. An additional eight intermittent drainages were considered significant enough to be named on the topographic maps: Walker Creek, Bow Willow Creek, Palm Canyon Wash, Goat Canyon, Carrizo Creek, Rockhouse Canyon, Mortero Canyon, and Pinto Canyon. Most of these drainages feed into the Carrizo Creek catchment system, the exceptions being Palm Canyon Wash, Boulder Creek, Myer Creek, and Pinto Canyon, which feed into Coyote Wash farther to the south. Both the Carrizo and the Coyote drainage systems empty into the Salton Basin to the east.

To help differentiate minor from potentially more substantial drainages, the Strahler system of stream order classification has been applied to the study region's mapped drainages (Figure 152). Third-order drainages (representing the junction of two second-order drainages) and higher-order drainages have been distinguished from first- and second-order drainages. Third-order drainages within the study region include portions of Bow Willow Creek, Tule Creek, Boundary Creek, Carrizo Creek, Boulder Creek, and Pinto Canyon. The interpretive assumption is that high-order drainages would have been more likely to have prolonged and reliable water flow, either on the surface or at shallow depths, than would be the case with lower-order drainages. However, this assumption is no more than approximately correct. Among the four sections of drainages that have been mapped as containing perennial flow, three sections, including Tule Creek in upper McCain Valley, Boundary Creek in Jewell Valley, and most of the perennial stream course of Boulder Creek in Carrizo Gorge, are merely second-order drainages, while the perennial stream course of Myer Creek in Carrizo Gorge includes first-order and second-order segments as well as a longer third-order segment. The remaining third-order or higher drainages, including Bow Willow Creek, lower portions of Boundary Creek, Carrizo Creek, and Pinto Canyon, are mapped as being only intermittent. In periods of cooler and wetter climate, some of these higher-order streams may have been perennial.

Forty-five springs have been mapped within the study region. Springs that are named on the USGS topographic maps include Bankhead, Iron, Sacotone, Redondo, Arsenic, Dos Cabezas, and Mountain springs. The distribution of springs is, to an extent, geographically complementary to the distribution of the high-order drainages. Most of the springs are associated with first-order ($n = 19$) or second-order ($n = 10$) drainages, or are not associated with any mapped drainages ($n = 9$), rather than being associated with third-order or higher drainages ($n = 7$).

The distances of locations from springs and from high-order drainages may have been significant variables in prehistoric site selection. To lay the foundation for evaluating this factor, the study region has been characterized by those distances for the regional sample points and for the NADB-area sample points. Figure 153 shows the proportions of the study region and of NADB areas that are located at distances from the nearest spring, expressed in 1,000-ft. intervals. The mean distances are 4,725 ft. for the study region as a whole and 5,575 ft. for NADB areas.

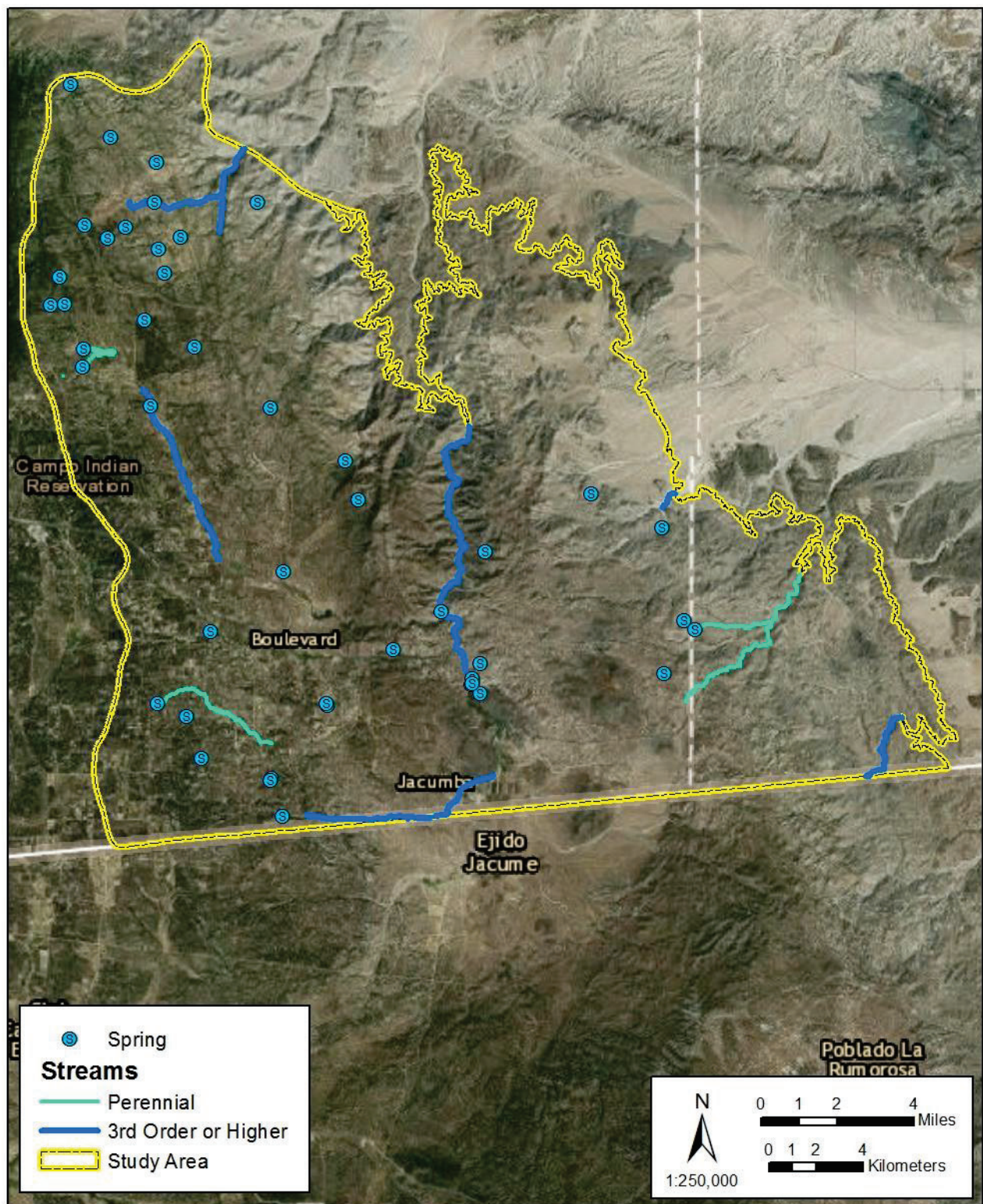


Figure 152. Map showing springs, perennial streams, and first-, second-, and higher-order drainages in the Jacumba/McCain Valley study region.

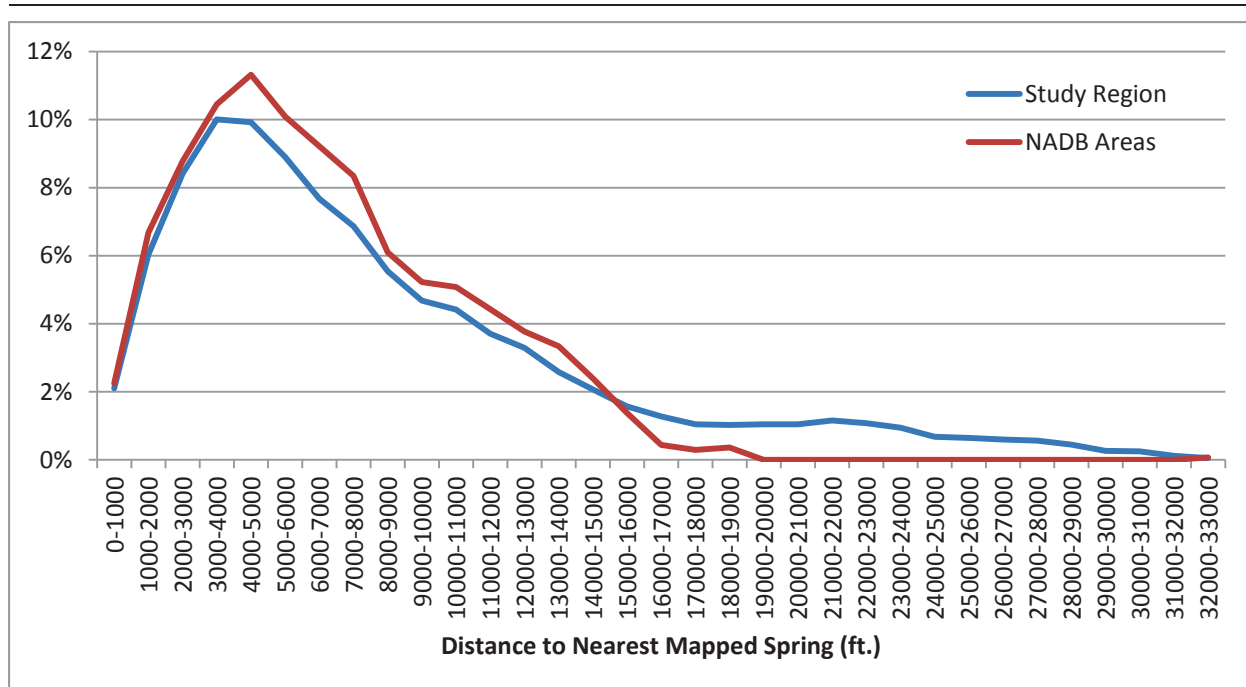


Figure 153. Relative frequencies of distances to the nearest spring.

Figure 154 shows the distances to the nearest perennial stream or third-order or higher drainage. The mean distances are 6,304 ft. for the study region as a whole and 6,208 ft. for the NADB areas. (The NADB area distances are bimodal, with modes at 1,500-2,000 and 7,000-7,500 ft.) Figure 155 shows the distances to the nearest potential water source, whether it is a spring, a perennial stream, or a high-order drainage. In this case, the mean distances are 4,688 ft. for the whole study region and 4,568 ft. for the NADB areas. For 45.7 percent of the study region and for 46.2 percent of NADB areas, the closest of these possible water sources is a spring.

Other potentially important water sources for the region's prehistoric inhabitants were *tinajas*, or natural bedrock tanks that collect water and hold it for extended periods, if not permanently. The occurrences of *tinajas* in the region have not been systematically mapped, and consequently their numbers and distribution cannot be accurately estimated. However, some archaeological site records have reported the presence of *tinajas* within site boundaries or in their vicinity. Records for 16 sites in the Jacumba/McCain Valley region include such reports: SDI-4295, -6787, -10230, -11076, -15625, -15626, -15628, -15634, -15640, -15641, -15643, -15800, -15801, -16212, -16213, and -20643. Ten of these sites were reported as containing a single *tinaja* each, while two sites each were reported as containing two *tinajas*, three *tinajas*, and multiple but unquantified *tinajas*. The *tinajas* were reported as being at the sites in 13 of the cases, while in the remaining three cases the *tinajas* were located 180 m, 500 m, and 850 m from the sites.

Changes in regional patterns of hydrology undoubtedly occurred during the prehistoric period. Tectonic movements, erosion, and sedimentation may have opened or closed particular springs. Downcutting or sedimentary buildup may have altered the characteristics of drainages, and the water table may have risen or fallen. It is possible that stream capture during the prehistoric period may have altered general drainage patterns; Shipek (1986:6) claimed that such an event was memorialized in a Kumeyaay myth about drainages in the Cuyamaca area, although the interpretation is very dubious (cf. Laylander 2006:170).

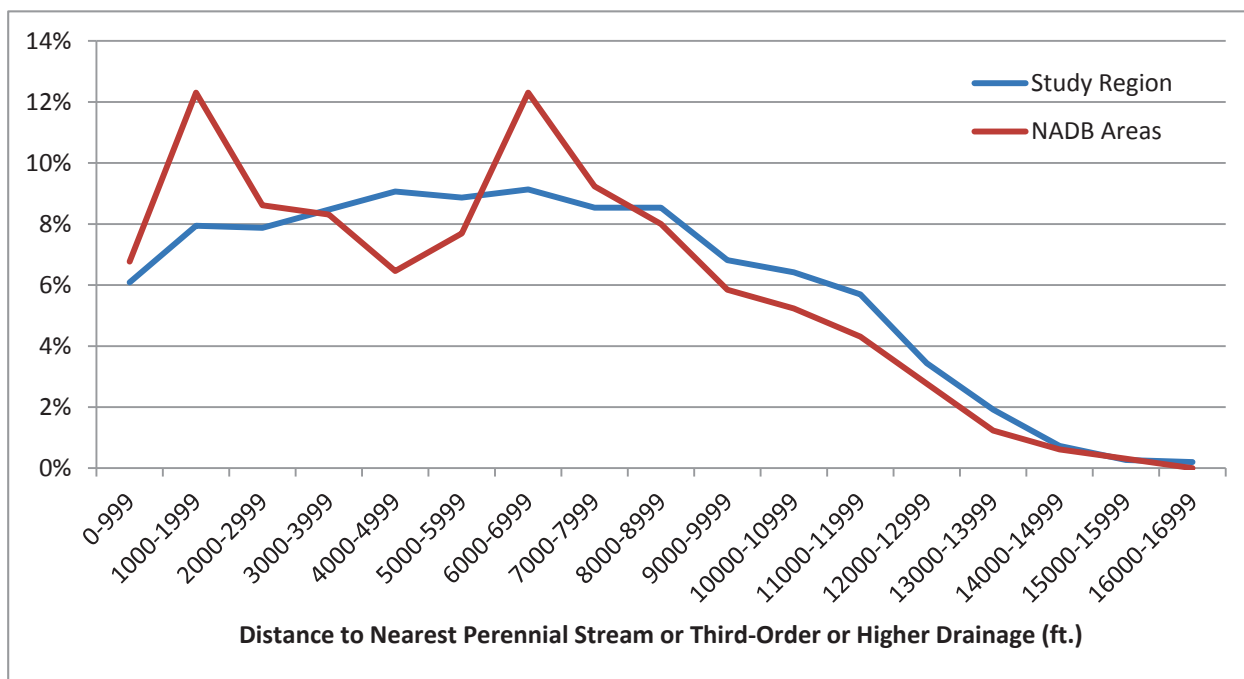


Figure 154. Relative frequencies of distances to the nearest perennial stream or third-order or higher drainage.

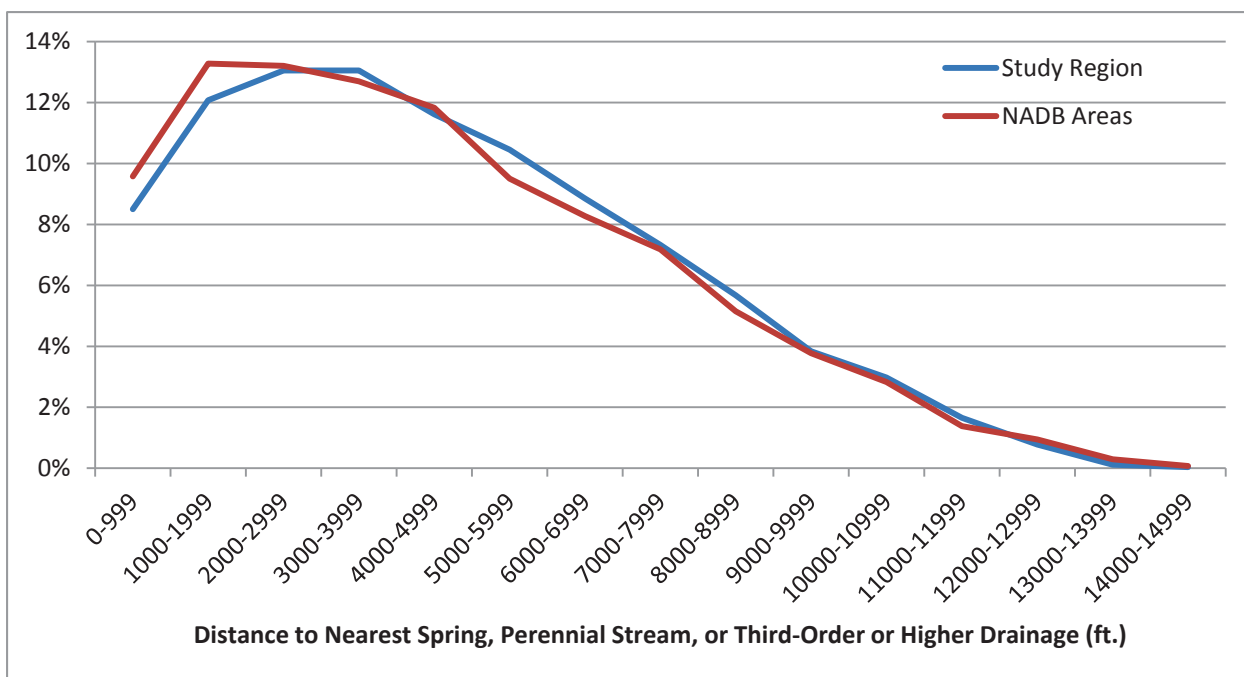


Figure 155. Relative frequencies of distances to the nearest spring, perennial stream, or third-order or higher drainage.

A more significant and better-documented prehistoric change in hydrology occurred to the east of the study region, in the cyclical appearance and disappearance of Lake Cahuilla (Laylander 1997a, 2006; Schaefer 1994; Schaefer and Laylander 2007). The Colorado River offered a reliable, perennial source of fresh water as well as associated biotic resources, located about 110 km east of the study region. When the river naturally diverted its course away from its lower delta and into the Salton Basin, it created a vast lake, 180 km long and up to 50 km wide. At least four full stands of Lake Cahuilla and subsequent recessions during the period between ca. A.D. 800 and 1700 have been documented, as well as earlier but less clearly defined stands (Philobosian et al. 2011). The importance of the lake in regional settlement patterns has been debated, but it seems almost certain that its presence or absence made some significant difference in prehistoric mobility patterns that extended as far west as the study region.

Biota

The best available index for the natural biological resources that were available in the study region under latest prehistoric conditions is the mapped modern distribution of vegetation units. As summarized in Table 8 and Figure 156, the present analysis for the Jacumba/McCain Valley and Ocotillo regions has distinguished 29 units. These represent a condensation of 59 units in the Hudson classification system (Oberbauer et al. 2008). The 29 units in turn are grouped into five larger habitat categories: Lower Sonoran Desert habitats (representing 12 of the vegetation units, 35.4 percent of the Jacumba/McCain Valley region, and 16.7 percent of NADB areas), Upper Sonoran Desert habitats (four vegetation units, 5.9 percent of the region, and 8.2 percent of NADB areas), Chaparral habitats (six vegetation units, 50.3 percent of the region, and 64.7 percent of NADB areas), Montane habitats (six vegetation units, 5.7 percent of the region, and 6.4 percent of NADB areas), and Disturbed areas (2.6 percent of the region, and 4.0 percent of NADB areas). As would be expected, these generalized habitats are associated with particular elevation ranges, although with considerable overlap: Lower Sonoran Desert at the lower elevations, Upper Sonoran Desert at intermediate elevations, and Chaparral and Montane habitats at higher elevations (Figure 157).

Table 8. Concordance of Mapped Vegetation Units

Present Study	Oberbauer et al. (2008)	Keeler-Wolf et al. (1998)
<i>Lower Sonoran Desert Habitats</i>		
Active Desert Dunes	Active Desert Dunes (22100)	
Badlands/Mudhill Forbs	Badlands/Mudhill Forbs (25000)	Barren or Barren/Rock
Desert Saltbush Scrub	Desert Saltbush Scrub (36110) Wildflower Field (42300)	
Mixed Desert Scrub	Mixed Desert Scrub (63700)	
Sonoran Desert (Creosote Bush) Scrub	Sonoran Desert (Creosote Bush) Scrub (33000) Acacia Scrub (33700) Encelia Scrub (33600) Sonoran Desert Mixed Scrub (33200)	Creosote Desert Scrub White Bursage
Cheesebush (Burrowbush)		(Subgroup of Sonoran Desert Scrub)
Sonoran Mixed Woody Scrub	Sonoran Mixed Woody Scrub (33210)	
Sonoran Mixed Woody and Succulent Scrub	Sonoran Mixed Woody and Succulent Scrub (33220)	Desert Succulent Scrub
Southern Riparian Scrub	Southern Riparian Scrub (63000) Mule Fat Scrub (63310) Great Valley Willow Scrub (63410) Tamarisk Scrub (63810)	Colorado Desert Wash Scrub Desert Wash Smoketree-Desert Willow
Desert Dry Wash Woodland	Sonoran Wash Scrub (33230) Desert Dry Wash Woodland (62200)	
Mesquite Bosque	Mesquite Bosque (61820)	Mesquite

Present Study	Oberbauer et al. (2008)	Keeler-Wolf et al. (1998)
Desert Fan Palm Oasis Woodland	Desert Fan Palm Oasis Woodland (62300)	
<i>Upper Sonoran Desert Habitats</i>		
Mojavean Desert Scrub	Mojavean Desert Scrub (34000) Blackbrush Scrub (34300)	
Pinyon and Juniper Woodland	Pinyon and Juniper Woodland (72000) Peninsular Pinyon and Juniper Woodlands (72300) Peninsular Juniper Woodland and Scrub (72320)	California Juniper Juniper
Sagebrush Scrub	Sagebrush Scrub (35200) Big Sagebrush Scrub (35210)	
Upper Sonoran Subshrub Scrub	Upper Sonoran Subshrub Scrub (39000)	
<i>Chaparral Habitats</i>		
Upper Sonoran Ceanothus Chaparral	Upper Sonoran Ceanothus Chaparral (37800) Interior Live Oak Chaparral (37A00)	
Upper Sonoran Mixed Chaparral	Upper Sonoran Mixed Chaparral (37100) Granitic Northern Mixed Chaparral (37130) Northern Mixed Chaparral (37131)	Mixed Chaparral Montane Manzanita Chaparral
Chamise Chaparral	Chamise Chaparral (37200)	
Granitic Chamise Chaparral	Granitic Chamise Chaparral (37210)	
Red Shank Chaparral	Red Shank Chaparral (37300)	
Semi-Desert Chaparral	Semi-Desert Chaparral (37400)	
<i>Montane Habitats</i>		
Cismontane Alkali Marsh	Alkali Seep (45320)	Cismontane Alkali Marsh
Cismontane Woodland	Cismontane Woodland (71000) Coast Live Oak Woodland (71160) Dense Coast Live Oak Woodland (71162) Open Coast Live Oak Woodland (71161) Coast Live Oak Forest (81310)	
Coastal Scrub	Coastal Scrub (32000) Riversidian Upland Sage Scrub (32710) Flat-topped Buckwheat (32800)	
Wetlands and Meadows	Wetlands and Meadows (45000) Montane Meadow (45100) Freshwater Seep (45400) Freshwater Marsh (52400)	Freshwater
Riparian Forests	Riparian Forests (61300) Southern Coast Live Oak Riparian Forest (61310) Southern Arroyo Willow Riparian Forest (61320)	
Valley Foothill and Grassland	Valley Foothill and Grassland (42000)	
<i>Disturbed</i>		
Disturbed Habitat	Disturbed Habitat (11000) Urban Developed (12000) Field/Pasture (18310) Non-native Grassland (42200) Non-Vegetated Channel, Floodway, Lakeshore Fringe (64200) Eucalyptus Woodland (79100)	Urban

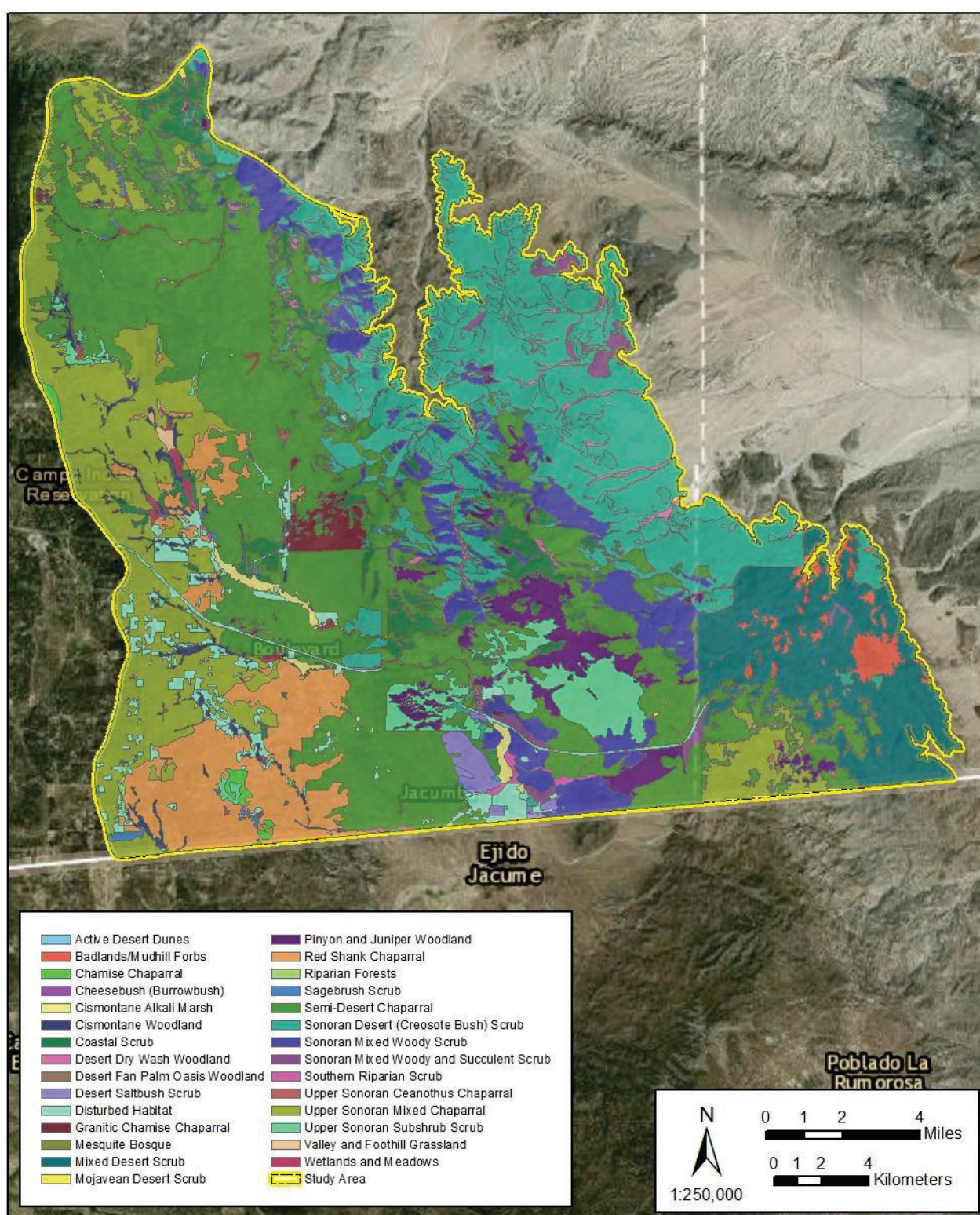


Figure 156. Map of vegetation units in the Jacumba/McCain Valley region.

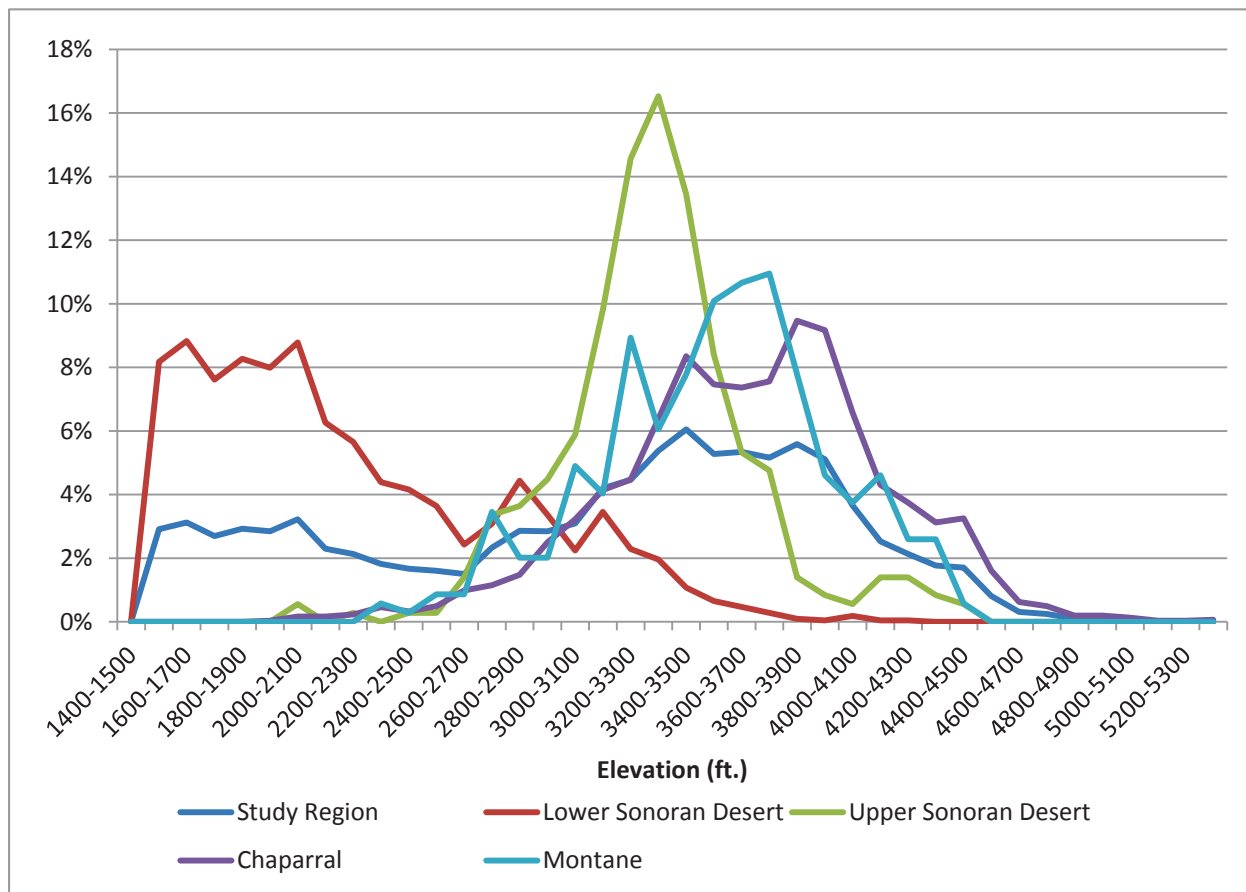


Figure 157. Relative frequencies of major biological habitats, by elevation.

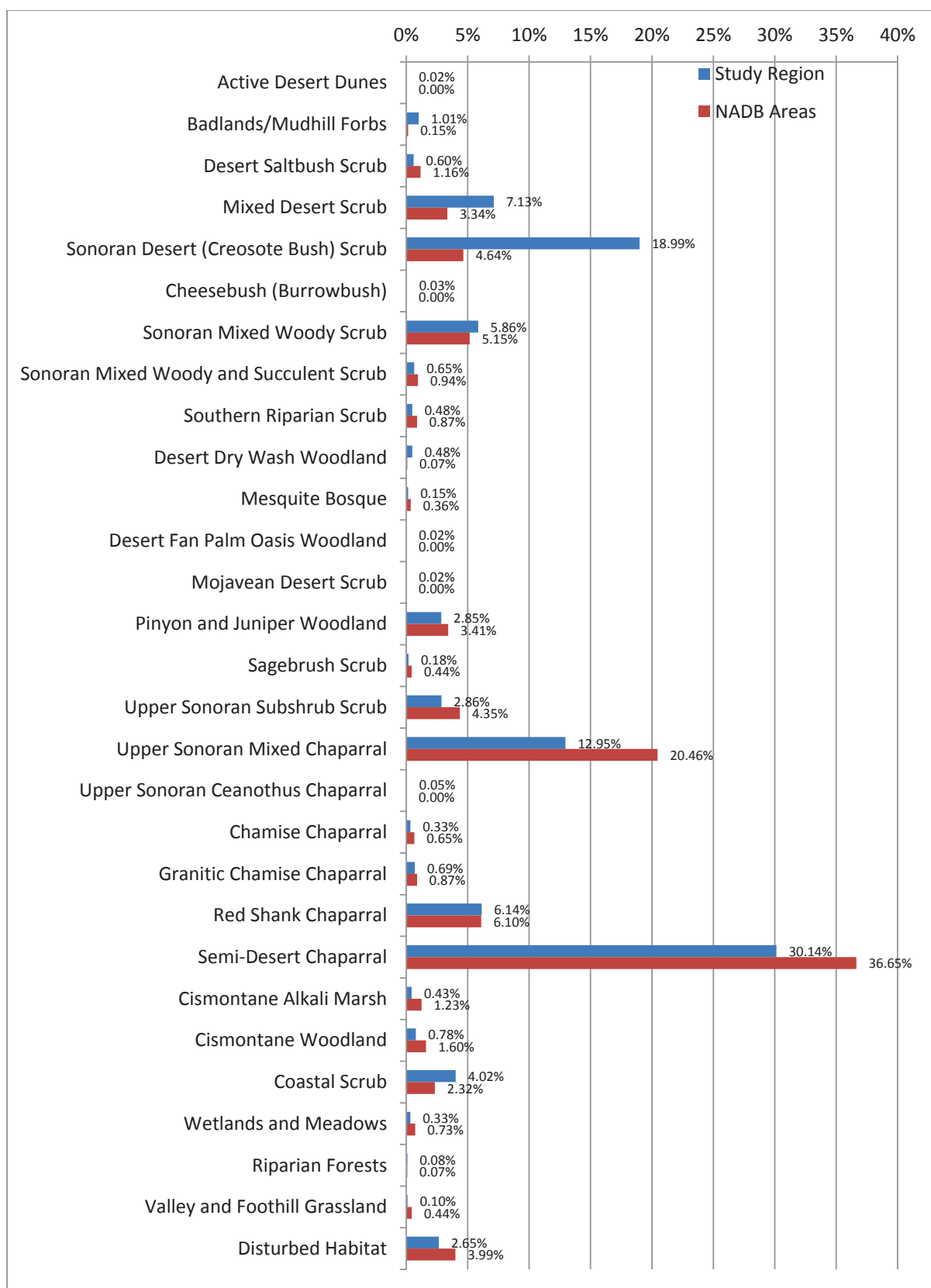


Figure 158. Relative frequencies of mapped vegetation units in the Jacumba/McCain Valley region.

The representation of the mapped vegetation units within the study region and within NADB areas is shown in Figure 158 (previous page). The three most abundantly represented units are Semi-Desert Chaparral, accounting for 30.1 percent of the study region and 36.7 percent of NADB areas; Sonoran Desert (Creosote Bush) Scrub, represented in 19.0 percent of the study region but only 4.6 percent of NADB areas; and Upper Sonoran Mixed Chaparral, in 13.0 percent of the study region and 20.5 percent of NADB areas.

ARCHAEOLOGICAL SITE TYPES AND ATTRIBUTES

Definitions

To analyze the prehistoric cultural landscapes of the study region, comparable data have been extracted from the region's existing archaeological site records. This has been done at two levels: the more nearly direct, observational level of the site attribute, and the more interpretive level of the site type. Key considerations in formulating this database have been the existence of reasonably complete and reliable information on the categories and their usefulness in detecting meaningful patterning in the regional prehistoric landscapes.

Site Attributes

Categories of site attributes are those used in section P3b of the standard California Department of Parks and Recreation (DPR) Primary record, as codified in Appendix 4 of the DPR Instructions for Recording Historical Resources. Their use is important because they conform to BLM's GIS database protocols. However, some amplifications have also been employed, as discussed below. These site attributes are listed below, with additions to the DPR attribute codes given in small letters (e.g., AP2-a). The value codes for the attributes, primarily providing quantitative information, are also indicated. The frequencies of the attributes are summarized in Table 9.

AP1 Unknown (*This category has not been used.*)

AP2 Lithic Scatter (*utilitarian stone artifacts, potentially including both tools and manufacturing debris, but excluding special items such as beads and ornaments*)

AP2-a Ground Stone (*portable milling items, potentially including hand stones/manos, pestles, milling stones/metates/milling slabs/basins, mortars, and abraders, but excluding percussing stones and nonutilitarian ground artifacts such as ornaments and gaming pieces*) – 0 = none observed; 1 = 1 item observed; 2 = 2-5 items observed; 3 = more than 5 items observed; 9 = present, but insufficient information for quantification.

AP2-b Flaked Stone Tools (*excluding cores,debitage,percussing tools, and nonutilitarian items such as ornaments*) – 0 = none observed; 1 = 1 item observed; 2 = 2-5 items observed; 3 = more than 5 items observed; 9 = present, but insufficient information for quantification.

AP2-c Percussing Stones (*including hammer stones, choppers, pecking stones, and anvils*) – 0 = none observed; 1 = 1 item observed; 2 = 2-5 items observed; 3 = more than 5 items observed; 9 = present, but insufficient information for quantification.

AP2-d Lithic Waste (*including cores,debitage, flakes, shatter, and chunks, but excluding items with evidence of use*) – 0 = none observed; 1 = 1-25 items observed; 2 = 26-200 items observed; 3 = more than 200 items observed; 9 = present, but insufficient information for quantification.

AP2-e Obsidian – 0 = none observed; 1 = 1-25 items observed; 2 = 26-200 items observed; 3 = more than 200 items observed; 9 = present, but insufficient information for quantification.

AP3 Pottery Scatter (*excluding special non-vessel ceramic items, such as pipes, anvils, figurines, miniature vessels, disks, toys, gaming pieces, etc.*)

AP3-a Sherd Count – 0 = none observed; 1 = 1-5 sherds observed; 2 = 6-50 sherds observed; 3 = more than 50 sherds observed; 9 = present, but insufficient information for quantification.

AP3-b Minimum Number of Vessels – 0 = no vessel sherds observed; 1 = 1 vessel observed; 2 = 2-5 vessels observed; 3 = more than 5 vessels observed; 9 = insufficient information.

AP3-c Wares Represented – 0 = no pottery observed; 1 = brownware only observed; 2 = buffware only observed; 3 = both brownware and buffware observed; 9 = insufficient information.

AP4 Bedrock Milling (*including mortars, cupules, basins, slicks, rubs, and anvil surfaces*)

AP4-a Bedrock Mortars – 0 = none observed; 1 = 1 mortar observed; 2 = 2-5 mortars observed; 3 = more than 5 mortars observed; 9 = present, but insufficient information for quantification.

AP4-b Cupules – 0 = none observed; 1 = 1 cupule observed; 2 = 2-5 cupules observed; 3 = more than 5 cupules observed; 9 = present, but insufficient information for quantification.

AP4-c Other Bedrock Milling (*including basins, slicks, rubs, and anvil surfaces*) – 0 = not present; 1 = 1 other milling element observed; 2 = 2-5 other milling elements observed; 3 = more than 5 other milling elements observed; 9 = present, but insufficient information for quantification.

AP5 Petroglyphs (*including pecked, scratched, or engraved images on bedrock or boulders, but excluding cupules*) – 0 = none observed; 1 = 1 panel observed; 2 = 2-5 panels observed; 3 = more than 5 panels observed; 9 = present, but insufficient information for quantification.

AP6 Pictographs (*painted image on bedrock or boulders*) – 0 = none observed; 1 = 1 panel observed; 2 = 2-5 panels observed; 3 = more than 5 panels observed; 9 = present, but insufficient information for quantification.

AP7 Architectural Features (*including rock houses, rock walls, and hunting blinds, consisting of stacked boulders and/or cobbles, but excluding sleeping circles, rock alignments, rock rings, and cairns*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP8 Cairns / Rock Features (*excluding hearths, earth ovens, milling features, rock art, and architectural features*)

AP8-a Rock Alignments (*including some geoglyphs, but excluding trail elements*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP8-b Cairns (*including ducks*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP8-c Rock Rings (*including some geoglyphs, but excluding earth ovens and architectural features*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 =

more than 5 features observed; 9 = present, but insufficient information for quantification.

AP8-d Pavement Clearings (*including “sleeping circles” and some geoglyphs, but excluding trails*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP9 Burials (*including inhumations and cremations, but excluding incidental human remains such as isolated teeth*)

AP9-a Inhumations – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP9-b Cremations – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP10 Caches – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP11 Hearths/Pits (*including hearths, earth ovens, roasting pits, clean-outs from those features, and scattered fire-affected rocks*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP12 Quarries (*including locations where lithic raw materials were tested, procured, and potentially subject to initial manufacturing; including outcrops, surface scatters, and excavated pits; including material quarried for flaked lithic tools, ground stone, percussing stone, and nonutilitarian uses*) – 0 = none observed; 1 = bedrock/boulder quarry observed; 2 = cobble/pebble quarry observed; 9 = present, but insufficient information for quantification.

AP13 Trails (*excluding linear earthworks, walls, and rock alignments*) – 0 = none observed; 1 = 1 or more trails observed.

AP14 Rock Shelters/Caves (*including overhanging cliffs or boulders, volcanic tunnels, or solution cavities containing evidence of prehistoric human use; excluding small sheltered caches and rock shelter/caves that lack observed evidence of human use*) – 0 = none observed; 1 = 1 feature observed; 2 = 2-5 features observed; 3 = more than 5 features observed; 9 = present, but insufficient information for quantification.

AP15 Habitation Debris (*This category has not been used.*)

AP16 Other

AP16-a Vertebrate Faunal Remains (*excluding human remains or materials interpreted as naturally present*) – 0 = none observed; 1 = 1-25 specimens observed; 2 = 26-200 specimens observed; 3 = more than 200 specimens observed; 9 = present, but insufficient information for quantification.

AP16-b Invertebrate Faunal Remains (*including freshwater and marine remains, but excluding materials interpreted as naturally present*) – 0 = none observed; 1 = 1 specimen observed; 2 = 2-5 specimens observed; 3 = more than 5 specimens observed; 9 = present, but insufficient information for quantification.

AP16-c Floral Remains (*excluding materials interpreted as naturally present*) – 0 = none observed; 1 = unidentified charcoal only; 2 = identified specimens only; 3 = both unidentified charcoal and identified specimens; 9 = present, but insufficient information.

AP16-d Midden Soil (*including soil distinguished as anthropogenic on the basis of a distinctly darker color, greasy texture, or other characteristics, but excluding deposits distinguished as anthropogenic only the basis of the presence of artifacts or faunal remains*) – 0 = none observed; 1 = midden soil observed.

AP16-e Bone Artifacts (*including tools such as awls, punches, flaking tools, and fishhooks, but excluding nonutilitarian items such as beads and ornaments*) 0 = none observed; 1 = bone artifacts observed.

AP16-f Special Items (*including beads, ornaments, crystals, pipes, effigies, wooden and vegetal artifacts, shaft straighteners, pigments, etc.*) – 0 = none observed; 1 = 1 specimen observed; 2 = 2-5 specimens observed; 3 = more than 5 specimens observed; 9 = present, but insufficient information for quantification.

Table 9. Frequencies of Site Attributes in the Jacumba/McCain Valley Study Region

Attribute	Count for Value *				Total	
	1	2	3	9	Count	Percent of Sites (n = 1,362)
AP2 – Lithic Scatter					1,067	78.3
AP2-a – Ground Stone	162	122	36	54	372	27.3
AP2-b – Flaked Stone Tools	137	104	31	77	349	25.6
AP2-c – Percussing Stones	91	39	12	52	194	14.2
AP2-d – Lithic Waste	430	173	48	363	1,014	77.4
AP2-e – Obsidian	38	22	6	33	99	7.3
AP3 – Pottery Scatter					713	52.3
AP3-a – Sherd Count	141	205	83	284		
AP3-b – Minimum Number of Vessels	57	3	7	646		
AP3-c – Wares Represented	210	47	146	310		
AP4 – Bedrock Milling					490	36.0
AP4-a – Bedrock Mortars	70	74	45	32	221	16.2
AP4-b – Cupules	5	4	11	6	26	1.9
AP4-c – Other Bedrock Milling	90	136	115	53	394	28.9
AP5 – Petroglyphs	17	4	--	2	23	1.7
AP6 – Pictographs	18	7	6	4	35	2.6
AP7 – Architectural Features	18	--	--	1	19	1.4
AP8 – Cairn/Rock Features					58	4.3
AP8-a – Rock Alignments	6	--	--	1	7	0.5
AP8-b – Cairns	16	8	1	5	30	2.2
AP8-c – Rock Rings	15	1	--	--	16	1.2
AP8-d – Pavement Clearings	1	--	1	--	2	0.1
AP9 – Burials					22	1.6

Attribute	Count for Value *				Total	
	1	2	3	9	Count	Percent of Sites (n = 1,362)
AP9-a – Inhumations	--	--	--	--	--	--
AP9-b – Cremations	6	3	1	12	22	1.6
AP10 – Caches	8	1	--	6	15	1.1
AP11 – Hearths/Pits	164	68	7	10	249	18.3
AP12 – Quarries	4	28		9	41	3.0
AP13 – Trails	38				38	2.8
AP14 – Rock Shelters/Caves	82	19	--	13	114	8.4
AP16 – Other					264	19.4
AP16-a – Vertebrate Faunal Remains	34	5	--	34	73	5.4
AP16-b – Invertebrate Faunal Remains	10	4	--	10	24	1.8
AP16-c – Floral Remains	56	1	--	1	58	4.3
AP16-d – Midden Soil	138				138	10.1
AP16-e – Bone Artifacts	7				7	0.5
AP16-f – Special Items	20	13	1	2	36	2.6

* See the attributes discussion above for the various meanings of the values applied to specific attributes. Shaded cells signify potential fields that are not applicable.

Isolate Attributes

Information on prehistoric archaeological isolates has been entered into the GIS database. Isolates have been defined as three or fewer artifacts or specimens. Recorded attributes of isolates include (a) flaked lithics, (b) portable ground stone, (c) pottery, and (d) other. The frequencies of the isolate attributes are summarized in Table 10.

Table 10. Frequencies of Isolate Attributes in the Jacumba/McCain Valley Study Region

Isolate Attribute	Count *	Percent
Flaked Lithic	150	77.3
Portable Ground Stone	19	9.8
Pottery	34	17.5
Other #	1	0.5
Total	194	100.00

* Counts refer to the numbers of isolate locations with the attribute, not the numbers of isolated artifacts.

The single isolate in this category is a shell ornament.

Site Types

The classification of sites into site types is generally much more subjective and less rigorous than attribute classifications, and may also do less justice to the multifunctional or palimpsest character of many sites. Use of types in this field may be a relic of “essentialist” thinking. Akin to Platonic idealism, essentialism would tend to see archaeological variation as representing departures from a small set of ideal types rather than as either more-or-less uniform or clustered variation along natural continua. However, site classification by type is a well-established practice, and types may be useful shorthand categories for interpreting regional prehistoric archaeological landscapes. A site typology for the present study region was

recently developed by Anna Noah (2012:61-68), and the discussion of it is reproduced largely verbatim below, with a few minor modifications.

This is a discussion of the types, rather than an operationalized classification system. In creating the GIS database, the data analysts have assigned recorded sites to these types on an intuitive basis. Where possible, the typology has been applied to each site on the basis of a new assessment by the analyst of the reported attributes, rather than merely on the basis of the original recorder's classification of the site. Table 11 summarizes the frequencies of site types.

Table 11. Frequencies of Site Types in the Jacumba/McCain Valley Study Region

Site Type	Count	Percent
Habitation Base	44	3.2
Temporary Camp	294	21.6
Travel Camp	--	--
Biotic Resource Extraction/Processing Site	374	27.5
Lithic Quarry and/or Workshop	54	4.0
Milling Implement Quarry and/or Production Site	--	--
Spiritual/Ceremonial Site	20	1.5
Trail	11	0.8
Cleared Circle/Rock Ring Site	7	0.5
Artifact Scatter	494	36.3
Pot Drop	53	3.9
Other *	11	0.8
Total	1,362	100.00

* The "Other" category includes seven sites with "spirit sticks" or "prayer sticks," an "apparent pulping station," a rock enclosure, a rectangular rock alignment, and a cairn.

Habitation Base

This is a site that was occupied by a family or community for a period of weeks or months (Schaefer and Laylander 2011). These sites are generally large, with multiple loci or areas of artifact and feature concentrations. They contain an abundance and diversity of artifact types, usually including faunal material (i.e., shell, bone) and/or botanical remains, and features, such as house remains (e.g., pit houses, occupied rock shelters, rock rings), hearths and fire-affected rock, and well-developed bedrock milling features. Evidence of ceremonial activity (e.g., rock art, funerary evidence, ceramic pipes) may be present. The range of artifacts may include scraping, chopping, and cutting tools; projectile points; milling equipment; battered implements; cores and debitage, the latter dominated by later-stage tool production and maintenance; bone artifacts, such as awls; a variety of pottery forms (for cooking and storage) and types; and shell or stone beads and ornaments. A variety of lithic materials, including exotics, would be expected. Site location, as well as faunal and floral remains recovered from these sites, may indicate exploitation of several environmental zones during more than one season. Habitation bases represent long-term occupation or repeated temporary occupation and usually exhibit a well-developed midden. Archaeologists have also called this site type "village" (e.g., Hanks 1976), "major habitation," and "medium- to long-term habitation."

Temporary Camp

These sites (Hanks 1976) represent brief occupations by a family, a community, or a task-specific group organized to obtain particular resources. Temporary camps exhibit a few types of artifacts and ecofacts indicative of limited day-to-day activities, including food preparation and consumption. These artifacts may include a few flaked stone tools, debitage, ground stone, pottery, and a narrow range of faunal remains. These sites may also include features specific to certain extractive tasks, such as bedrock milling features, roasting pits, lithic reduction areas, hearths, or fish traps. Although not expected, evidence of ceremonial activity may be present. Structural remains, if present, do not represent a large investment of energy (Schaefer and Laylander 2011). A developed residential midden is not expected at a temporary camp. These sites may be positioned to maximize access to a particular resource. Other terms used for temporary camps include extractive camp, short-term habitation, campsite, and minor habitation site. Although extraction of local resources seems to be a primary goal at most temporary camps, it may be that other types of temporary camps exist. For example, short-term camps could be established near where a community-wide ceremonial event was carried out. Such sites might be recognizable by their ephemeral nature, distance from extractive resources, and proximity to ceremonial sites.

Travel Camp

Schaefer and Laylander (2011) suggest that this site type may be present in areas traversed by a long-distance travel corridor. Travel camps represent an ephemeral occupation where very limited evidence of habitation is present. This evidence may include a hearth or fire-affected rock, minimally used ground stone artifacts (such as a portable metate or a cobble mano), a few flaked lithics or potsherds, a cleared circle, and perhaps some evidence of food consumption. This site type probably represents a single overnight encampment along a travel corridor by a family, community, or task-specific group or individual. Treganza (1942:153) observed “the ashes of a single night’s fire” along trails connecting the mountains and desert in the study region. Otherwise, local archaeologists have not typically differentiated ephemeral travel camps from temporary camps or “artifact scatters,” and it may be challenging to do so, particularly at the survey level. The USDI Bureau of Land Management’s site typology included “transient rock shelter,” with an inferred use of overnight camping en route to another location (Hanks 1976).

Biotic Resource Extraction/Processing Site

These are sites where plant or animal resources were extracted from the environment and/or where they were processed. In practice, it is rarely possible to recognize purely extractive sites from archaeological evidence. Exceptions to this include hunting blinds and rock rings found on bedrock outcroppings in oak woodlands, which have been interpreted as granary foundations (James 1995). Extraction of a biotic resource is more typically inferred by evidence for processing the resource where it naturally occurs. Biotic resource extraction/processing sites may be recognized by several types of rock features, including rock walls overlooking places where game congregate (hunting blinds); rock rings on bedrock outcrops, particularly when found in or near oak woodlands (acorn granaries); bedrock milling features; cooking features (agave or other resource roasting pits, grills, open rock-lined firing pits, etc.; see McCarthy 2011); and fish traps. Bedrock anvils or rubs may occur with agave roasting pits. If these types of features are found in association with habitation debris, the site would be considered a temporary camp or possibly a habitation base. Biotic resource extraction/processing sites may contain a variety of resource processing artifacts, including manos, pestles, metates, battered implements, and chopping tools. Lithic tools indicative of cutting, chopping, and percussive tasks, along with large mammal bones, would characterize game butchering sites. BLM-defined site types that fall in this category are milling stations and roasting pits (Hanks 1976).

Lithic Quarry and/or Workshop

This site category includes primary quarries, that is, outcrops or extrusions of tool stone material (cf. Hanks 1976), such as occur at Obsidian Butte and the “wonderstone” quarries outside the study region. Also

included are secondary quarries, at which tool stone materials occur as float in ancient or more recent alluvial sediments, such as the desert pavement terraces at the foot of the Peninsular Range. Quarries may exhibit evidence of extensive assaying and the early stages of lithic reduction, such as hammer stones, primary flakes, and cores, from which useable flakes or blanks were removed for expedient use or further reduction elsewhere. However, the later stages of tool production may also be represented at a lithic workshop located within or near a quarry. Both quarrying and workshop activity can be embedded within other site types, such as habitation bases or temporary camps. Townsend's (1986) research at sites in Jacumba Valley revealed that quarrying was an embedded activity at habitation bases and temporary camps, and that no pure quarry sites were included in the 11 sites in her study.

Milling Implement Quarry and/or Production Site

These are sites where raw material for the production of metates, manos, pestles, or mortars was quarried and/or where these milling implements were manufactured. Quarries are recognized by the presence of the sought-after material in primary bedrock or secondary contexts, by tested blocks of stone and artifacts such as hammer stones (possibly with chisel-shaped working ends) and wedges, and by dense concentrations of flakes, shatter, and broken and discarded preforms (Schneider 1996:303-306). Workshops will exhibit later stages of production and will include hammer stones and a greater percentage of interior flakes. No sites of this type were identified in the study region as a result of Noah's literature review. However, a ground stone (coquina) bedrock quarry has been recorded in the Superstition Hills to the north (Joan Schneider, personal communication 2011) and several ground stone manufacturing loci, embedded in temporary camps, were investigated west of Superstition Mountain (Schaefer 1988). In the Picacho Basin near the Colorado River, numerous "cylindrical basalt artifact chipping stations" were investigated in a basalt lava field. After an exhaustive study, the researchers concluded that the cylindrical artifacts were preforms for pestles and/or two-handed manos, which were later finished at base camps (Pendleton 1986). Farther afield, a sandstone quarry and ground stone production site near Wellton, Arizona was found to contain an estimated 46,000 workshop areas where metates, pestles, and manos were produced (Schneider 1996). While no milling implement quarries or major production sites had been recorded in the study region (evidence of minor milling implement reduction had been reported), suitable raw materials are present in the sandstone outcrops scattered throughout the Yuha Desert. Evidence of milling implement production may be found either at workshop sites or embedded in habitation bases. This site type was not included in the BLM site typology (Hanks 1976).

Spiritual/Ceremonial Site

Sites that fall into this category include geoglyphs and other rock feature complexes, such as cairn alignments and astronomical sites; rock art, including pictographs, petroglyphs, and cupule arrangements; and cremation or burial locations. Most of these types of features are identified as separate site types in BLM site typologies (e.g., Hanks 1976). Each may also occur as a component within a site of another type, such as a habitation base. Certain trails may also fall into this category and may be recognized by their association with other features, including those just listed, as well as rock alignments, trail shrines, shattered quartz concentrations, pot drops, and small rock rings, alone or in clusters, known as vision circles or power circles (Apple 2005; Baksh 1997; Ezzo and Altschul 1993; Johnson 1985). It is important to recognize that these types of features often co-occur with one another and are strong indicators of a larger ritual landscape, which would include not only the archaeologically recognizable features, but also natural features, such as mountains, water bodies, plant and animal communities, and views. An example of such a ritual landscape has been identified in the Ocotillo area, where contemporary Native Americans have identified a traditional cultural property (TCP) containing a large number of spiritual/ceremonial sites and sacred natural features (Simmons 2012; Whitley and Schaefer 2012).

Trail

This category comprises human trails and associated features. Traditional human trails, regardless of where they occur in the world, typically measure between 30 and 40 cm in width and tend to follow the most direct route between two points, without contouring or making switchbacks up the slope (Becker and Altschul 2008:429). In the Yuha/Jacumba area, trails are most often preserved and detected on old desert pavement surfaces, where they may be sharply defined or faint, and disappear where erosion has been active, such as in washes. Trail markers are sometimes observable at the top of topographic breaks, guiding the traveler to the next stable segment of trail, and in canyons, trail markers may be the primary evidence of a travel route. Long-distance trails may line up with prominent features on the horizon, which may or may not be the ultimate destination. Parallel trails sometimes occur and may reflect a group of travelers traversing the landscape in parallel; abandonment of an older trail perhaps for religious motivations, such as avoidance of a trail of the dead (Rogers 1966:51); or a general travel corridor traveled by many people over time.

Trails may traverse habitation bases, temporary camps, or any other site type. Sometimes trails have not been separately recorded, but are only mentioned as components of other site types. This practice makes it difficult to compile an inventory of trails and trails segments from a site record review or database in order to reconstruct prehistoric trail networks. However, the original BLM site typology recognized that a “trail is an entity in itself – a route of travel interlinking the various activity areas and sites of the aboriginal populations” (Hanks 1976:Section II.14).

Features associated with trails include those mentioned above for spiritual/ceremonial sites; trail markers; pot drops, which may reflect either accidental breakage or a ceremonial sacrifice (Rogers 1966:49); and lithic reduction areas.

Distinguishing human trails from paths created by large mammals or off-road vehicles can be challenging. Becker and Altschul (2008:426-432) make the case that some of the best-known prehistoric trail studies in California may have included animal trails in the mapped trail systems. It should also be noted that major Native American trails continue to be used by modern hikers or undocumented immigrants, who themselves may leave trail markers or “ducks.”

Because the nature of cultural resource compliance work often requires archaeologists to limit surveys to small or narrow project areas, trails have frequently not been viewed on a regional basis to determine whether the short trail segments identified led anywhere or were something other than human footpaths. There have been notable exceptions to this, such as the North Baja Pipeline project, which traced several aboriginal trails near the Colorado River for distances up to 14 km (Cleland and Apple 2003).

Becker and Altschul (2008) performed energy expenditure analyses to study cattle, burro, and human trails, and found ways to differentiate among them where trails occur on slopes:

The available data indicate that energy expenditure for burros and cattle increases in a curvilinear fashion in relation to slope with ever-larger amounts of energy required to climb steeper grades, whereas the data on humans show an initial substantial loss in energy efficiency for climbing gentle slopes and an increase in energy efficiency, relative to gentle slopes, for climbing grades roughly between 15 and 25 percent. If reliable, these data help to explain why traditional human trails from around the world are observed to ascend steep slopes rather than contour around them, and conversely, why animal trails reportedly follow contours, avoiding steep slopes whenever possible.... In general, however, the data support the hypothesis that when human physiology is accounted for, human trail systems conform to a least-cost model of energy expenditure [Becker and Altschul 2008:435].

The most widely accepted criterion for distinguishing human from animal trails is the physical association of the trail with cultural remains. However, even this can be problematic. Near Kingman, Arizona, projected impacts from a pipeline project to four trails, two of which had adjacent lithic scatters, were mitigated by a requirement for full documentation of any trails within a 2-mi.-wide corridor along the pipeline. After fully mapping the impacted trail system beyond the project boundaries, it was determined that three of the trails converged at a stock watering tank, and the fourth led to and followed a bulldozer track associated with an earlier pipeline construction project (Becker and Altschul 2008:430-431). This cautionary tale points out one of the values of mapping a trail route well beyond the direct impact area of a project.

Burros are not present in the study region, but cattle have grazed on galleta grass on the desert floor and in the Peninsular Range (McCain 1955; Van Wormer 2008). Biologists have documented the nature of bighorn sheep movement to watering holes, and archaeologists can study these data if trails are documented in sheep habitat. It is important to recognize that bighorn sheep probably inhabited more extensive ranges in the past. According to Katherine Siva Sauvel, a Cahuilla cultural authority, bighorn sheep used to gather and follow trails across valleys to bear their young in a certain location, but this is no longer possible because the herds have been enclosed (Sauvel and Elliott 2004:216). The problem of off-road vehicle activity is significant both for its general destructive impact on archaeological resources and for confounding the prehistoric trail record.

Cleared Circle/Rock Ring Site

Rogers (1966) referred to this enigmatic site category as sleeping circle sites. These can range from isolated cleared circles to clusters of boulder-rimmed circles in close juxtaposition (Rogers 1939:7, 1966:5, 14, 44-45). Rogers attributed rock circle sites to the San Dieguito period. Few artifacts are found in or around the circles. These sites are sometimes classified as habitation bases or temporary camps, but the absence of evidence for household activities lends doubt to such a classification, at least in most cases (but see Apple et al. 1997 for a notable exception in which charcoal and fish bones were found in rock circles near Lake Cahuilla recessional shorelines).

Contemporary Quechan cultural authorities describe small rock circles and cleared circles, found near the Colorado River and ranging in size from 0.5 to 1.5 m, sometimes with a cobble or boulder in the center, as power circles or vision quest circles (Baksh 1997:17, 22-23; Cleland 2005:5; Ezzo and Altschul 1993; Johnson 1985; Pigniolo et al. 1997). They suggest that larger circles (approximately 2.5 to 3 m in diameter) may have served a residential function (Cleland 2005:5). Furthermore, they suggest that in actual or dream travel, the smaller circles were used to obtain power to assist along the trail and that the larger circles were places to rest along the way (Pigniolo et al. 1997:123). In the Pilot Knob area near the Colorado River, an analysis of a large sample of cleared circle and rock ring diameters suggested the possibility of a third category of large cleared circles greater than 5 m in diameter with possible ceremonial associations (Cleland 2005:11).

Schneider (personal communication 2014) recently collected soil samples from beneath embedded rocks in a rock circle site in Anza-Borrego Desert State Park for optically stimulated luminescence (OSL) dating. Results of this pilot study assigned probable ages of A.D. 1794 $\pm$ 33 years and A.D. 1590 $\pm$ 53 years to the rock circles.

In addition to the obvious cultural origin of many hundreds of cleared circles in the Colorado Desert, it should be noted that natural processes, such as the decomposition of roots where desert bushes formerly grew and displaced large stones in the root zone, can also produce “cleared circles.” Deflated mounds from rodent burrowing in desert pavements may also produce cleared circles mistaken for cultural features (McAuliffe and McDonald 2006; Whitley and Williams 2011). However, the pseudo-features may be recognizable when they are found to occur in concentrations of dozens to hundreds, usually without any artifacts, in areas where humans were unlikely to have concentrated, often in spatial patterns paralleling ancient drainage channels. Many of the cleared circle sites that were previously recorded in Anza-Borrego

Desert State Park have been excluded from the present database because they apparently represent natural deflation features. Some arrays of cleared circles in the Colorado Desert, previously interpreted as prehistoric features, have subsequently been determined to be modern gravel collection areas (Bendímez et al. 1987). The cleared circle/rock circle category was not included in the original BLM site typology (Hanks 1976).

Artifact Scatter

Although not a functional category, artifact scatters of various configurations are recorded in virtually every positive archaeological survey, and are generally felt to represent incidental activities on the landscape. According to BLM site categories, this category includes pottery scatters, small lithic (flaked stone) scatters, and small artifact scatters, which consist of two or more categories of artifact, such as pottery, ground stone, flaked stone tools, and debitage. In the archaeological definition, artifact scatters lack evidence of midden, hearths, or other thermal features. Depending on size, type, and variety of artifacts, an artifact scatter may be interpreted as a temporary camp or a biotic resource extraction/processing site. A large lithic scatter made up of a variety of artifact types (e.g., battered implements, borers/drills, retouched flakes, steep-sided unifacial tools, etc.) is not an incidental artifact scatter and must be interpreted based on the particularities of the site assemblage.

Pot Drop

A pot drop is a small, discrete concentration of sherds from a single vessel. Multiple pot drops may be found in proximity to one another. Pot drops in the Colorado Desert occasionally consist of two individual vessels (Cleland and Wahoff 2006:98). Because pot drops are regularly associated with trails, travel, and spiritual practices, they represent an important resource category in the study region. In particular, concentrations of pot drops may indicate a place of traditional cultural importance, as contemporary Native Americans have emphasized (e.g., Lucas 2011; Pignuolo et al. 1997). Pot drops found nonrandomly distributed along trails have long been recognized as potentially representing apparently intentional symbolic and/or ceremonial acts (cf. Schaefer 2013:41; Schaefer and Laylander 2007:254).

Other Site Types

Although rock shelters are often recorded as a separate site type, these features typically have characteristics that would allow them to be placed in another functional category, such as habitation base, extractive camp, travel camp, or spiritual/ceremonial site. An exception to this would be a cache, which might require a separate site category. The original BLM site typology recognized rock shelters or “utilized shelters or caves” as falling into three categories: occupation rock shelter, transient rock shelter (an overnight travel camp along a trail), and storage rock shelter (Hanks 1976). Rock shelters with rock art were classified as rock art sites.

The Problem of Site Limits

Horizontal site limits have been defined in a variety of ways. For instance, one convention has been to recognize a gap of 30 or 50 m in the distribution of observed surface cultural materials as defining a site limit. In other cases, physiographic discontinuities, such as arroyos or steep slopes, have been taken as limits. The varied definitions of sites may bias or influence the interpretation of regional archaeological landscapes in two ways. First, the inclusion or exclusion of sparse, outlying materials within the boundary of a site will often strongly affect the surface area and the average artifact density reported for the site. Second, the lumping together or splitting apart of archaeological manifestations located in moderate proximity to each other will often strongly affect the reported regional density of sites and the types to which those sites are assigned. “Lumpers” will create a regional picture of larger sites that are more frequently multifunctional but fewer in number and containing lower average densities of remains within their boundaries. “Splitters” will recognize more sites and ones that are smaller, more intensively used, and more specialized in function.

Evaluation of the Site Typology

Comparing site type assignments and records of detailed site attributes within the GIS provides an opportunity to evaluate the effectiveness of the site typology for categorizing the region's archaeological record. This also may suggest possible revisions in the typology to make it more effective.

Habitation Bases, Temporary Camps, and Travel Camps

Sites that are assignable to these types represent something of a continuum in size and in function. They all represent, to a significant degree, locations that were used for consumption and not merely production. Interpretively, they differ from each other in the length of their episodes of occupation. However, in practice it is rarely possible to convincingly assess that dimension on the basis of archaeological evidence, particularly on the basis of survey-level observations. A temporary camp or travel camp that was frequently revisited, perhaps at different seasons, might look much the same as a habitation base, and a habitation base that was occupied rarely or only once might well be mistaken for a temporary camp or travel camp.

In the present study, none of the recorded sites have been classified as travel camps. This reflects the problems in distinguishing this category on the basis of survey-level archaeological evidence. Conceptually the distinction between a temporary camp, used to exploit local resources, and a travel camp, used as a location for the short-term consumption of primarily nonlocal resources, may be clear and interpretively interesting, but in practice the distinction is difficult to make on the basis of limited evidence. It is not unlikely that travel camps are represented in the study region's sites, but for present purposes they are likely to have been assigned to other categories, including temporary camps and artifact scatters.

As discussed above, a number of empirical attributes are expected for habitation bases and have been used in assigning archaeological sites to that category. For the site attributes that are documented in the GIS, it is possible to examine the consistency with which these attributes distinguish between habitation bases and temporary camps.

One of the proposed diagnostic attributes is the sizes of habitation bases and temporary camps. As they were mapped in the GIS, the areas of habitation bases range from 107 m² to 2,008,000 m². Temporary camps range from 77 m² to 280,000 m². Of habitation bases, only 15.9 percent are reported as being less than 10,000 m² in area, whereas 73.8 percent of temporary camps are below that size limit. In the distribution of sizes, sites classified as habitation bases have a clear tendency to have larger areas, but it is also clear that there is a substantial overlap in the size distributions.

An attribute that is fairly clearly distinguished in the discussion of site types is midden. It has been proposed that habitation bases "usually exhibit a well-developed midden," whereas "a developed residential midden is not expected at a temporary camp." However, in the GIS database, only slightly over half of the records for habitation bases (n = 24; 54.6 percent) reported the presence of midden soil, while more than one-quarter of the temporary camp records (n = 85; 28.9 percent) reported middens.

Faunal remains and features such as bedrock milling features, rock rings, and hearths are said to be "usually" present at habitation bases, although they may also be present at temporary camps. Vertebrate and/or invertebrate faunal remains were reported from only 40.9 percent of habitation bases (n = 18) and from 16.3 percent of temporary camps (n = 48). Bedrock milling features, excluding cupules, were reported at 90.9 percent of habitation bases (n = 40) and at 78.2 percent of temporary camps (n = 230). At sites with bedrock milling, the numbers of milling elements were on average substantially greater at habitation bases than at temporary camps, although in this attribute the ranges also overlap (Figures 159 and 160). Rock rings are reported at only a single habitation base (2.3 percent) and at six of temporary camps (2.0 percent). Thermal features (hearths or pits) are reported at 11.4 percent of habitation bases (n = 5) and at 13.6 percent of temporary camps (n = 40).

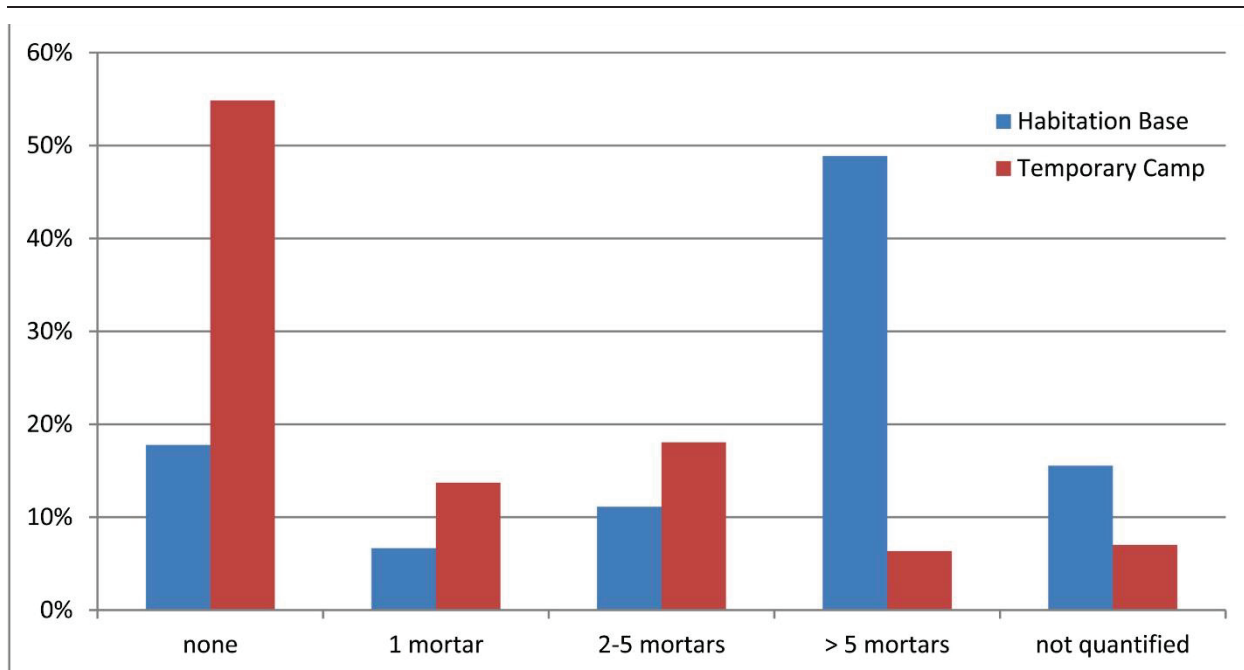


Figure 159. Numbers of bedrock mortars at habitation sites and temporary camps.

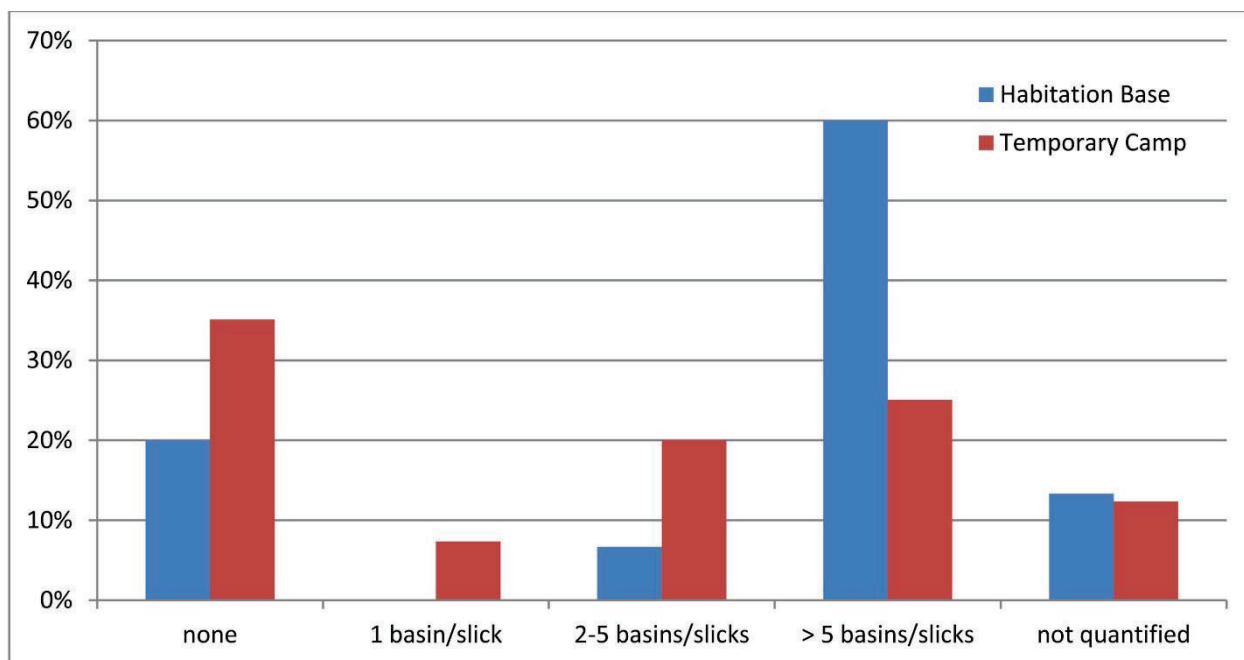


Figure 160. Numbers of bedrock basins and slicks at habitation sites and temporary camps.

Diversity of artifact types is another characteristic suggested as indicative of habitation bases. A detailed typology of flaked lithic tools has not been included in the GIS database, and in any case the reporting of tool types on site records is likely to have been highly inconsistent. Three categories of lithic tools – ground stone, flaked stone tools, and percussing stones – have been included in the GIS, and the number of these categories represented at a site may be taken as one measure of diversity. Reported assemblages from habitation bases tend to include representation from more of these categories than temporary camps, although, again, there is substantial overlap in diversity between the two types (Figure 161).

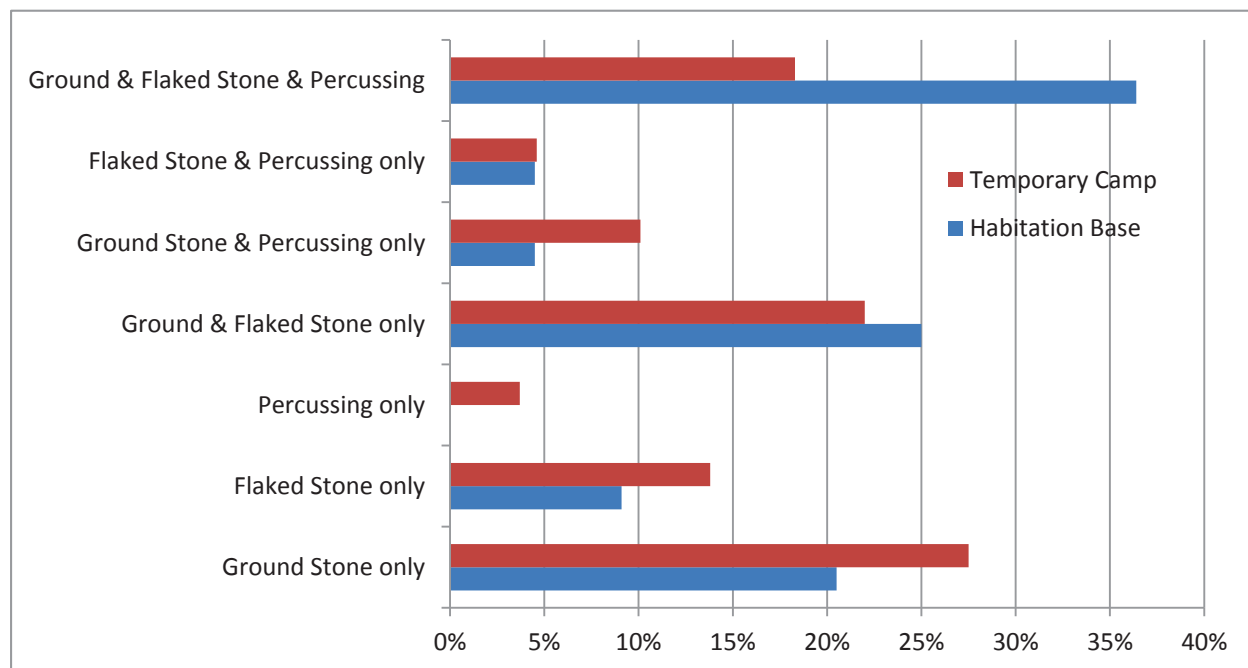


Figure 161. Relative frequencies of flaked, ground, and percussing stone artifacts at habitation sites and temporary camps.

In conclusion, sites that have been assigned to the habitation base and temporary camp types show significant quantitative differences in several attributes. However, this analysis, based primarily on survey-level archaeological evidence, has not identified any qualitative differences or quantitative discontinuities between them.

Biotic Resource Extraction/Processing Sites, Lithic Quarries and/or Workshops, and Milling Implement Quarries and/or Production Sites

Two potential problems need to be considered with respect to these site types, which are, in principle, intended to encompass sites that were focused on specific tasks. One is that multi-functional locations might be assigned to these types, whereas such locations should perhaps more properly be classified as temporary camps or even as habitation bases. A second possible problem is that use of the types as representing the frequencies and geographical distributions of particular activities within the archaeological landscape may result in underrepresentation of their activities within the regional landscape, if those activities are also substantially represented within habitation bases and temporary camps.

The region's 374 biotic resource extraction/processing sites include sites with hearths/pits (n = 195 sites; 52.1 percent of the sites that were assigned to this type), bedrock milling features (n = 188, excluding one site with only cupules; 50.3 percent), ground stone artifacts (n = 66; 17.6 percent), hunting blinds (n = 5;

1.3 percent), caches (n = 4; 1.1 percent), and rock rings (n = 3; 0.8 percent). However, as noted in the discussion above that defined the type, such sites may often also contain classes of remains that are more ambiguous concerning site function. Although their presence is not necessarily incompatible with the interpretation of a focus on resource extraction and/or processing, it might suggest the sites' alternative identification as multipurpose occupation sites, such as habitation bases or temporary camps. These additional attributes reported at the biotic resource extraction/processing sites include lithic waste (n = 182; 48.7 percent), pottery (n = 96; 25.7 percent), flaked stone tools (n = 41; 11.0 percent), percussing stones (n = 28; 7.5 percent), midden soil (n = 16; 4.3 percent), cupules (n = 3; 0.8 percent), vertebrate faunal remains (n = 4; 1.1 percent), and even one site with a petroglyph and a marine shell. It seems apparent that while the category of biotic resource extraction/processing sites may capture sites where those activities predominate in the archaeological record, there is no indication of a consistent qualitative distinction, and probably no clear quantitative discontinuity, between those sites and multifunction occupation sites.

The other issue concerns how well this category represents the scope of archaeological evidence for biotic resource extraction and processing activities in the region. To address this issue, the proportions of the sites that have attributes indicative of those activities that have been classified as belonging to that type may be considered (Table 12). The high proportion of sites having hearths or pits that have been assigned to this type reflects the high incidence of isolated agave roasting pits in the region. However, in general, the use of this type as a proxy for the frequency and geographic patterning of prehistoric biotic resource extraction and processing activities appears likely to yield unreliable results.

Table 12. Proportions of All Sites and of Biotic Resource Extraction/Processing Sites with Selected Attributes

Attribute	Sites with Attribute		
	All Sites	Biotic Resource Extraction/Processing Sites	
		Count	Percent of All Sites
Hearth / Pit	249	195	78.3
Bedrock Milling (excl. cupules)	463	188	40.6
Ground Stone Artifacts	372	66	17.7
Hunting Blinds	4	4	100.0
Granary / Storage Features	2	1	50.0
Caches	15	4	26.7
Rock Rings	15	3	20.0

Sites classified as flaked lithic quarries and workshops can be similarly examined for attributes that may indicate less narrowly focused use of their locations. Table 13 indicates the proportions of these sites that contain several additional attributes. These data suggest that additional attributes are relatively uncommon and that few of the sites classified as quarries and workshops would naturally fall into any alternative categories. On the other hand, 31.7 percent of the sites that were reported as containing quarries were classified as belonging to other types, including habitation bases (n = 3; 7.3 percent), temporary camps (n = 4; 9.8 percent), biotic resource extraction/processing sites (n = 3; 7.3 percent), and artifact scatters (n = 3; 7.3 percent). In addition to the quarries, an undetermined but probably very large number of sites with the characteristics of flaked lithic workshops have been assigned to these alternative site types. While the classification of a site as a flaked lithic quarry/workshop is probably relatively reliable when it has been applied, this type likely provides only a highly incomplete picture of the regional distribution of the activities that it purports to represent.

Table 13. Flaked Lithic Quarry Sites with Selected Additional Attributes

Attribute	Flaked Lithic Quarry and Workshop Sites with Attribute	
	Count	Percent
Ground Stone Artifacts	5	9.3
Pottery	6	11.1
Bedrock Milling	1	1.9
Cairn	1	1.9
Hearth / Pit	5	9.3

No milling quarry/workshop sites were identified in this sample. One such site was reported in the adjacent Ocotillo region. This site type is probably too limited to warrant separate treatment in archaeological landscape analyses as a major type, rather than being assigned to an “Other” category.

Spiritual/Ceremonial Sites

As discussed above, certain classes of features have been suggested as likely to have been indicative of spiritual/ceremonial activity. These include, but are not necessarily limited to, human burials, rock art, cupules, and rock alignments. Twenty-one sites in the study region have been typed as spiritual/ceremonial sites. In addition to the features mentioned above, *yonis* (naturally occurring but sometimes modified features in boulders or bedrock that resemble female genitalia) and “spirit sticks” (or “prayer sticks,” found in rock shelters) have sometimes been cited as evidence of spiritual/ceremonial functions (Gough 1986, 1996; McGowan 1982). It has also been noted that these features do not occur exclusively at sites that lack other categories of cultural remains. For instance, 61.9 percent of the spiritual/ceremonial sites also contain lithic artifacts and/or pottery. The large majority of the sites that contain spiritual/ceremonial features have been assigned to other site types, as summarized in Table 14. This calls into question the usefulness of the spiritual/ceremonial site type as a means for distinguishing the role of these activities within the regional archaeological landscape.

Table 14. Presence of Spiritual/Ceremonial Feature Types at Spiritual/Ceremonial and Other Site Types

Attribute	Sites with Attribute		
	All Sites	Spiritual/Ceremonial Sites	
		Count	Percent of all Sites
Burial	22	6	27.3
Petroglyph / Pictograph	55	9	16.4
Cupule	26	2	7.7
Rock Alignment	8	1	12.5
<i>Yoni</i>	11	2	18.2
Spirit Stick	18	2	11.1

Trail

Eleven trail sites have been recognized within the site typology. Among sites assigned to other site types, 27 have been recognized as having a trail as an attribute. In the study region's GIS, none of the sites classified as trails overlap with areas recorded as containing other site types, although 13 out of 61 trail sites in the adjacent Ocotillo region show such overlaps with a total of five other sites. If a site typology is to be used, inclusion of "trail" as a type is clearly warranted by its distinct characteristics. Possibly the assignment of separate site designations to trails that are documented within the areas of other sites may be justified. For purposes of analyzing regional archaeological landscapes, however, "trail" seems to be more effective as an attribute than as a type.

Cleared Circle / Rock Ring Sites

Of the six cleared circle/rock ring sites, most ($n = 5$) do not contain any lithic artifacts or pottery; only one site contains lithics. However, in the adjacent Ocotillo region, where cleared circle/rock ring sites are much more numerous ($n = 48$), the majority of these sites ($n = 33$) contain lithic artifacts. In addition, 12 sites assigned to other site types contain rock rings and/or pavement clearings. As is the case with several other site types, this category seems to succeed only very imperfectly at isolating a particular activity or at representing the distribution of that activity within the region.

Artifact Scatters

In the study region, 494 sites were classified as artifact scatters. The characteristics of such sites are likely to merge into or overlap with those of sites that are designated as temporary camps or even habitation bases. A few of the artifact scatter sites also contain additional attributes, as summarized in Table 15. The percentages of more complex sites that have been included in this category is small. However, more telling is that fact that a large proportion of sites assigned to other types also contain artifact scatters: 78.5 percent of other sites contain lithic artifacts and/or pottery. The artifact scatter type would perhaps be most effective if it were redefined as a residual category, encompassing small, not-too-diverse sites that lack any defined features, but including lithic workshops and pot drops.

Table 15. Additional Attributes Recorded at Artifact Scatter Sites

Attribute	Count of Sites	Percent
Bedrock Milling	2	0.4
Architectural Feature	1	0.2
Rock Alignment	1	0.2
Cairn	7	1.4
Rock Ring	1	0.2
Cache	4	0.8
Quarry	3	0.6
Trail	2	0.4
Rock Shelter	4	0.8
Vertebrate Faunal Remains	10	2.0
Invertebrate Faunal Remains	2	0.4
Midden Soil	11	2.2
Spirit Stick	2	0.4

Pot Drops

A pot drop, as defined above, is a small scatter of sherds from a single vessel, without other associated cultural remains. In the study region, 53 sites were categorized as pot drops, but some problems seem to exist with the application of this type. Of the pot drops, three were each reported to contain more than 50 sherds. Five of the sites contains sherds from both buffware and brownware vessels. Two contained lithic artifacts.

Conclusions

The application of the site typology to the Jacumba/McCain Valley region suggests some limitations to the value of such a typology. The use of a site typology is particularly convenient in cultural resource management, for its ability to convey concisely an impression of the general character, complexity, and extent of a resource. Site type designations may be required for National Register of Historic Places evaluations and Multiple Resource submissions. However, as a tool for analyzing prehistoric archaeological landscapes, the vagueness and ambiguities contained in the impressionistic site type distinctions may make analyses based on site types substantially less useful than analyses based on site attributes.

RESEARCH DOMAIN – CHRONOLOGY

Putting the prehistoric landscapes of the Jacumba/McCain Valley region in a chronological context is fundamental to working toward a deeper understanding of the region. Unfortunately, specific chronological information on the sites within the study region is still quite limited. In the context of a GIS-based landscape analysis, the issue of distinguishing pre-ceramic (pre-ca. A.D. 800) and ceramic-period (post-ca. A.D. 800) sites may be addressed.

Many ceramic-period components are readily recognized at the survey level of investigation, because pottery is relatively abundant and its presence at sites has generally been reliably reported (Figure 162). Recognizing pre-ceramic-period sites (in the absence of the anecdotal forms of evidence discussed above, such as radiocarbon dates or diagnostic projectile point forms) is much more problematic, but it may be possible, at least on a probabilistic basis.

A conclusive separation of individual sites as either ceramic-period or pre-ceramic on the basis of survey-level observations is not possible. If a site is found to contain pottery, it would be unwarranted to assume that it does not also include a pre-ceramic component. If no pottery is reported at a site, it cannot be assumed that the site is pre-ceramic in age. Pottery may be present on the site's surface but may have gone unobserved, or it may be present only in the subsurface deposit. Either the specific activities that were performed at a site or simple chance may be responsible for an absence of pottery at a ceramic-period site. However, on a probabilistic basis, it may be possible to discern differences between sites that are known to contain ceramic-period components and sites that have a relatively higher probability of being pre-ceramic.

The absence of pottery is not very likely to be chronologically diagnostic at casually used sites, such as milling stations, small lithic scatters, or thermal features. On the other hand, it is more likely to be significant at more substantial, multi-activity areas where the presence of some pottery would be likely if the site had been used during the ceramic period. Comparing the distribution of such multi-activity sites with and without pottery may potentially indicate chronological differences in settlement patterns and landscape use.

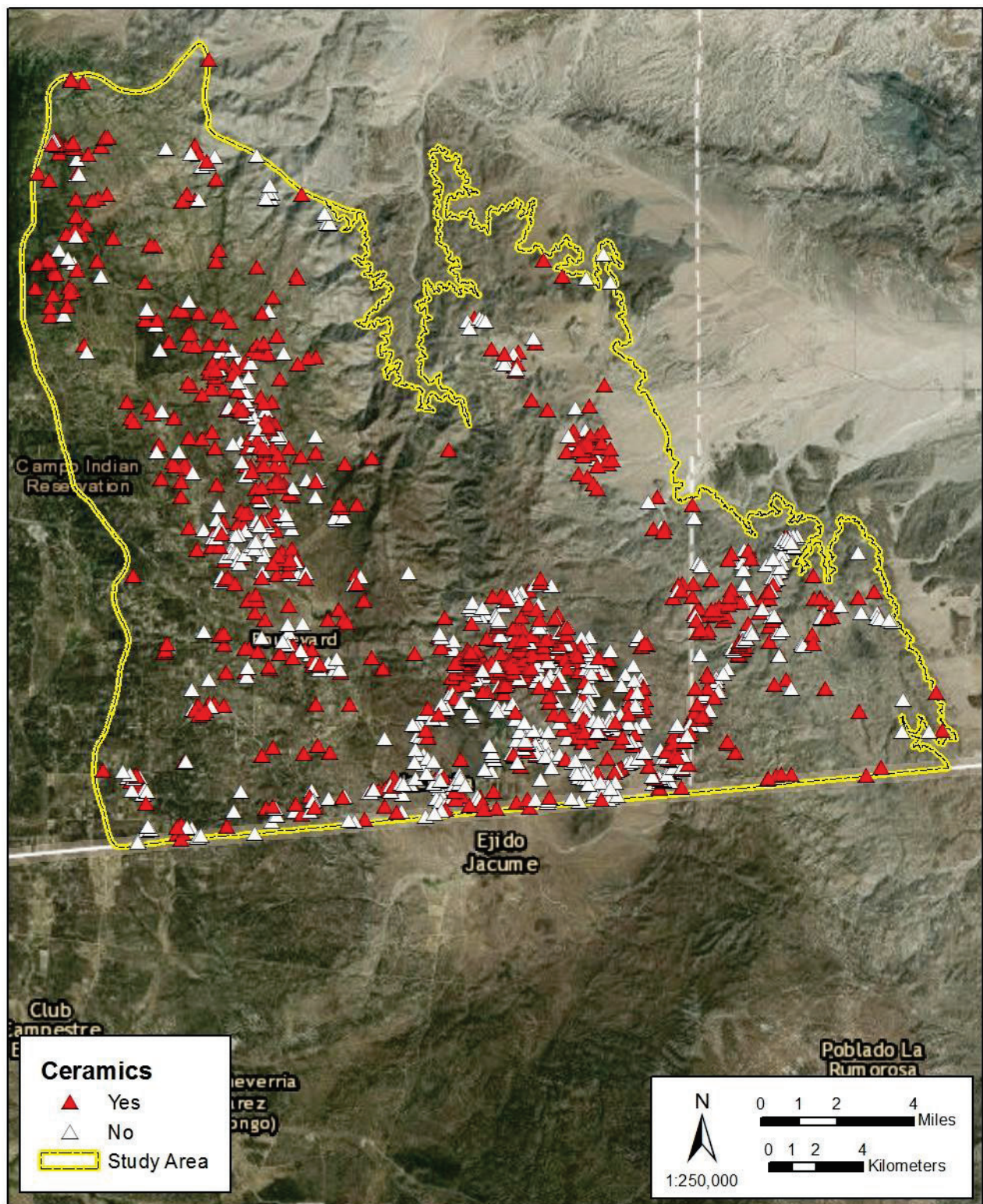


Figure 162. Ceramic and non-ceramic cultural resources in the Jacumba/McCain Valley region. (Attribute AP3, values 1 and 0 respectively).

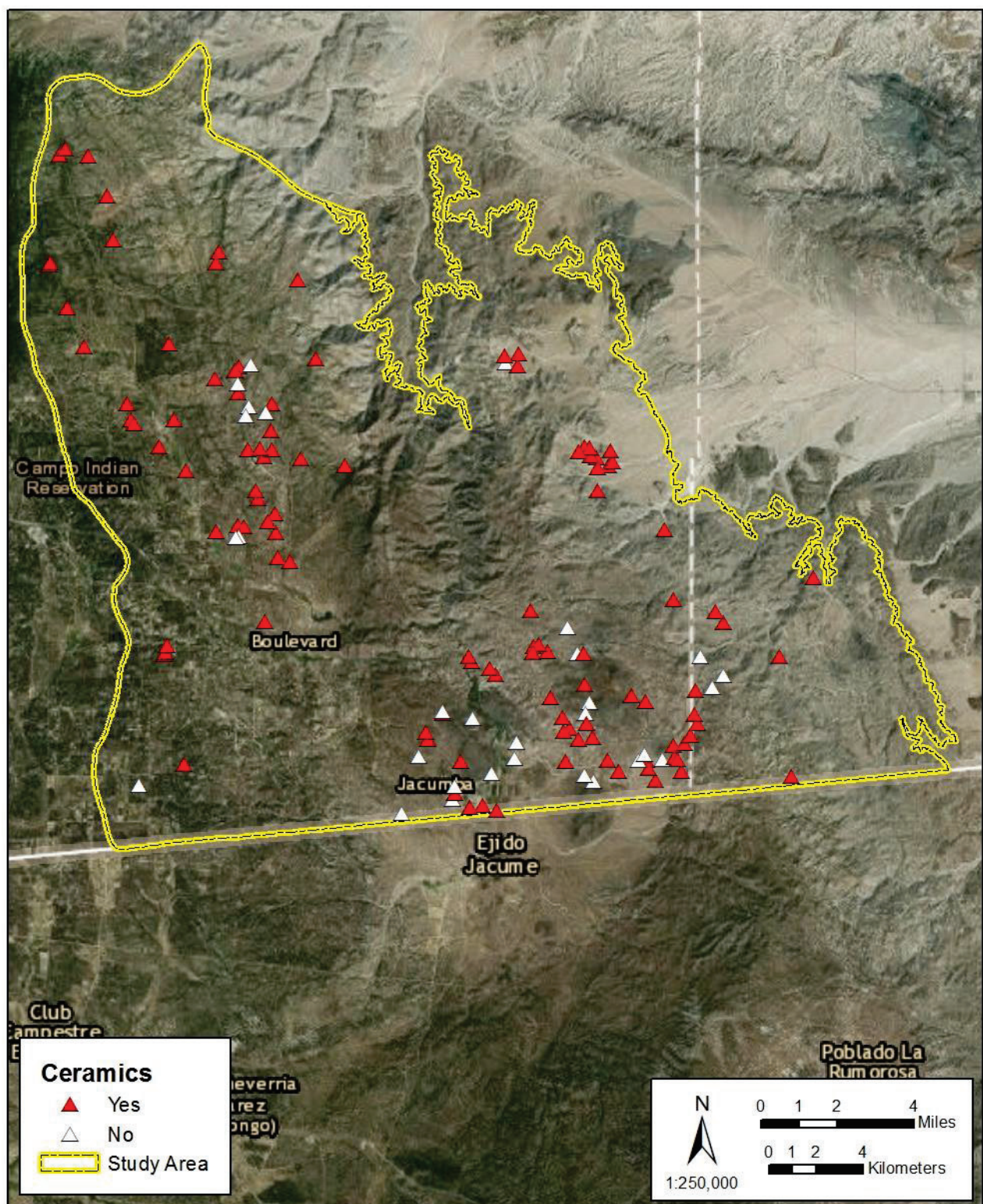


Figure 163. Ceramic and non-ceramic substantial, multi-activity sites in the Jacumba/McCain Valley region.

To test this possibility, a subset of sites has been defined on the basis of the recorded presence of two attributes: lithic waste in excess of 25 items, and milling tools and/or features (portable and/or bedrock). Sites belonging to this subset (here termed, for convenience, “substantial multi-activity sites”) likely represent areas where multiple activities occurred, probably involving both male and female members of the community, if it is assumed that the different attributes were produced contemporaneously. Such areas would have a strong possibility of also containing ceramic sherds, if pottery was part of their occupants’ technological repertoire. The quantification of lithic wastes as exceeding 25 items means that surface visibility and archaeological observations at the site were sufficient to have noted potsherds, if they were present. Comparing the distribution of sites that fall into this class and that either contain or lack recorded pottery may provide one rough basis for looking at some aspects of prehistoric change in the region’s archaeological landscapes.

Of the recorded sites, 140 fall into the substantial multi-activity site class. Of these, 110 have been reported to contain pottery, while 30 have not (Figure 163, previous page). As noted, the ratio of these two sets cannot be taken as an indication of the relative intensity of pre-ceramic-period and ceramic-period activity in the region. Locations that were well-suited for ceramic-period occupation were also likely to have been preferred locations for earlier occupation, and many pre-ceramic components probably lie unrecognized under a veneer of ceramic-period remains.

Statistical comparisons of substantial multi-activity sites with and without pottery are presented in the sections that follow. In general, the two sets of sites are not clearly distinguishable. Possible conclusions from this would be that either the defined classes were not very effective in separating pre-ceramic and ceramic-period sites, or else that there was little change in the analyzed attributes of such sites between those two time periods.

RESEARCH DOMAIN – SETTLEMENT

A fundamental aspect of landscape archaeology concerns the specific choices that prehistoric people made in selecting locations for their use, on the basis of the locations’ natural and cultural contexts. This section examines archaeological evidence concerning site patterning within the Jacumba/McCain Valley region that may help to reveal the criteria behind those choices. However, in such an analysis, it is essential to keep in mind the potential of biases occurring in the preservation, discovery, reporting, and interpretation of the evidence.

Correlations of Site Locations with Environmental Attributes

Physiography

The physical arrangement of landforms undoubtedly affected prehistoric choices of locations for activities. One approach to seeking a relatively objective understanding of how those effects worked is to compare the frequencies in the physiographic characteristics of site locations with the corresponding frequencies for the study region as a whole. A check on this, to offset potentially incomplete and biased site information, is to compare the frequencies with those for the NADB areas, taken as representing areas that have been systematically inventoried for sites, as discussed above. The physiographic variables in the GIS that are available for statistical analysis include elevation, slope, and aspect.

Elevation

Comparisons in elevation have been made here in two ways. Graphically, comparative elevation data are shown grouped in 200-ft. intervals in Figures 164 through 166. Statistically, the proportions of different classes below and above the study region’s median elevation of 3,329 ft. are presented in Table 16, and the Fisher’s exact test statistic has been used to evaluate differences as being either possibly merely random or as statistically significant in Table 17.

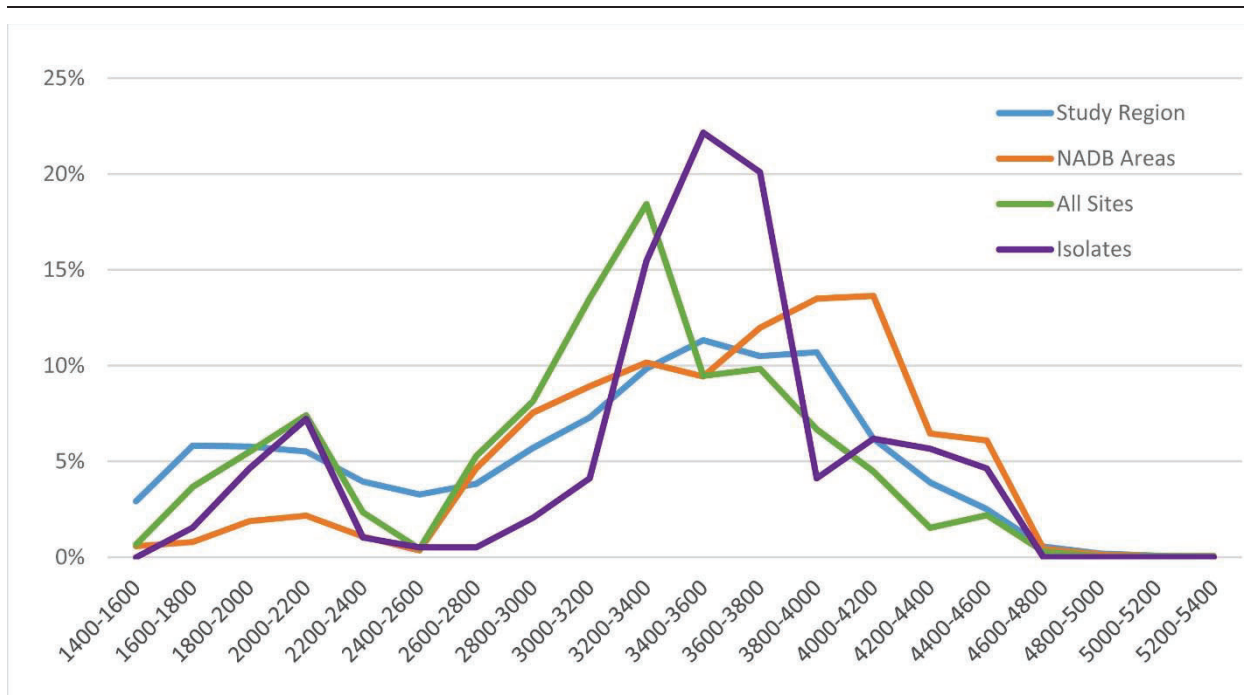


Figure 164. Relative frequencies of sites and isolates, by elevation.

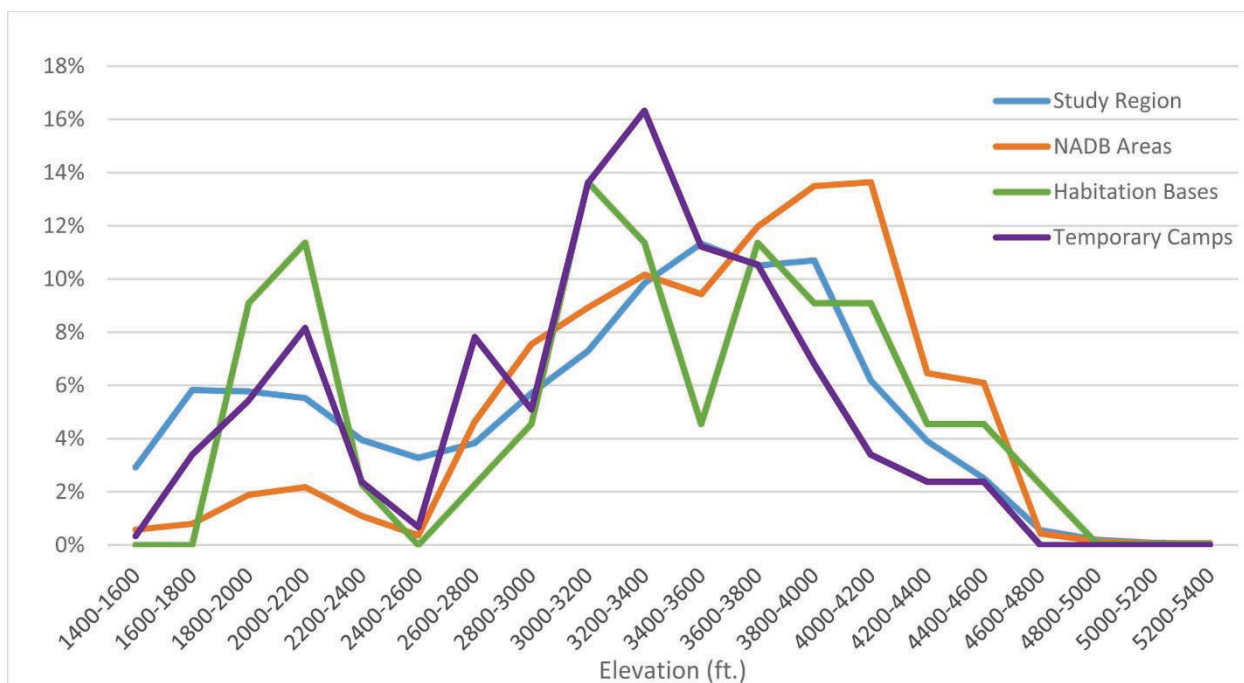


Figure 165. Relative frequencies of habitation bases and temporary camps, by elevation.

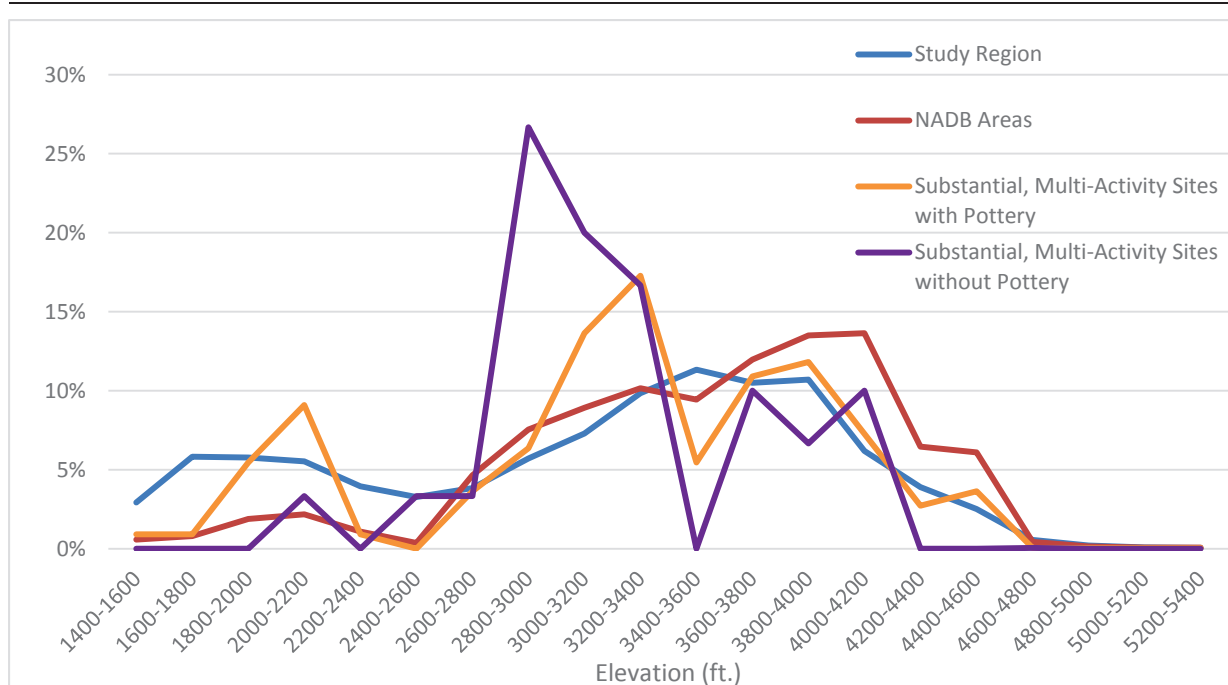


Figure 166. Relative frequencies of substantial, multi-activity sites with and without pottery, by elevation.

Table 16. Elevations below and above the Regional Median Elevation (3,329 ft.) at Cultural Resources by Types and at Regional Sample Points

	Below 3,329 ft.		Above 3,329 ft.	
	n	%	n	%
Regional Sample Points	3,022	50.0	3,023	50.0
NADB Area Points	473	34.3	906	65.7
All Sites	815	59.8	547	40.2
Isolates	60	30.9	134	69.1
Habitation Bases	23	52.3	21	47.7
Temporary Camps	176	59.9	118	40.1
Substantial Multi-Activity Sites with Pottery	57	51.8	53	48.2
Substantial Multi-Activity Sites without Pottery	19	63.3	11	36.7

Table 17. Fisher's Exact Test Values for Differences in the Frequencies of Elevations Below and Above the Regional Median Elevation

	NADB Area Points	All Sites	Isolates	Habitation Bases	Temporary Camps	Substantial Multi-Activity Sites with Pottery	Substantial Multi-Activity Sites without Pottery
Regional Sample Points	<0.0001	<0.0001	<0.0001	0.8800	0.0010	0.7730	0.1994
NADB Area Points		<0.0001	0.3737	0.0161	<0.0001	0.0004	0.0016
All Sites			<0.0001	0.3501	1.0000	0.1069	0.8510
Isolates				0.0089	<0.0001	0.0004	0.0009
Habitation Bases					0.4117	1.0000	0.4739
Temporary Camps						0.1745	0.8453
Substantial Multi-Activity Sites with Pottery							0.3050

Bold numbers indicate statistically significant differences (with less than 0.0500 probability that the differences are merely random).

Figure 164 shows the frequency distributions of elevations for all archaeological sites and for isolates, along with those for the study region as a whole and for NADB areas, which were previously presented in Figure 144. The secondary mode in elevations that was noted for the study region as a whole but that is not strongly represented in NADB areas is clearly expressed in the elevation distributions of both sites and isolates. With regard to the primary mode, the distributions of site and isolate elevations also more closely match the characteristics of the study region as a whole than that for the NADB areas. The statistics in Tables 16 and 17 confirm that elevations at sites tend to be lower than the study region's median elevation, whereas isolates tend to be higher in elevation than either sites or the region as a whole.

Figure 165 shows the elevation distributions for habitation bases and temporary camps. These two data sets fairly closely match each other, but temporary camps are confirmed statistically in Tables 16 and 17 as lower in elevation than the study region as a whole, and both temporary camps and habitation bases are lower than NADB areas.

Figure 166 shows the distributions for substantial multi-activity sites with and without pottery, as those were defined above. The sites lacking pottery do not show any clear difference from ceramic sites in distributions with respect to elevation, except possibly at elevations between 2,800 and 3,200 ft., where non-ceramic sites appear to be more frequent.

Slope

The second physiographic variable investigated through the GIS is slope. The median slope for the study region is 33.5°. It might be hypothesized that locations on relatively flat ground would have been preferred for habitation sites. Cultural deposits in flatter areas are more likely to have survived subsequent erosion, although they are also more likely to have been concealed by subsequent sedimentation.

Figure 167 shows the distribution of slopes at sites and isolates, and Tables 18 and 19 compare the distributions of sites above and below the regional median slope. Several observations may be suggested.

The distribution of slopes at sites generally matches the distribution of slopes throughout the region. The distribution of slopes at isolates differs significantly from the distribution for sites. Isolates are concentrated in flatter areas than those containing sites, which is perhaps contrary to expectations. However, the slopes of isolates closely match the slopes of NADB areas. Rather than reflecting a difference between sites and isolates in the locations that were used for prehistoric activities, the difference likely reflects the recording of isolates primarily during NADB-documented cultural resource management studies, which have been conducted disproportionately in flatter areas. The distributions of slopes at habitation bases and temporary camps do not differ significantly from those for the study region as a whole. Finally, the distributions of slopes at substantial multi-activity sites with and without pottery do not differ significantly from each other in this respect.

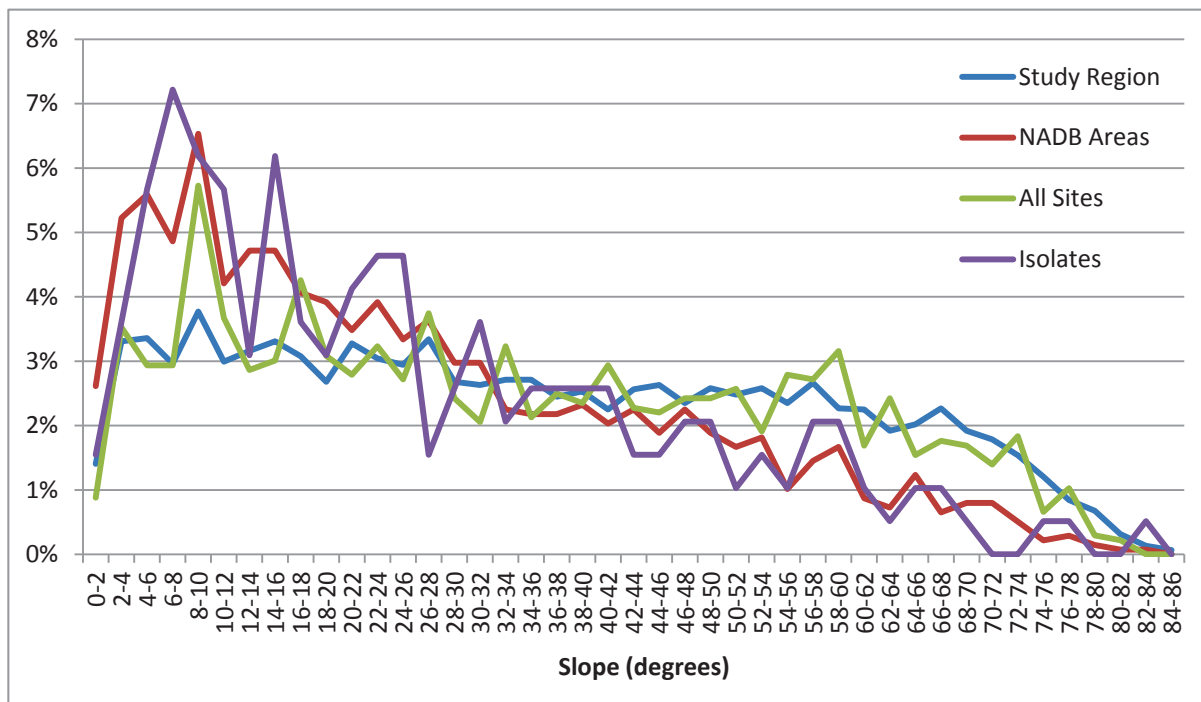


Figure 167. Relative frequencies of substantial, multi-activity sites with and without pottery, by elevation.

Table 18. Slopes less than and greater than the Regional Median (33.5°) at Cultural Resource Types and Regional Sample Points

	Less than 33.5°		Greater than 33.5°	
	n	%	n	%
Regional Sample Points	3,017	49.9	3,028	50.1
NADB Area Points	941	68.3	437	31.7
All Sites	707	51.9	655	48.1
Isolates	134	69.1	60	30.9
Habitation Bases	27	61.4	17	38.6
Temporary Camps	143	48.6	151	51.4
Substantial Multi-Activity Sites with Pottery	69	62.7	41	37.3

	Less than 33.5°		Greater than 33.5°	
	n	%	n	%
	20	66.7	10	33.3

Table 19. Fisher's Exact Tests of Differences in Frequencies of Slopes

	NADB Area Points	All Sites	Isolates	Habitation Bases	Temporary Camps	Substantial Multi-Activity Sites with Pottery	Substantial Multi-Activity Sites without Pottery
Regional Sample Points	<0.0001	0.1870	<0.0001	0.1337	0.6764	0.0091	0.0700
NADB Area Points		<0.0001	0.8692	0.3287	<0.0001	0.2436	0.8445
All Sites			<0.0001	0.2246	0.3346	0.0293	0.1390
Isolates				0.3728	<0.0001	0.3108	0.8334
Habitation Bases					0.1454	1.0000	0.8062
Temporary Camps						0.0137	0.0833
Substantial Multi-Activity Sites with Pottery							0.8311

Bold numbers indicate statistically significant differences (with less than 0.0500 probability of the differences being random).

Aspect

The third physiographic variable examined is aspect. Locations with aspects oriented toward the southeast, south, and southwest would have received more sunlight and would generally have been warmer than other locations. Tables 20 and 21 compare the frequencies of these southerly aspects for the region as a whole with the previously discussed cultural resource categories. The main statistically significant pattern identified is that southerly aspects are somewhat more frequent at sites than at random regional points.

Table 20. Frequencies of Southerly Aspects at Cultural Resource Types and Regional Sample Points

	Aspect			
	W – NW – N – NE – E		SE – E – SW	
	n	%	n	%
Regional Sample Points	4,000	66.2	2,045	33.8
NADB Area Points	839	60.9	539	39.1
All Sites	851	62.5	511	37.5
Isolates	115	59.3	79	40.7
Habitation Bases	28	63.6	16	36.4

	Aspect			
	W – NW – N – NE – E		SE – E – SW	
	n	%	n	%
Temporary Camps	187	63.6	107	36.4
Substantial Multi-Activity Sites with Pottery	79	71.8	31	28.2
Substantial Multi-Activity Sites without Pottery	24	80.0	6	20.0

Table 21. Fisher's Exact Tests of Differences in Frequencies of Southerly Aspects

	NADB Area Points	All Sites	Isolates	Habitation Bases	Temporary Camps	Substantial Multi-Activity Sites with Pottery	Substantial Multi-Activity Sites without Pottery
Regional Sample Points	0.0002	0.0106	0.0540	0.7501	0.3774	0.2239	0.1242
NADB Area Points		0.4093	0.6949	0.7560	0.3920	0.0248	0.0368
All Sites			0.3858	1.0000	0.7399	0.0515	0.0561
Isolates				0.6144	0.3425	0.0346	0.0418
Habitation Bases					1.0000	0.3377	0.1953
Temporary Camps						0.1273	0.1060
Substantial Multi-Activity Sites with Pottery							0.4852

Bold numbers indicate statistically significant differences (with less than 0.0500 probability of the differences being random).

One hypothesis to account for the higher frequency of southerly aspects at sites as a whole might be that aspect was a significant consideration in the selection of bedrock milling locations. Tables 22 and 23 summarize and evaluate the relevant frequencies, both for all sites with bedrock milling and specifically for biotic resource extraction/processing sites with bedrock milling. These sites do not differ significantly in aspect either from the region as a whole or from NADB areas.

Another test was to evaluate the frequencies of southerly aspects at artifact scatters. Intentional selection for aspect at these locations is not particularly likely. However, artifact scatters represent a numerous category of sites and often consist of relatively sparse, inconspicuous sites that might be expected, like isolates, to have been more frequently recorded in NADB areas. Tables 24 and 25 summarize and evaluate these frequencies. Southerly aspects are significantly more frequent for artifact scatters than for the regional sample points, but they do not differ significantly from the frequencies for NADB points.

Table 22. Frequencies of Southerly Aspects at Regional Sample Points and at Bedrock Milling Locations

	Aspect			
	W – NW – N – NE – E		SE – E – SW	
	n	%	n	%
Regional Sample Points	4,000	66.2	2,045	33.8
NADB Area Points	839	60.9	539	39.1
All Sites with Bedrock Milling Features (Excluding Cupules)	294	63.5	169	36.5
All Biotic Resource Extraction/Processing Sites with Bedrock Milling Features (Excluding Cupules)	117	62.2	71	37.8

Table 23. Fisher's Exact Tests of Differences in Frequencies of Southerly Aspects at Bedrock Milling Sites

	NADB Area Points	All Sites with Bedrock Milling Features (Excluding Cupules)	All Biotic Resource Extraction/Processing Sites with Bedrock Milling Features (Excluding Cupules)
Regional Sample Points	0.0002	0.2422	0.2738
NADB Area Points		0.3210	0.7503
All Sites with Bedrock Milling Features (Excluding Cupules)			0.5902

Bold number indicates a statistically significant difference (with less than 0.0500 probability of the difference being random).

Table 24. Frequencies of Southerly Aspects at Regional Sample Points and at Artifact Scatters

	Aspect			
	W – NW – N – NE – E		SE – E – SW	
	n	%	n	%
Regional Sample Points	4,000	66.2	2,045	33.8
NADB Area Points	839	60.9	539	39.1
Artifact Scatters	294	59.5	200	40.5

Table 25. Fisher's Exact Tests of Differences in Frequencies of Southerly Aspects at Artifact Scatters

	NADB Area Points	Artifact Scatters
Regional Sample Points	0.0002	0.0031
NADB Area Points		0.5922

Bold numbers indicate statistically significant differences (with less than 0.0500 probability of the differences being random).

In conclusion, the physiographic dimensions of elevation, slope, and aspect seem to have played only limited roles in the selection of locations for prehistoric activity within the study region. Sites as a whole and temporary camps in particular are somewhat more frequently reported at lower elevations. There is no clear evidence that slope or aspect were significant determining factors.

Geology

Differences in the geological resources that were available in the immediate vicinity of potential site locations are likely to have been a consideration in the selection of locations for at least certain types of prehistoric activity. In particular, this is the case for sites containing quarries and sites containing bedrock milling features. Geological differences are also likely to have influenced the survival or discovery of some other site types, most notably trails. Figure 168 summarizes the geological contexts of these categories.

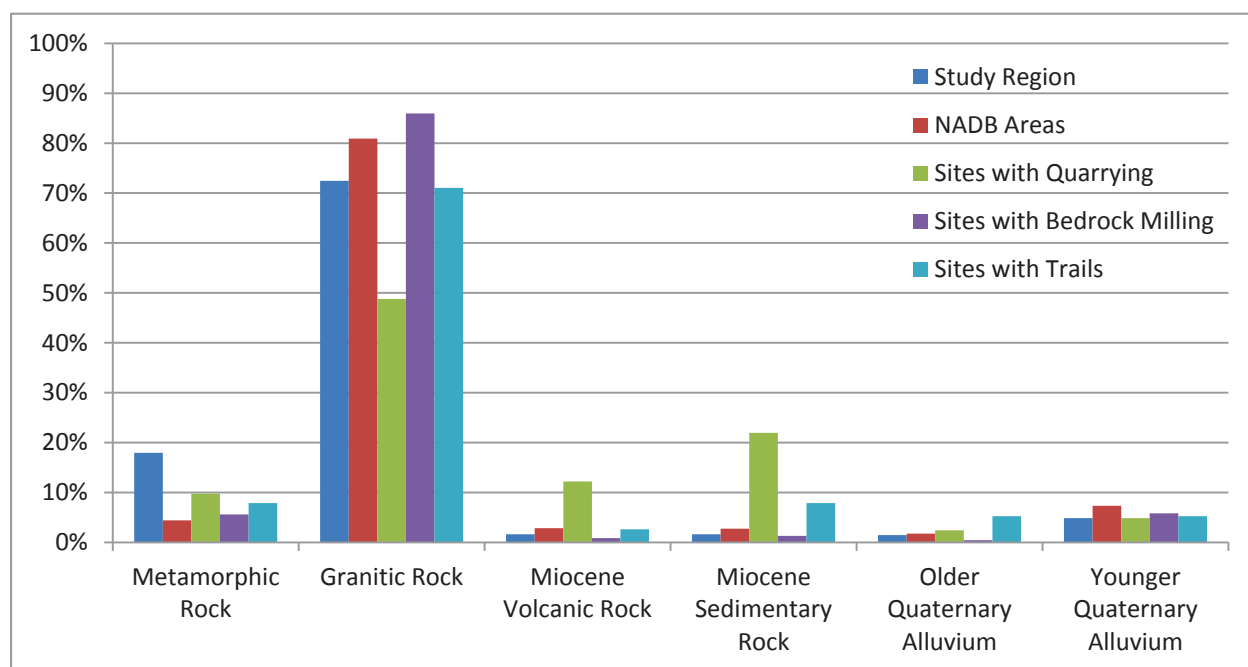


Figure 168. Relative frequencies of site types, by geological context.

Quarries are most commonly documented in granitic areas, perhaps due to the availability of quartz as a resource for flaked lithic tools. However, granitic rock underlies the majority of the study region, and quarries are proportionately underrepresented in this portion of the study region. As expected, quarries are proportionately overrepresented in areas of Miocene volcanic rock of the Jacumba Pyroclastics. They are also overrepresented in areas of Miocene sedimentary rock, which consists of Table Mountain Gravels, containing “well-rounded to angular clasts derived from local sources (Jacumba area), and clasts of material similar to the Santiago Peak Volcanics” (Strand 1962). The Santiago Peak Volcanics were seemingly a preferred source of flaked lithic material in prehistoric western San Diego County.

Bedrock milling features are somewhat overrepresented in granitic areas, which would be expected, in part because of the superior platforms for milling provided by those rocks. The features are underrepresented in areas of metamorphic rock, which is not as easily explained. The underrepresentation may be due to the greater vulnerability of many types of metamorphic rock to degradation by erosion and weathering. Alternatively, it may merely reflect the fact that metamorphic rock occurs most abundantly in the Carrizo Gorge area, which has received comparatively little archaeological investigation; the representation of metamorphic rock at bedrock milling sites is similar to its representation within NADB areas.

Trails are more evenly represented in various geological contexts than might have been expected. They are overrepresented in areas of older alluvium, which would be expected because of the optimal conditions for the preservation and detection of trails in those areas. However, they are also overrepresented in areas mapped as containing Miocene sedimentary rock.

Soils

Soil types, per se, are not likely to have been important considerations in prehistoric settlement decisions. However, it may be possible to use differences in soil as proxies for the likely distribution of paleoenvironmental vegetation communities, in cases where those distributions might not be reflected by modern vegetation distributions, for instance because of climatic changes or modern disturbances. Above all, different soil types may be indicative of natural conditions of deposition or erosion that may have differentially exposed, buried, or destroyed prehistoric cultural deposits subsequent to their original deposition.

As noted above, mapped soils data are available for about 60 percent of the study region, excluding the eastern and northeastern portions. The analysis presented here only concerns possible settlement patterning within those mapped areas.

A number of patterns are observed (Figure 169). In bedrock areas, sites with trails are overrepresented, while isolates and pot drops are underrepresented. The latter two cases, rather than representing differential preservation or discovery, may be explained by the fact that bedrock is also underrepresented in NADB areas as compared to the general regional sample. In areas with soils formed from the weathering of underlying bedrock, there is an underrepresentation of sites with trails. In areas with soils formed within alluvial deposits, isolates and artifact scatters are overrepresented, but, again, NADB areas are similarly overrepresented. In gullied areas, all sites, substantial multi-activity sites without pottery, artifact scatters, and trails are all overrepresented. In at least the first three of these cases, this may reflect more frequent exposure of previously buried deposits.

Hydrology

Access to fresh water was a necessity for extended prehistoric occupation at a habitation base or temporary camp. Some other sites would also be expected to be associated with convenient water sources. These might include biotic resource extraction/processing sites with bedrock mortars, because those features are generally presumed to have been most commonly used to process acorns, and the ground acorn meal would require leaching. Access to water would be expected to have been less important at some other sites, such as biotic resource extraction/processing sites containing hearths/pits, many of which were likely used to roast agave hearts.

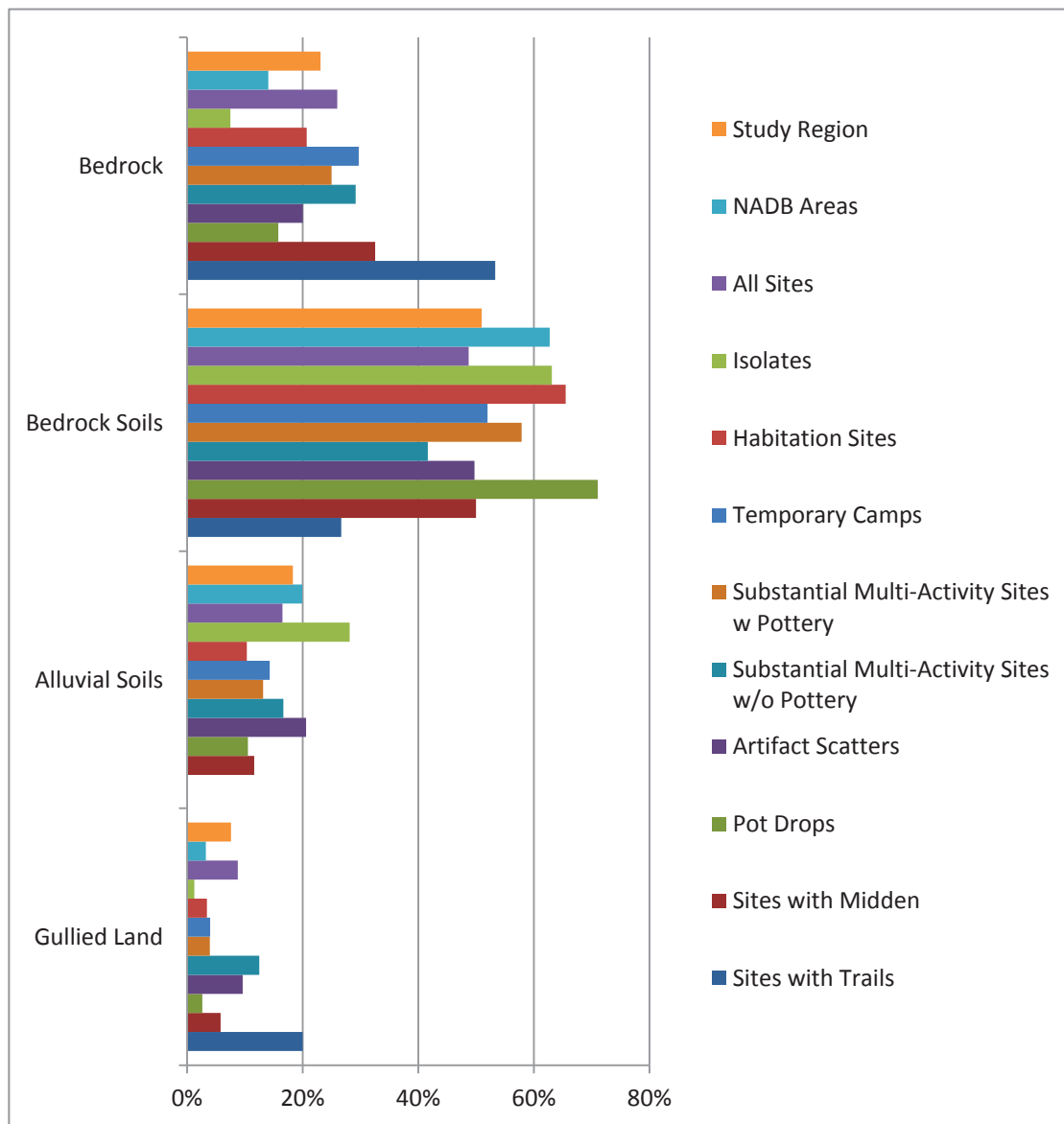


Figure 169. Relative frequencies of site types, by soils context.

Figures 170 through 173 summarize the distances from springs for all sites, isolates, habitation bases, temporary camps, substantial multi-activity sites with and without pottery, sites with mortars, and biotic resource extraction/processing sites with hearths/pits. Figures 174 through 177 summarize the corresponding distances of those cultural resources from perennial streams or from third-order or higher drainages. Figures 178 through 181 summarize the distances of those cultural resources to the closer of these possible water sources. To evaluate these patterns statistically, the frequencies of distances to the closest of the three potential water sources have been compared with the median distance for sample points within the study area as a whole, which is 4,284 ft. (Tables 26 and 27).

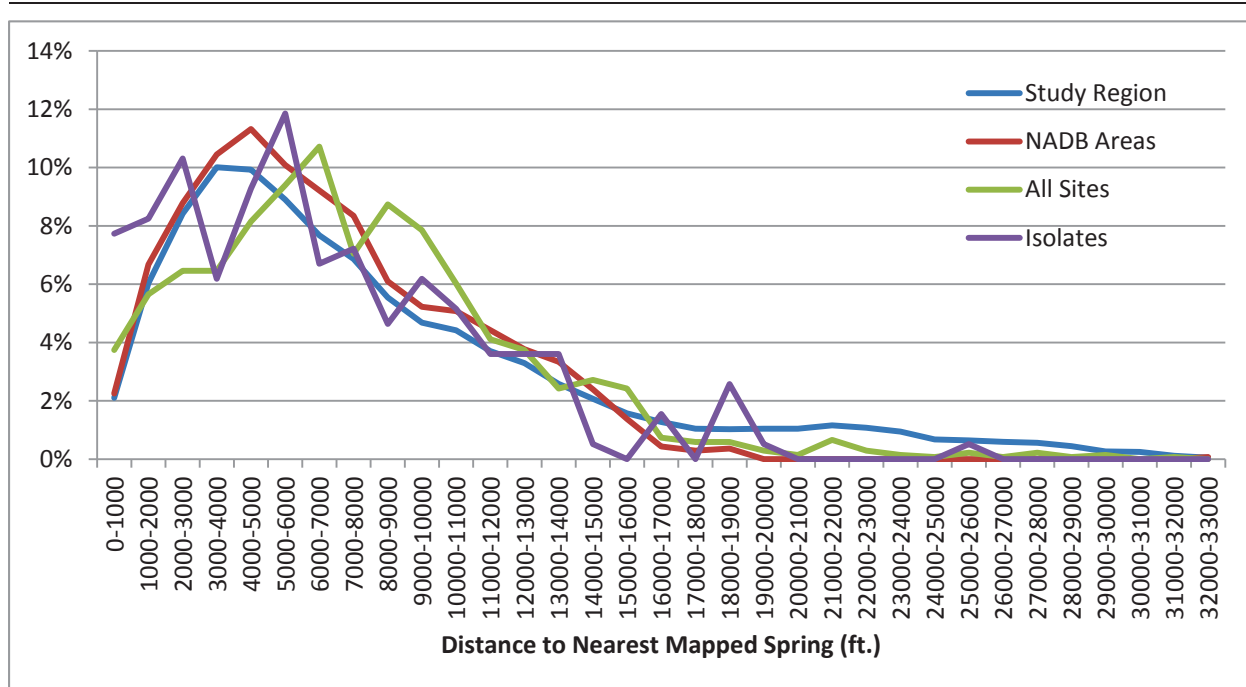


Figure 170. Relative frequencies of sites and isolates, by distance to the nearest spring.

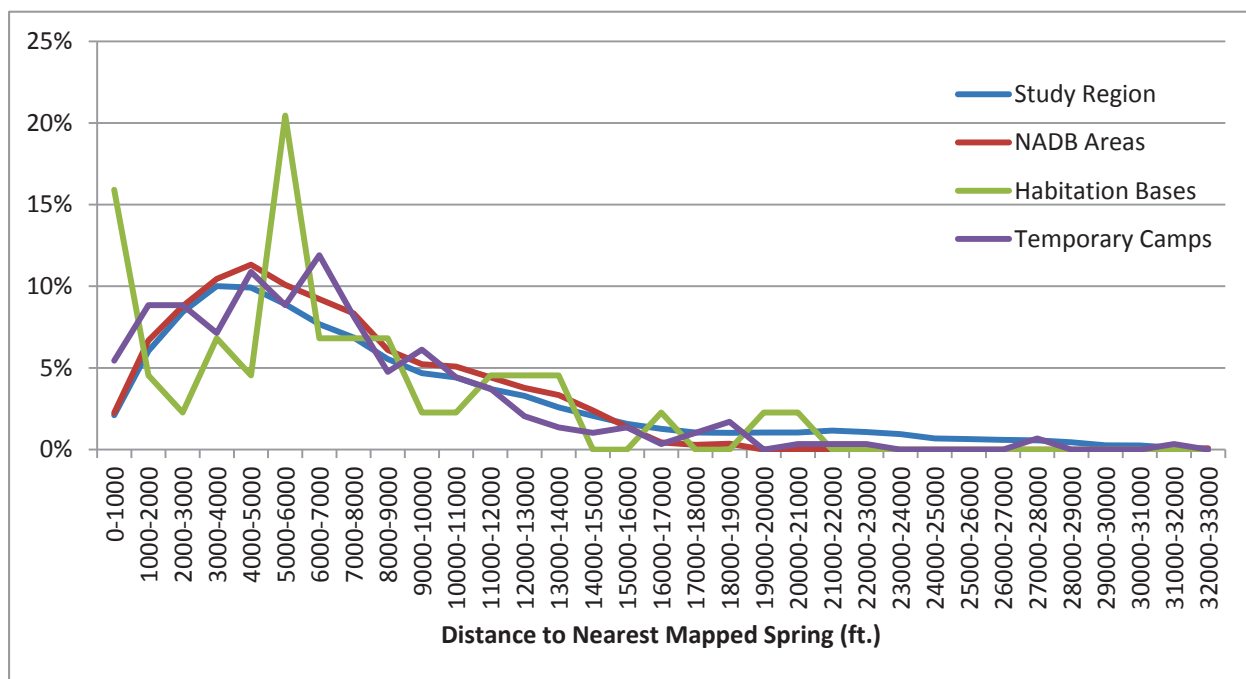


Figure 171. Relative frequencies of habitation bases and temporary camps, by distance to the nearest spring.

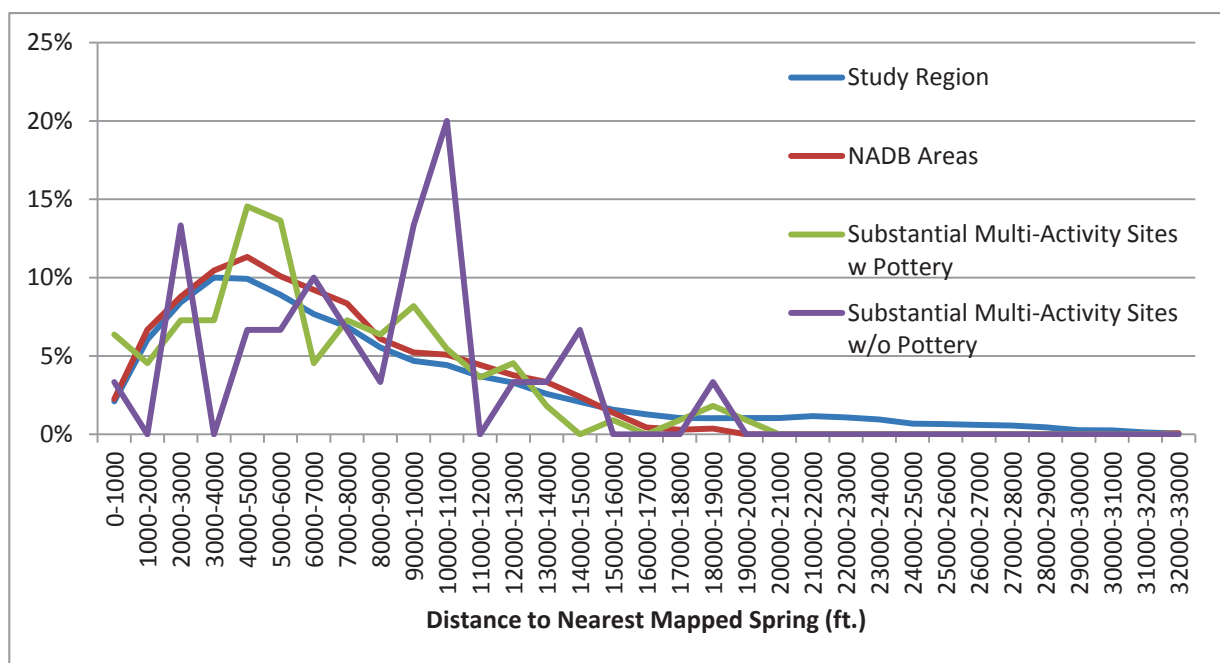


Figure 172. Relative frequencies of substantial, multi-activity sites with and without pottery, by distance to the nearest spring.

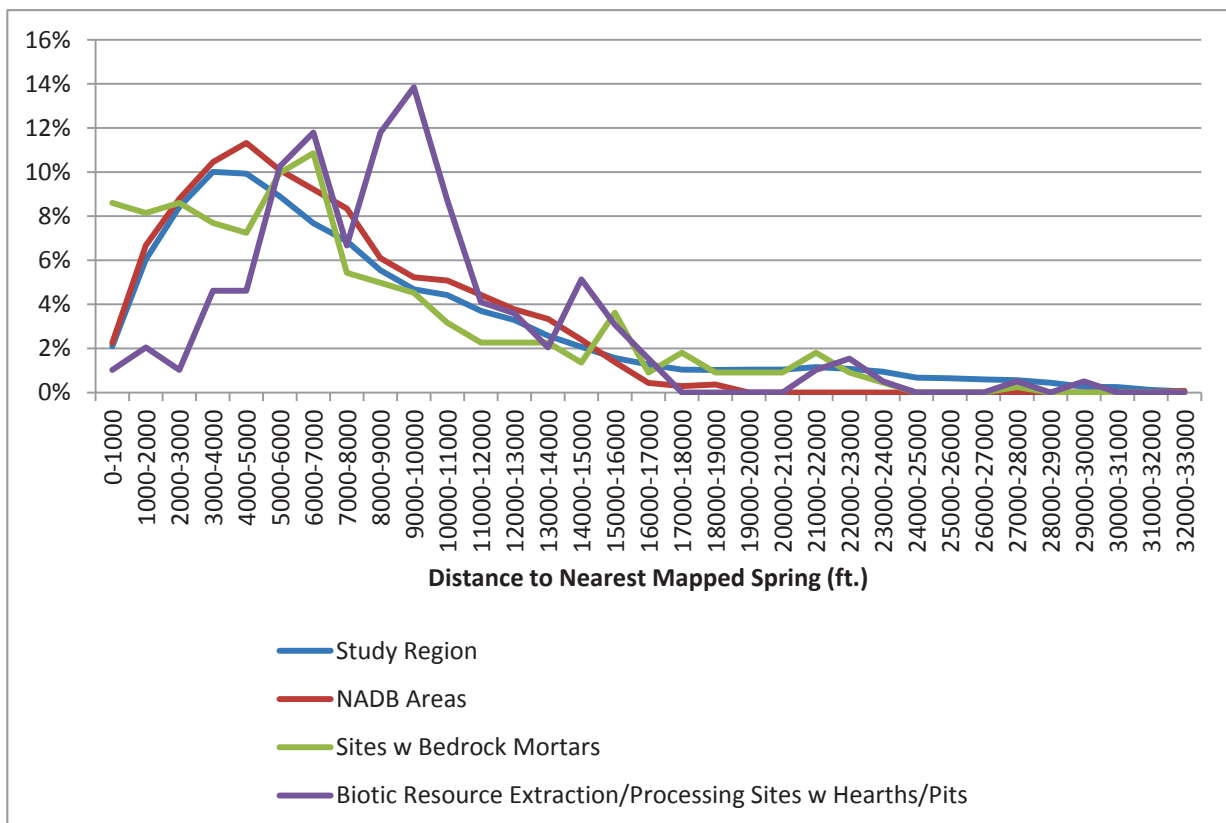


Figure 173. Relative frequencies of sites with mortars and of biotic resource extraction/processing sites with hearth/pit features, by distance to the nearest spring.

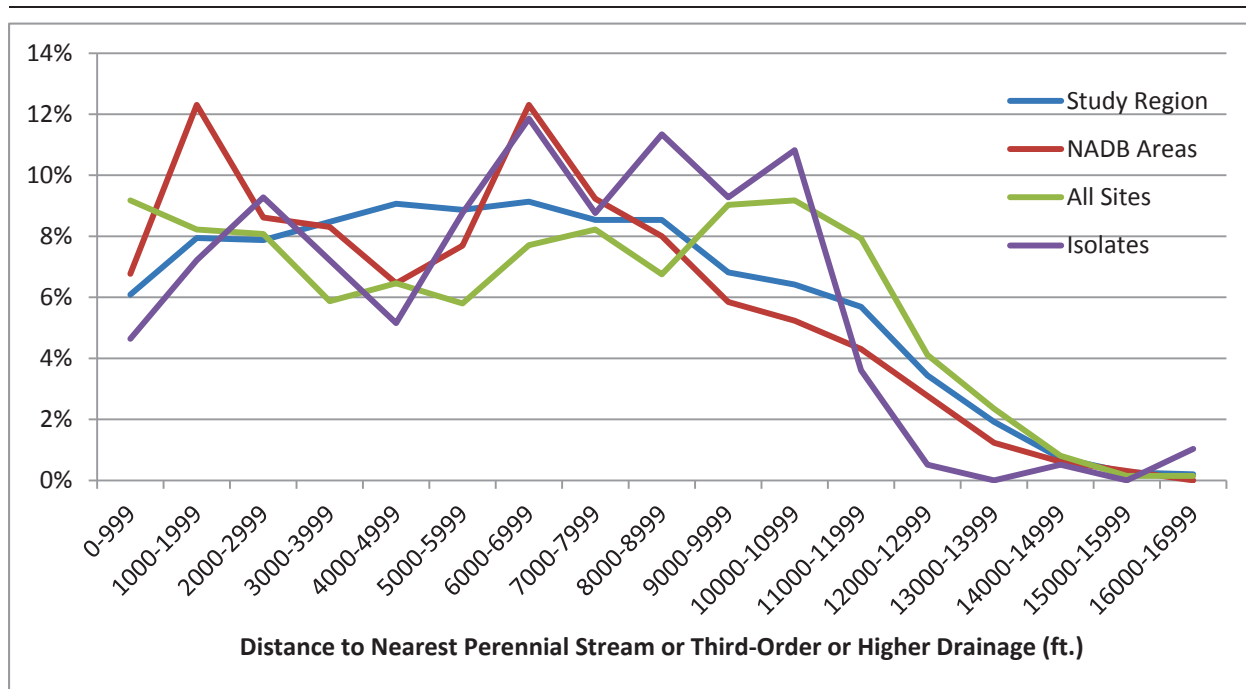


Figure 174. Relative frequencies of sites and isolates, by distance to the nearest perennial stream or third-order or higher drainage.

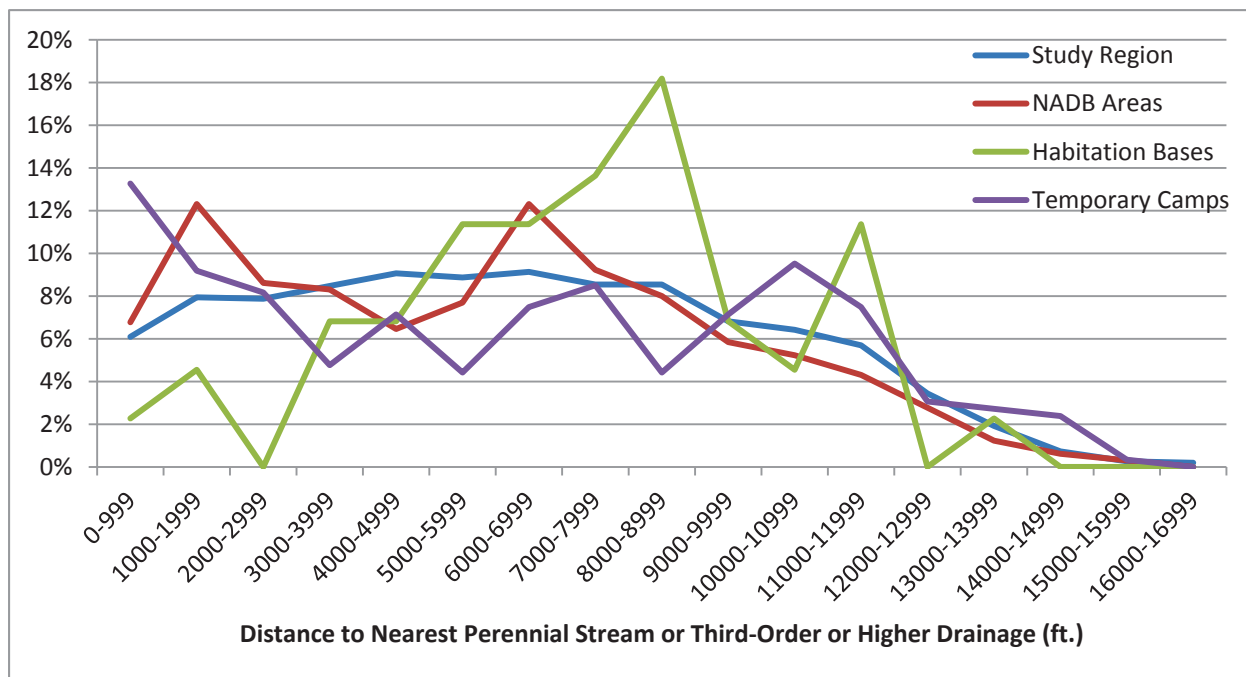


Figure 175. Relative frequencies of habitation bases and temporary camps, by distance to the nearest perennial stream or third-order or higher drainage.

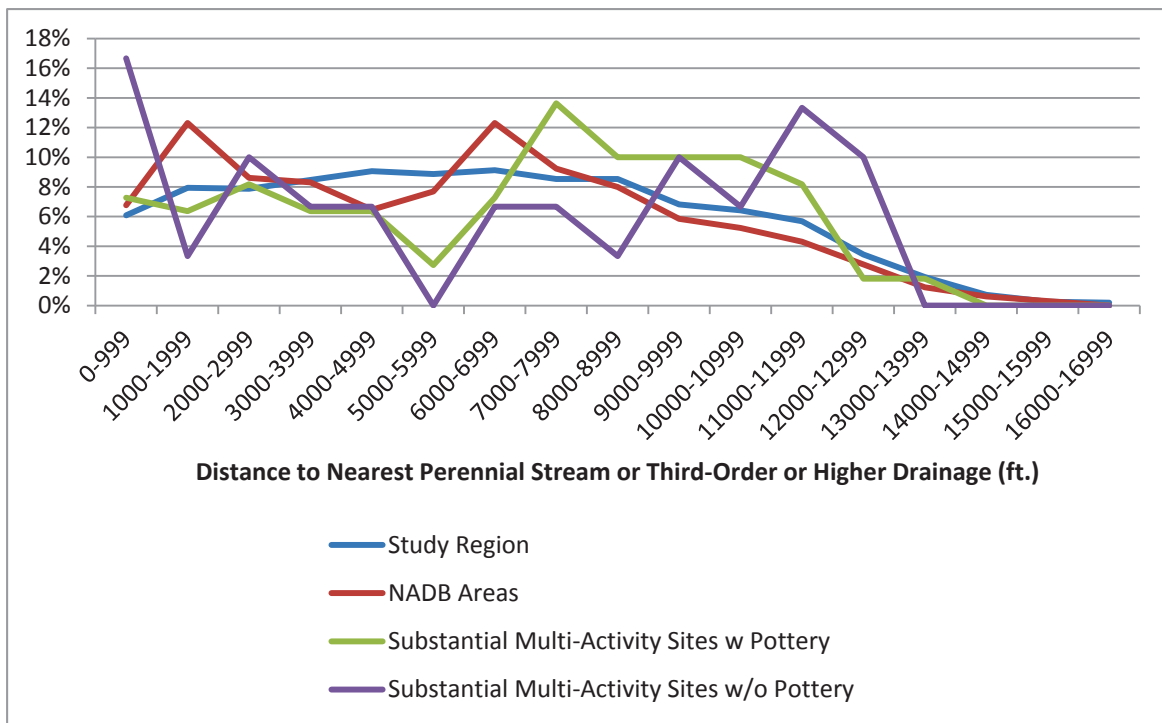


Figure 176. Relative frequencies of substantial, multi-activity sites with and without pottery, by distance to the nearest perennial stream or third-order or higher drainage.

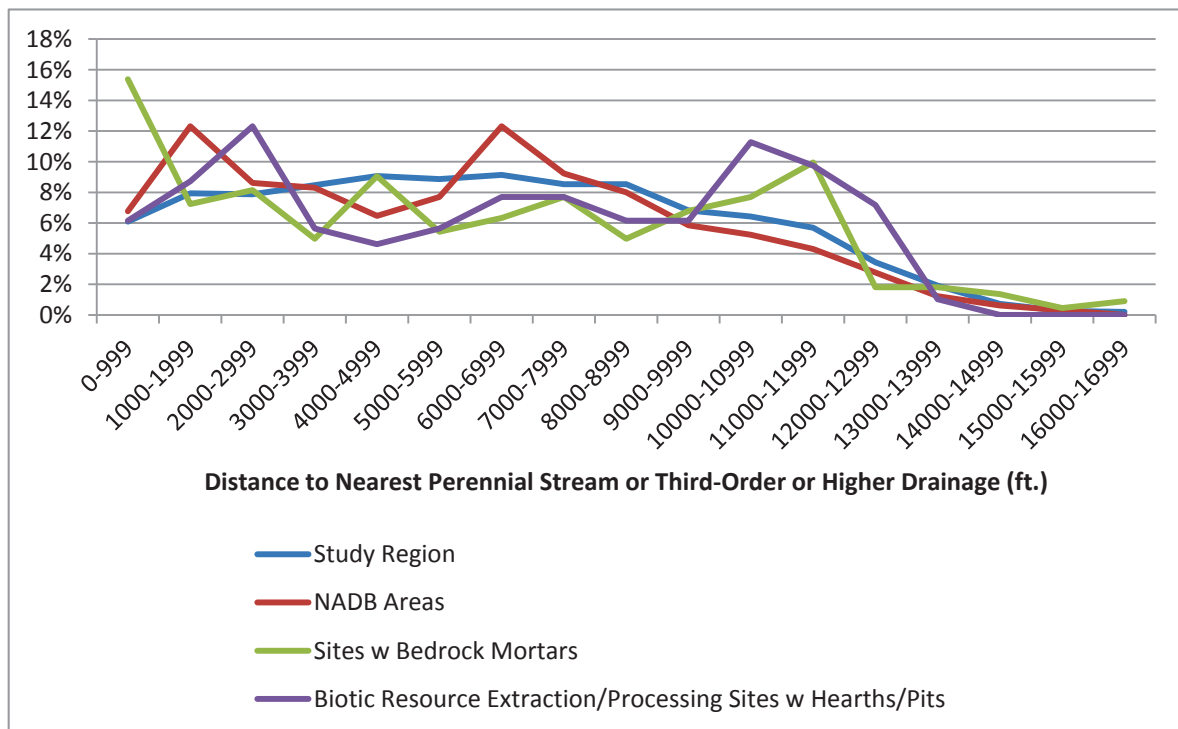


Figure 177. Relative frequencies of sites with mortars and of biotic resource extraction/processing sites with hearth/pit features, by distance to the nearest perennial stream or third-order or higher drainage.

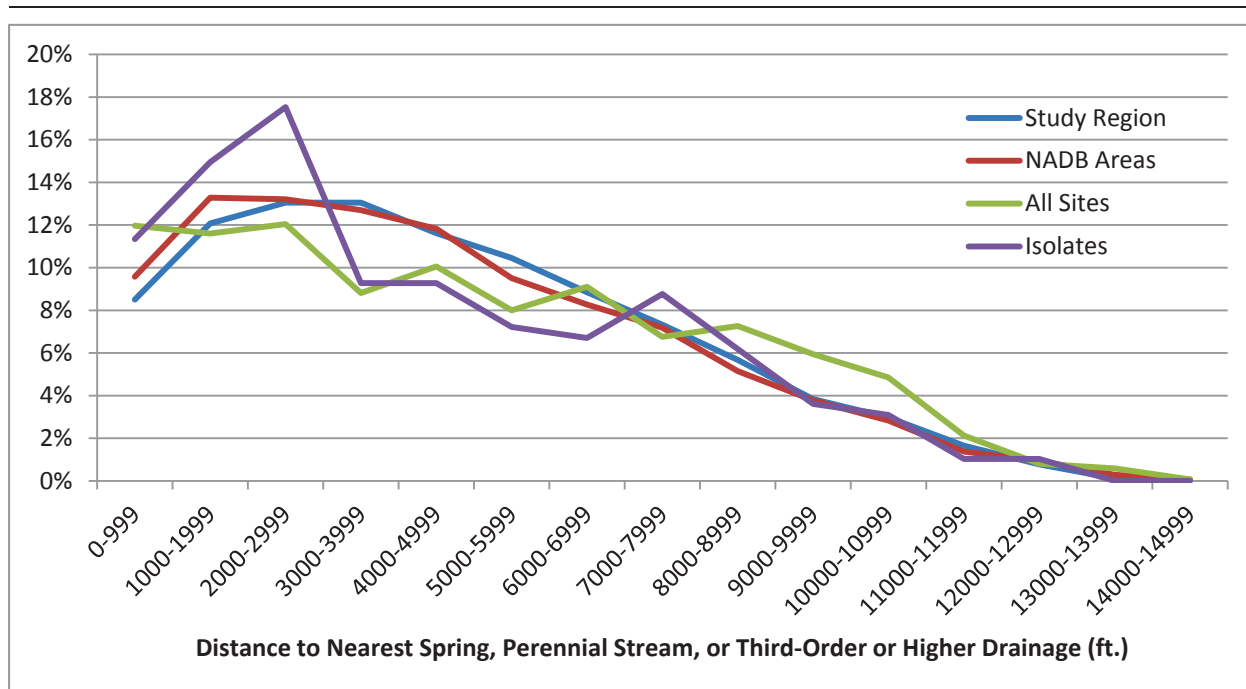


Figure 178. Relative frequencies of sites and isolates, by distance to the nearest spring, perennial stream, or third-order or higher drainage.

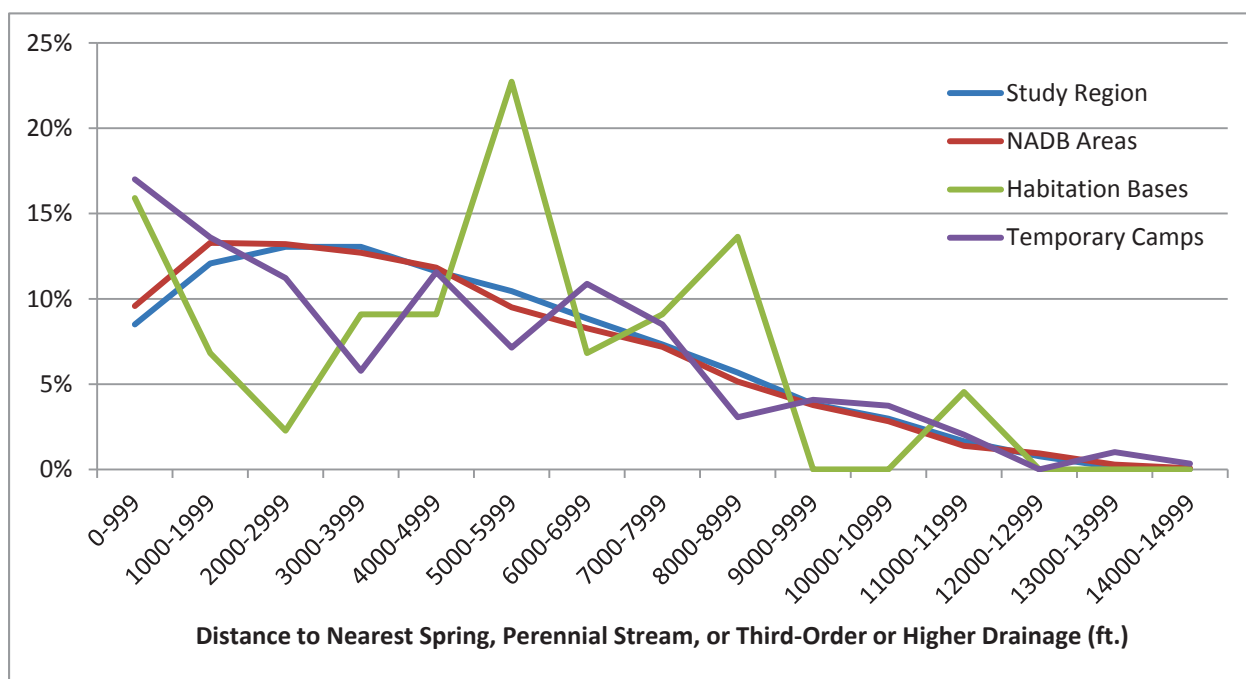


Figure 179. Relative frequencies of habitation bases and temporary camps, by distance to the nearest spring, perennial stream, or third-order or higher drainage.

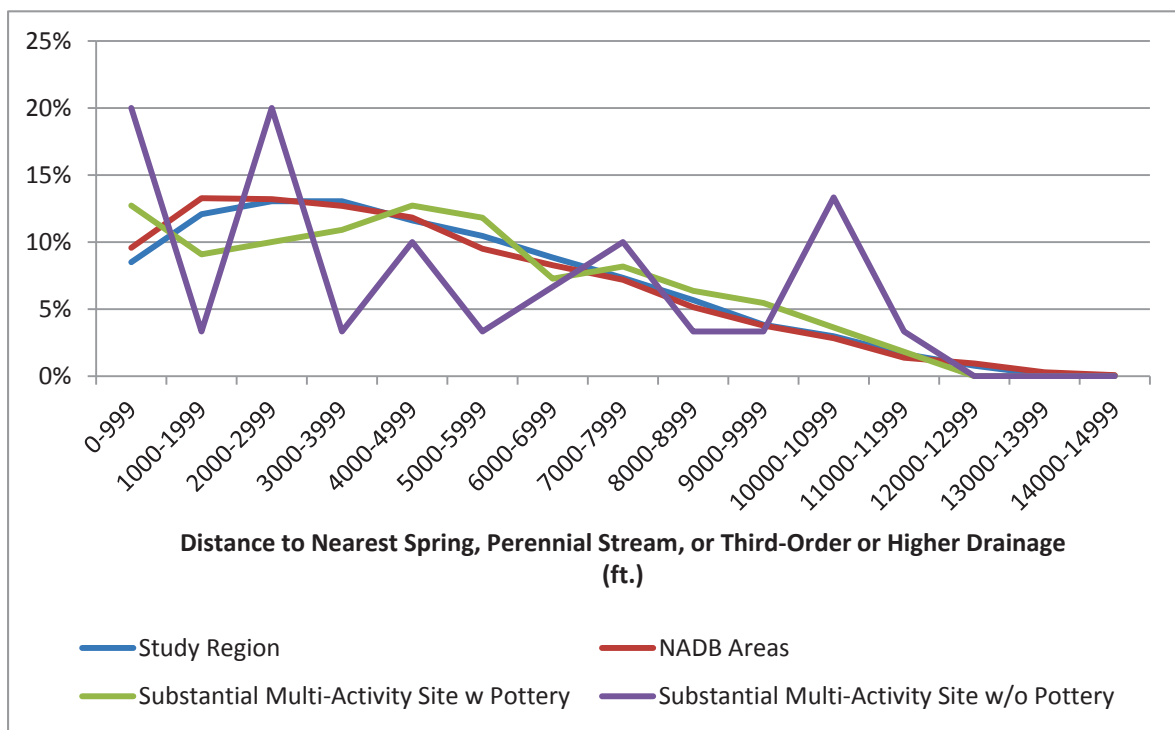


Figure 180. Relative frequencies of substantial, multi-activity sites with and without pottery, by distance to the nearest spring, perennial stream, or third-order or higher drainage.

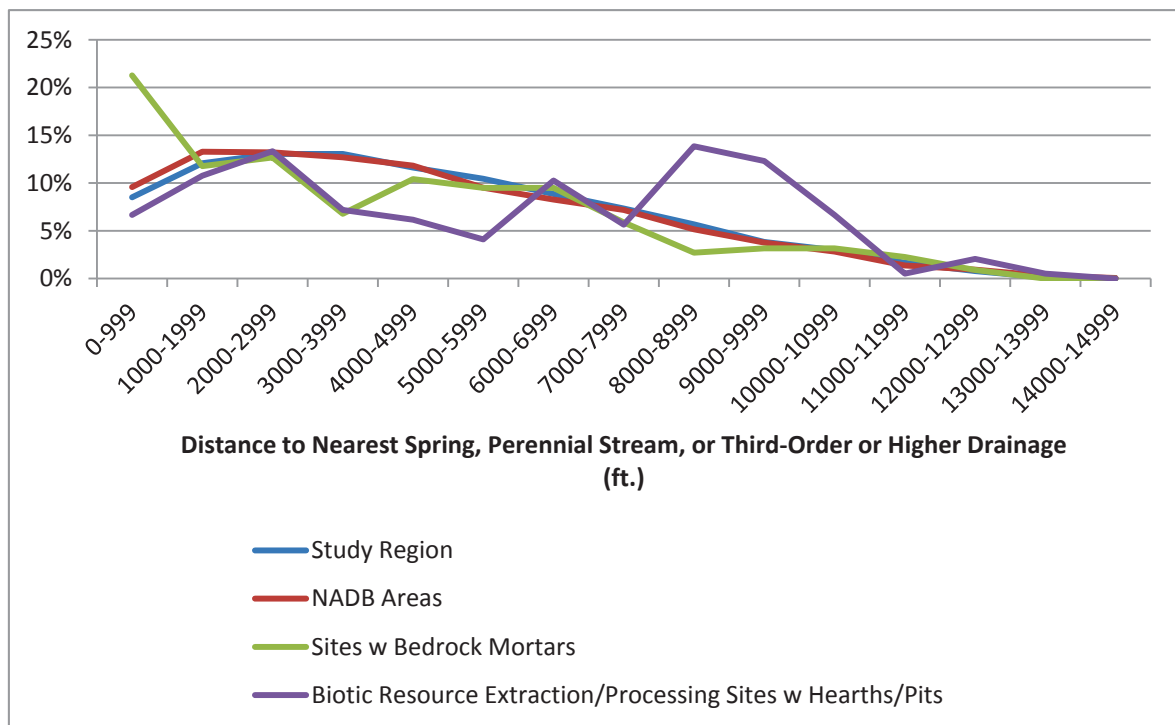


Figure 181. Relative frequencies of sites with mortars and of biotic resource extraction/processing sites with hearth/pit features, by distance to the nearest spring, perennial stream, or third-order or higher drainage.

Table 26. Frequencies of Distances to the Nearest Water Source from Cultural Resource Types and from Regional Sample Points

	Distance to Nearest Water Source *			
	< 4,284 ft.		> 4,284 ft.	
	n	%	n	%
Regional Sample Points	3,022	50.0	3,023	50.0
NADB Area Points	723	52.5	655	47.5
All Sites	636	46.7	726	53.3
Isolates	104	53.6	90	46.4
Habitation Bases	16	36.4	28	63.4
Temporary Camps	145	49.3	149	50.7
Substantial Multi-Activity Sites with Pottery	50	45.5	60	54.5
Substantial Multi-Activity Sites without Pottery	14	46.7	16	53.3
Sites with Bedrock Mortars	122	55.5	99	44.5
Biotic Resource Procurement/Extraction Sites with Hearths/Pits	76	39.0	119	61.0

*Water sources are here defined as mapped springs, perennial streams, and third-order or higher drainages.

Table 27. Fisher's Exact Tests of Differences in the Frequencies of Distances to the Nearest Water Source

	NADB Area Points	All Sites	Isolates	Habitation Bases	Temporary Camps	Substantial Multi-Activity Sites with Pottery	Substantial Multi-Activity Sites without Pottery	Sites with Bedrock Mortars	Biotic Resource Extraction/Processing Sites with Hearths/Pits
Regional Sample Points	0.1006	0.0286	0.3433	0.0950	0.8579	0.3867	0.8552	0.1323	0.0059
NADB Area Points		0.0025	0.8179	0.0454	0.3354	0.1659	0.5821	0.4685	0.0004
All Sites			0.0772	0.2191	0.4397	0.8428	1.0000	0.0202	0.0458
Isolates				0.0455	0.3569	0.1900	0.5571	0.7676	0.0044
Habitation Bases					0.1447	0.3685	0.4709	0.0310	0.8641
Temporary Camps						0.5041	0.8492	0.2123	0.0262
Substantial Multi-Activity Sites with Pottery							1.0000	0.1029	0.2783
Substantial Multi-Activity Sites without Pottery								0.4369	0.4307
Sites with Bedrock Mortars									0.0012

Bold numbers indicate statistically significant differences (with less than 0.0500 probability of the differences being random).

The following observations may be offered concerning the significance of proximity to possible water sources in the selection of locations for prehistoric activity. Several categories of cultural resources occur more frequently within 1,000 ft. of the mapped possible water sources than would be expected from random distributions within the study region. However, these represent only small proportions of those resources: for instance, 12.0 percent of all sites, and 15.9 percent of habitation bases.

Perhaps surprisingly, the majority of sites belonging to several categories, including all sites, habitation bases, and substantial multi-activity sites, are located at distances greater than the region's median distance from possible water sources. However, those differences are not confirmed as statistically significant.

Sites containing bedrock mortars tend to be located closer than the median distance from possible water sources. They are statistically closer than is true for sites in general or for habitation bases (which may also contain mortars). This tends to support the common supposition that mortars were used in resource processing that required the availability of water, such as leaching tannic acid from acorn meal.

Biotic resource extraction/processing sites that contain hearths/pits are significantly more frequently located at greater distances from water sources. This likely reflects the distance of the region's agave-growing areas from water sources and the minimal importance of available water for this particular type of activity.

Biota

Differences in the availability of particular biological resources must have done much to shape the character of archaeological landscapes. Faunal resources were an important part of this picture, but the ranges of animal species tended to be broad, and quantitative information on their relative frequencies that might be indicative of prehistoric conditions is not readily available. Vegetation resources were at least equally important prehistorically, their modern distributions have been more thoroughly mapped, and their distributions may, to some degree, serve as proxies for faunal resources as well.

Figure 182 charts the relative frequencies of all archaeological sites against the frequencies of the major habitats within the study region as a whole and in NADB areas. The most notable feature in this distribution is that sites tend to be substantially overrepresented in Upper Sonoran Desert habitat.

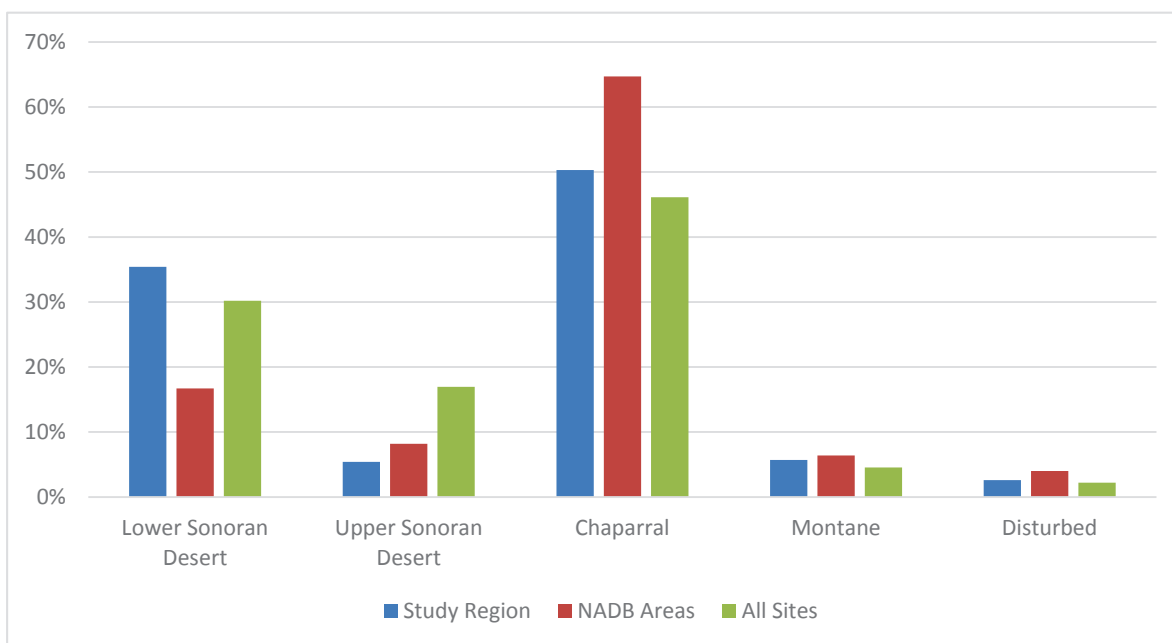


Figure 182. Relative frequencies of sites, by major biological habitats.

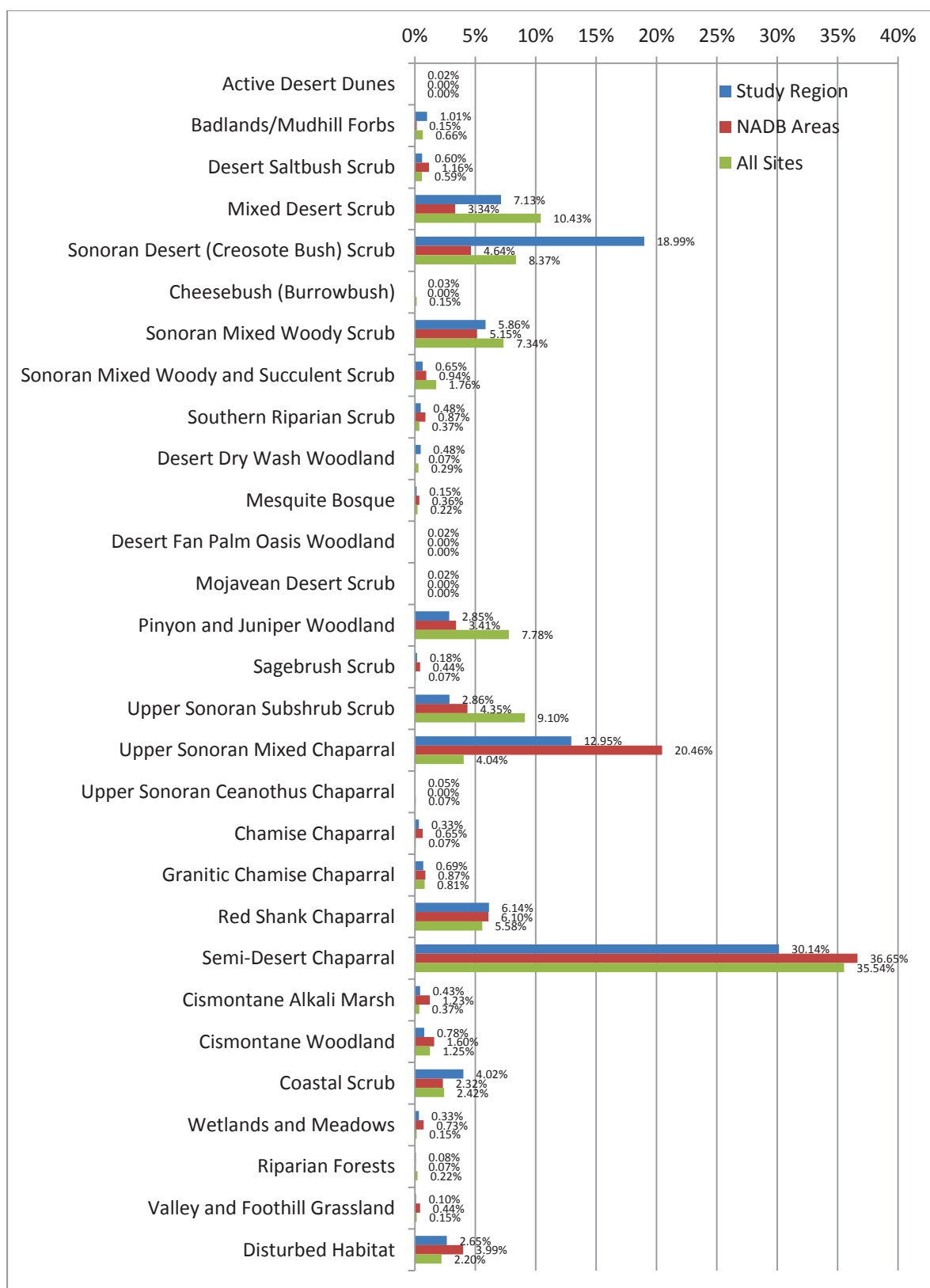


Figure 183. Relative frequencies of sites, by vegetation units.

Figure 183, above, compares the relative frequencies of sites within specific vegetation units. Sites are overrepresented in areas of Pinyon-Juniper Woodland and Upper Sonoran Subshrub Scrub, and to a lesser degree in areas of Mixed Desert Scrub and Sonoran Mixed Woody Scrub. They are substantially underrepresented in Upper Sonoran Mixed Chaparral.

One general prediction has been that sites would be found at relatively low frequencies in areas of Sagebrush Scrub and in all chaparral habitat. While this expectation holds true for Upper Sonoran Mixed Chaparral, it was not found to be the case for the predominant chaparral unit in this region, Semi-Desert Chaparral. In sum, sites were found to be less frequent in chaparral/sagebrush areas to a statistically significant degree (Tables 28 and 29). More specific associations between vegetation units and particular site types and attributes are discussed below.

Table 28. Frequencies of Chaparral and Sagebrush Locations for All Sites and Isolates and for Regional Sample Points

	Vegetation Units			
	Chaparral, Sagebrush		Other	
	n	%	n	%
Regional Sample Points	3,052	50.5	2,993	49.5
NADB Area Points	898	65.2	480	34.8
All Sites	629	45.6	733	54.4
Isolates	131	67.5	63	32.5

Table 29. Fisher's Exact Tests of Differences in Frequencies of Sites and Isolates in Chaparral and Sagebrush Areas and in Other Areas

	NADB Area Points	All Sites	Isolates
Regional Sample Points	<0.0001	0.0044	<0.0001
NADB Area Points		<0.0001	0.5725
All Sites			<0.0001

Bold number indicates a statistically significant difference (with less than 0.0500 probability of the difference being random).

Site Densities and Proximity

Another aspect of prehistoric settlement patterns within regional archaeological landscapes concerns the density and clustering of sites, and in particular multi-functional occupation sites such as habitation bases and temporary camps. On the one hand, if it could be assumed that all habitation sites were in use simultaneously, a high density of such sites might be interpreted as indicative of a high prehistoric population density within the region. However, such an assumption of simultaneous use would need to be invoked very cautiously. An alternative explanation for high site density might be that favored occupation locations shifted frequently from season to season and from year to year.

A total of 44 habitation bases and 294 temporary camps have been recorded within the study region's area of approximately 544 km². This amounts to a mean density of one habitation base per 12.36 km², one temporary camp per 1.85 km², or one habitation site per 1.61 km². Within NADB areas, which amount to 123 km², the corresponding statistics are 35 habitation bases and 204 temporary camps, one habitation base per 3.51 km², one temporary camp per 0.60 km², and one habitation site per 0.51 km².

Another measurement of the proliferation of habitation sites is based on the distances between habitation sites. Table 30 summarizes the mean distances between these categories. The distances expressed in these figures may be slightly high, because they do not allow for edge effects, in which the nearest habitation site may lie outside of the study region's boundaries. However, by inspection of the mapped site locations, this bias seems unlikely to be large. The observed spacing is on the order of 0.2-0.3 km.

Table 30. Mean Distances from Habitation Sites to the Nearest Habitation Site

	Distance (ft.) to Nearest		
	Habitation Base	Temporary Camp	Either Habitation Base or Temporary Camp
<i>Sites within Study Region</i>			
Habitation Bases	2,938	940	779
Temporary Camps	3,793	1,087	920
<i>Sites within NADB Areas</i>			
Habitation Bases	2,801	861	709
Temporary Camps	3,363	871	696

The dispersion of contemporaneous habitation sites that would be expected in this region is not known. In the absence of more local specific information, it may be instructive to consider Binford's (1982) generalized figure of 10 km as a foraging radius, or a habitation site's hexagonal catchment area of 520 km². Using an excessively idealized model, one might expect to find only a single habitation site in the study region, or perhaps two – one located in the upper McCain Valley, and a second in Jacumba Valley. By this reckoning, the observed frequency of 1.61 km² per habitation site in the study region represents a proliferation of more than 300 times the potential minimum density of such sites. The theoretically proposed spacing between habitation sites of about 20 km (about 65,600 ft.) is 80 times the observed mean spacing of only about 250 m.

Some of the proliferation of habitation sites within the region may be explicable in terms of an imposition of smaller occupation catchments by the rugged terrain of the eastern margin of the Peninsular Range. However, most of the proliferation likely reflects a strong tendency on the part of the prehistoric inhabitants to occupy different site locations within a given catchment through time. It suggests that the prehistoric landscape was not understood as consisting of a fixed set of ideal occupation locations, but rather as a fluid set of potentially suitable locations. The choice that was made among such locations on any given occasion would have varied according to such factors as seasonal differences in the availability of targeted resources, the temporary local exhaustion of resources through intensive exploitation, changes in resource potential through such factors as vegetation community succession after fires and due to climatic change, the evolution in the available technologies for resource procurement and processing, relocation to get away from proliferating pests, and possibly ideologically motivated avoidance of some recently occupied sites, for instance after the death of a community member.

RESEARCH DOMAIN – MOBILITY AND EXCHANGE

Prehistoric travel and intercommunity exchange are attested by artifacts and materials that did not occur naturally in the vicinity of the archaeological sites at which they have been found. It is rarely possible to determine specifically whether such items were moved through mechanisms of exchange, or whether they were directly extracted or produced by the individuals who subsequently discarded them at the site. In the latter case, it is generally also unknown whether the individual who carried the item was living primarily within the local region of the site but had visited the distant source area, or whether he or she was a visitor to this region who lived in the source area. Ethnographic evidence suggests that all of these patterns of human and material movement and exchange may have been involved prehistorically, to varying degrees.

Lithic Materials

Nonlocal lithic materials provide the most abundant evidence of mobility and exchange. Some materials were moved over relatively short distances within the study region, while others traveled across substantial distances to reach the study region from outside. Possible and confirmed sources of lithic resources have been discussed above.

Obsidian is the lithic material exotic to the study region that has been most widely and reliably reported in archaeological contexts, and for which the source areas are best documented. As indicated above in Table 31, obsidian was reported in the records for 99 sites in the region (7.3 percent of all sites). At the majority of these sites, either from 1 to 25 pieces were reported ($n = 38$) or else quantification was not provided ($n = 33$). However, 22 sites were reported as containing 26 to 200 obsidian specimens, and six sites were reported as containing more than 200 specimens. These numbers suggest that some of the sites in the study region contained substantially more obsidian than has typically been found at sites in western San Diego County (cf. Laylander and Christenson 1988).

The association of obsidian with pottery may provide some clues as to changes in the use of this lithic material during the course of prehistory. Among the sites containing obsidian, pottery was reported as also present at 93 sites (93.9 percent), whereas pottery was present at only 62.9 percent of all sites that reported lithic wastes. Table 31 demonstrates a statistically significant positive association between the presence of obsidian and the presence of pottery at substantial, multi-activity sites (Fisher's exact test value of 0.0124). These patterns add some further support to the general observation that obsidian use in southern California was substantially more common during the late prehistoric period than it had been during earlier periods.

Table 31. Presence of Obsidian at Substantial, Multi-Activity Sites with and without Pottery

	Substantial, Multi-Activity Sites			
	Obsidian Reported		Obsidian Not Reported	
	n	%	n	%
Pottery Reported	36	32.7	74	67.3
Pottery Not Reported	3	10.0	27	90.0

Table 32 summarizes the frequency of the presence of obsidian by site type. As expected, most of the sites having obsidian (75.8 percent) have been classified as habitation bases or temporary camps. It is interesting that three of the sites classified as spiritual/ceremonial sites contained obsidian; all three of those sites also contained human cremations.

Table 32. Frequencies of Sites with Obsidian, by Site Type

	Sites with Obsidian		Sites without Obsidian	
	Count	Percent	Count	Percent
All Sites	99	7.3	1,263	92.7
Habitation Bases	24	54.5	20	45.5
Temporary Camps	51	17.3	243	82.7
Biotic Resource Extraction/Processing Sites	5	1.3	369	98.7
Lithic Quarries and/or Workshops	--	--	54	100.0
Spiritual/Ceremonial Sites	3	14.3	18	85.7
Trails	--	--	11	100.0
Cleared Circle/Rock Ring Sites	--	--	6	100.0
Artifact Scatters	16	3.2	478	96.8
Pot Drops	--	--	53	100.0
Other	--	--	9	100.0

The obsidian at the sites in the study region is presumed to have come primarily, although not exclusively, from the Obsidian Butte source, located to the northeast of the region, on the southeastern margin of the present Salton Sea. The characteristics of the east/west movement of obsidian may be addressed by comparing the frequency of obsidian at sites nearer than or farther than the median distance from that source (68.9 km), according to straight-line distances (Table 33). Contrary to what might be expected, the data indicate a weak tendency for obsidian to be more common at more distant than at closer sites. That tendency is very weak and statistically inconclusive; the Fisher's exact test values for all sites and for habitation bases and temporary camps are 0.8350 and 0.7936, respectively.

Table 33. Frequency of Obsidian at Sites Located nearer and farther than the Median Distance from Obsidian Butte (68.9 km)

		Sites nearer than 68.9 km		Sites farther than 68.9 km	
		n	%	n	%
All Sites	with Obsidian	49	7.1	50	7.5
	without Obsidian	642	92.9	621	92.5
Habitation Base / Temporary Camp Sites	with Obsidian	39	23.1	36	25.9
	without Obsidian	130	76.9	133	74.1

A progressive decrease in the frequency of obsidian at sites more distant from the source would be expected if obsidian had been transferred through a geographically small-scale, down-the-line exchange system. For instance, such a system might have involved the trading of obsidian from a social group living near the Obsidian Butte source to a group in the Ocotillo area, then to a group in the Jacumba area, and then to a

group in the McCain Valley area. Under such a system, obsidian would be likely to occur substantially more frequently at the nearer sites that were located at stages closer to the quarry.

The actual pattern that is observed here agrees with a previous investigation that found higher proportions of obsidian within debitage assemblages at sites in the Peninsular Range than at sites located either in the eastern desert or in the western foothill and coastal areas of San Diego County (Laylander and Christenson 1988). In that study, it was suggested that the mountain uplands had been areas where fall-season interactions took place between eastern-based and western-based groups, with the eastern groups bringing obsidian to the upland areas for purposes of intercommunity exchange.

Pottery

Pottery offers another form of evidence for the investigation of prehistoric patterns of mobility and exchange. Although detailed pottery types have been proposed as being diagnostic of geographically limited areas of manufacture (e.g., May 1978, 2001; Waters 1982), most of the type definitions and their geographical implications have not yet been subjected to serious empirical testing. In any case, the specific types have not been widely reported in archaeological site records. More applicable to the site record data that were used to create the present GIS is a more basic distinction between brown ware and buff ware. Brown ware, which was produced from residual clays, may have been both manufactured locally within the study region and imported from elsewhere in the Peninsular Range and in several surrounding regions. However, buff ware, which was produced from sedimentary clays, is believed to have come into this region only from the Lake Cahuilla, Colorado River, and delta regions to the east, and therefore to represent a reliable indicator of interregional exchange or travel.

As noted in Table 30, out of 713 records for sites recorded as containing pottery, 403 report information concerning the wares that are represented. (It seems likely that only brown ware was observed at a high proportion of the sites for which the site record does not specify the ware, inasmuch as brown ware would have been the expected ware in this region and therefore would have been less likely to have been considered to merit specific comment.) Forty-seven of the site records report only buff ware, and 146 report both brown ware and buff ware.

Table 34 indicates the frequency of sites with buff ware, by site type. Buff ware is significantly more common at habitation bases and temporary camps than at other site types (Fisher's exact test value of <0.0001). However, this may be a reflection of the larger artifact assemblages that were present and the more intensive investigations that were conducted at those sites. Table 35 confirms that the presence of buff ware is strongly correlated with the presence of higher total sherd counts (Fisher's exact test value of <0.0001).

Table 34. Frequencies of Buff Ware at Sites Containing Pottery, by Site Type

	Buff Ware Present		Buff Ware Absent	
	n	%	n	%
All Sites	193	47.9	210	52.1
Habitation Bases	19	86.4	3	14.6
Temporary Camps	81	65.9	42	34.1
Biotic Resource Extraction/Processing Sites	15	29.4	36	70.6
Lithic Quarries and/or Workshops	2	100.0	--	--

	Buff Ware Present		Buff Ware Absent	
	n	%	n	%
Spiritual/Ceremonial Sites	3	60.0	2	40.0
Trails	5	83.3	1	16.7
Artifact Scatters	59	39.1	92	60.9
Pot Drops	9	20.9	34	79.1

Table 35. Frequencies of Brown Ware and Buff Ware, by Sherd Counts and Site Types

	Buff Ware Present		Buff Ware Absent	
	n	%	n	%
1-25 Sherds Reported Present				
All Sites	27	26.0	77	74.0
Habitation Bases	--	--	--	--
Temporary Camps	7	33.3	14	66.7
>25 Sherds Reported Present				
All Sites	96	51.3	91	48.7
Habitation Bases	15	93.8	1	6.2
Temporary Camps	39	72.2	15	28.8

As in the case of obsidian, it may be useful to look at the association of buff ware with site elevation, using elevation as a measure of distance from the probable origins of the buff ware pottery in the lower Colorado Desert to the east of the study region. Table 36 summarizes the frequencies of sites with and without buff ware at elevations below and above the regional median (3,329 ft.). Buff ware is found to be more common in lower-elevation sites. This pattern is statistically significant for all sites (Fisher's exact test value of <0.0001) and for artifact scatters (Fisher's exact test value of 0.0044) but not quite significant for habitation bases and temporary camps (Fisher's exact test value of 0.0709). The pattern could be interpreted either as reflecting only limited exchange occurring between upland-based groups and lowland-based groups or as indicating that potsherds were more frequently discarded closer to the areas of their original production. The possibility should also be considered that if a bimodal settlement pattern was being practiced, the same potters might have produced Lower Colorado Buff Ware and Salton Brown Ware while residing in the lowlands during the winter and Tizon Brown Ware while residing in the uplands during the remainder of the year. Such a pattern might more obvious at higher elevations than the project area, however.

Table 36. Relative Frequency of Buff Ware at Ceramic Sites below and above the Region's Median Elevation (3,329 ft.)

	Buff Ware Present		Buff Ware Absent	
	n	%	n	%
All Sites				
Sites below 3,329 ft.	107	58.8	75	41.2
Sites above 3,329 ft.	86	38.9	135	61.1
Habitation Bases / Temporary Camps				
Sites below 3,329 ft.	51	77.3	15	22.7
Sites above 3,329 ft.	49	62.0	30	38.0
Artifact Scatters				
Sites below 3,329 ft.	34	52.3	31	47.7
Sites above 3,329 ft.	25	29.1	61	70.9
Pot Drops				
Sites below 3,329 ft.	5	27.8	13	72.2
Sites above 3,329 ft.	9	30.0	21	70.0

Marine Shell

Marine shell is another material that is exotic to the Jacumba/McCain Valley region. Shell is reported from 28 sites and isolates (Table 37). It is possible that some freshwater shell may have been included in these reports, although there are no specific indications that such is the case. It is also possible that fossil shell might have been counted, although again there are no specific suggestion of that. The region's bedrock formations do not include marine sedimentary rock, and the areas of the 28 sites and isolates with shell are all underlain by either granitic rock (n = 23), metamorphic rock (n = 2), or Quaternary alluvium (n = 3). The great majority of reported invertebrate faunal remains at the region's sites likely represent marine shell that was brought either from the Pacific Coast or from the Gulf of California.

Table 37. Invertebrate Faunal Remains Reported on Site and Isolate Records for the Study Region

Site	Reported Taxon	Site	Reported Taxon
IMP-207	Not specified	SDI-3997	Not specified
IMP-271	Scallop [Pectinidae]	SDI-4009	<i>Pecten</i>
IMP-433	Oyster [<i>Ostrea</i>]	SDI-4138	Abalone [<i>Haliotis</i>]
IMP-804	Scallop [Pectinidae]	SDI-4296	Not specified
IMP-1061	Scallops [Pectinidae]	SDI-6770	Not specified
IMP-1191	Not specified	SDI-8388	Not specified
IMP-4724	<i>Laevicardium elatum</i>	SDI-9314	Not specified
IMP-4730	Not specified	SDI-9330	Not specified

Site	Reported Taxon	Site	Reported Taxon
IMP-4737	<i>Olivella biplicata</i>	SDI-11689	Not specified
IMP-4943	Not specified	SDI-13670	Not specified
IMP-10852	Abalone [<i>Haliotis</i>]	SDI-15640	Not specified
IMP-10879	Not specified	SDI-15642	Bivalve
SDI-2702	Not specified	SDI-18024	Clam (Pismo?) [<i>Tivela stultorum</i>]
SDI-3992	<i>Chione</i>	SDI-19892	Not specified

Olivella biplicata, *Haliotis*, and *Tivela stultorum* are Pacific Coast taxa.

Specific taxa were not reported for the majority of the shell. Taxa that were reported include scallops, oysters, abalone, Pismo clam, *Laevicardium elatum* cockle, *Olivella biplicata*, and *Chione* clam. Three of these taxa are confined to the Pacific Coast, while the remaining four might have come from either the Pacific Coast or the Gulf of California.

In most cases, and perhaps in all cases, the amount of shell observed at the sites appears to have been too small to have represented a substantial dietary contribution. At three sites (IMP-4943, SDI-8388, and SDI-11,689), shell beads were recorded. *Olivella biplicata* likely represented a potential bead material, and abalone and *Laevicardium elatum* may also have been collected for use in ornaments. Other types of shell might have been used for tools. However, no evidence for bead, ornament, or shell tool manufacturing or use was reported at any of the sites. The shell was recorded at habitation bases (n = 4), temporary camps (n = 18), a biotic resource extraction/processing site, spiritual/ceremonial sites (n = 2), artifact scatters (n = 2), and an isolate. All three sites with shell beads were classified as temporary camps.

If most of the shell was reaching the study region from the Pacific Coast, it might be expected that sites with shell would occur most frequently at sites farther to the west, less than the median distance of 89.6 km from San Diego Bay. As Table 38 shows, the opposite is the case. Locations with shell tend to occur more frequently at sites farther from the bay than is the case for all sites and for habitation bases and temporary camps (Fisher's exact test values of 0.0617 and 0.0180, respectively; the first is not significant, while the second is significant). Accordingly, sites with shell also show a slight tendency to be closer to the Gulf of California than all sites and than habitation bases and temporary camps (Fisher's exact test values of 0.5378 and 0.0536, respectively, neither of which is significant). The reasons for this patterning are uncertain. One possibility is that the Gulf of California was a more important source of shell than was suggested by the identified and source-exclusive species.

Table 38. Frequency of Sites with Shell, by Distances from San Diego Bay and the Gulf of California

	Distance to San Diego Bay				Distance to Gulf of California			
	< 87.2 km		> 87.2 km		< 176.0 km		> 176.0 km	
	n	%	n	%	n	%	n	%
All Sites	671	50.1	667	49.9	683	50.1	679	49.9
Habitation Bases / Temporary Camps	189	55.9	149	44.1	128	37.9	210	62.1
Sites with Shell	7	29.2	17	70.8	14	58.3	10	41.7

RESEARCH DOMAIN – RESOURCE USE AND TECHNOLOGY

Much of the regional archaeological record consists of evidence that directly concerns resource use and technology within prehistoric landscapes. This evidence takes the forms of material residues from the resources that were being exploited, features and tools that were used to procure and process the resources, and locations that were chosen specifically for those activities. The archaeological signature of one critical resource – water – has been discussed in a previous section. The present section focuses on faunal, floral, and lithic resources within the regional prehistoric landscape, and the strategies for their exploitation that are manifested in the archaeological record.

Evidence Concerning Biological Resource Use

Several forms of archaeological evidence may betray the prehistoric exploitation of particular biological resources. These include discarded remains from the resources, their minute residues on the tools that were used to process them, particular types of features and artifacts that may be diagnostic of specific uses, and suggestive spatial associations between the features and artifacts and the natural occurrences of the resources that they likely targeted.

Faunal Remains

Substantial archaeological evidence of faunal and floral remains and residues has generally been acquired through intensive investigations at individual sites, rather than in the surveys documented in site records and incorporated into the a regional GIS. Nonetheless, some region-wide information on this topic is available for the Jacumba/McCain Valley study region.

Invertebrate faunal remains (marine shell) have been discussed above as an exotic resource. Although interesting as a manifestation of interregional mobility and/or exchange, the sparse remains do not suggest that shellfish were used locally as a major resource for food, tools, or ornaments.

Vertebrate faunal remains (non-human bone) were reported at 73 sites (5.4 percent of all sites). The frequencies of sites that were reported as containing bone are summarized by site type in Table 39. As would be expected, evidence for the processing and consumption of faunal resources is concentrated primarily, but not exclusively, at habitation bases and temporary camps. These habitation sites account for 79.5 percent of the sites reporting vertebrate faunal remains, and all of the sites reporting more than 25 specimens of faunal bone.

Table 39. Sites with Vertebrate Faunal Remains, by Site Type

	Sites with No. of Specimens				% of Sites with Vertebrate Faunal Remains
	1-25	26-200	Not Quantified	Total	
All Sites	34	5	34	73	5.4
Habitation Base	6	2	9	17	38.6
Temporary Camp	18	3	20	41	13.9
Biotic Resource Extraction/Processing Site	3	--	1	4	1.1
Spiritual/Ceremonial Site	1	--	--	1	5.0
Artifact Scatter	6	--	4		2.0

Table 40 summarizes the presence of vertebrate faunal remains at all sites and at habitation bases and temporary camps located above and below the region's median elevation of 3,329 ft. The higher proportion of habitation sites with faunal bone in lower-elevation habitation sites is confirmed as statistically significant (Fisher's exact test value of 0.0276), but the patterning for all sites falls slightly short of statistical significance (0.0855).

Table 40. Sites with Vertebrate Faunal Remains, by Elevation below and above the Regional Median Elevation (3,329 ft.)

	Sites below 3,329 ft.		Sites above 3,329 ft.	
	n	%	n	%
All Sites				
With Vertebrate Faunal Remains	51	6.3	22	4.0
Without Vertebrate Faunal Remains	765	93.8	524	96.0
Habitation Bases / Temporary Camps				
With Vertebrate Faunal Remains	42	21.0	16	11.6
Without Vertebrate Faunal Remains	158	79.0	122	88.4

Floral Remains

In the GIS, floral remains (exclusive of "spirit sticks," which are discussed below under the topic of ideology) were reported at 58 sites. For all but one site, those remains were limited to charcoal, representing the consumption of wood as a fuel. The single exception was site IMP-442, where the presence of seeds was also recorded. No specific sources of the wood represented by charcoal were recorded in these records. Site types with reported charcoal included habitation bases (n = 3), temporary camps (n = 12), biotic resource extraction/processing sites (n = 42), and a single lithic quarry/workshop site. Information on the presence of charcoal was, to a substantial extent, redundant with information on the presence of hearth/pit features. All of the sites reporting hearth/pit features also reported charcoal, while 79.3 percent of the sites reporting charcoal also contained hearth/pit features.

Task-diagnostic Artifacts and Features, and Spatial Associations with Particular Resource Areas

Faunal resource procurement can be specifically related to a single class of features, if those features have been correctly identified: hunting blinds. Four sites with hunting blinds have been reported in the study region: ECO-IC-20, IMP-346, IMP-782, and SDI-20,790. All of the sites are located in fairly low-elevation areas, between 1,869 and 3,500 ft. above mean sea level. All are situated on moderate to steep slopes, between 29° and 68°. None have any associated pottery, lithic tools, or faunal remains, and only one contains a single piece of lithic debitage.

Biotic resource processing features are somewhat more ambiguous as to their functions. Hearth/pit features served a variety of functions prehistorically, notably including cooking and the provision of light and personal warmth, as well as, perhaps less commonly, such tasks as firing pottery, heat-treating rock for flaking, and assisting in the preparation of other classes of artifacts.

One specific function for hearth/pit features is suggested by the ethnographic record as having been particularly important in this region: the pit-roasting of agave hearts (Castetter et al. 1938). Two factors may help in distinguishing features that were used for this function from hearths and pits used for other purposes: a scarcity of associated artifacts, and the occurrence of the features in modern vegetation units within which agave is a prominent constituent.

A total of 249 sites have been reported as containing hearths/pits. Of these, 195 have been typed as being biotic resource extraction/processing sites. Excluding sites that also contain milling features ($n = 22$) and/or more than 25 pieces of flaked lithic wastes ($n = 20$), there remains a residue of 157 sites with hearths or pits. These sites may be hypothesized as likely including a large proportion of agave roasting sites.

Table 41 summarizes the frequency of the selected hearth/pit sites by vegetation units. Units in which the frequencies of hearth/pit sites are greater than expected include mixed desert scrub, Sonoran Desert (creosote bush scrub), upper Sonoran subshrub scrub, Sonoran mixed woody scrub, and pinyon and juniper woodland. Agave is a notable constituent in all of these units except creosote bush scrub and, in most cases, pinyon/juniper woodland.

Several possible explanations may be offered to account for the anomalous frequencies of features in vegetation units not characterized by agave. The imprecise mapping of vegetation units may not adequately describe patterns of agave extending into ecotones between creosote or pinyon/juniper communities characterized by agave. Prehistoric or historic climate change may mean that the modern vegetation zones differ significantly from those present in the prehistoric past. It is possible that prehistoric intensification may have eliminated agave stands in some areas. Agave may have been transported into non-agave vegetation communities to take advantage of locally available fuel sources. A final explanation, which is likely true at least in some of the anomalous cases, is that other resources such as annulin-rich desert lilies, or cacti, or pinyon nuts, rather than agave, were being cooked in the pit features.

Table 41. Percentages of Selected Hearth/Pit Sites and Other Locations, by Vegetation Units

	Selected Hearth/Pit Sites* (n = 157)	All Sites (n = 1,362)	Regional Sample Points	NADB Areas
Mixed Desert Scrub	22.3	10.4	7.1	3.3
Sonoran Desert (Creosote Bush) Scrub	19.8	8.4	19.0	4.6
Upper Sonoran Subshrub Scrub	17.2	9.1	2.9	4.4
Semi-Desert Chaparral	14.0	35.5	40.1	36.7
Sonoran Mixed Woody Scrub	12.7	7.3	5.9	5.2
Pinyon and Juniper Woodland	10.2	7.8	2.9	3.4
Coastal Scrub	2.6	2.4	4.0	2.3
Sonoran Mixed Woody and Succulent Scrub	0.6	1.8	0.7	0.9
Disturbed Habitat	0.6	2.0	2.7	4.0

*Biotic resource extraction/processing sites with hearth/pit features, excluding sites with bedrock milling features or more than 25 pieces of lithic waste.

Bedrock milling features and portable ground stone tools represent another class of remains that likely had multiple functions. According to ethnographic evidence, these uses included preparing medicines, pulverizing small animal remains for consumption, and grinding pigments and pottery clay. However, the

primary function of milling features and tools is believed to have been the processing of plant foods, including in particular acorns, pine nuts, and a variety of small seeds. Accordingly, milling features and tools would be expected to occur more frequently in areas that had close access to preferred plant resources of these sorts. It is true that the resources that were processed with milling features and tools were not necessarily acquired in the immediate vicinity of the sites where the processing occurred. However, it would be reasonable to expect that sites involving milling would be disproportionately common within the vegetation units containing such resources.

Table 42 summarizes the percentages of sites with milling that occur within particular vegetation units. Most sites with milling occur in the semi-desert chaparral, mixed desert scrub, and Sonoran Desert (creosote bush scrub) units. However, these are also the units that account for most of the study region's territory and for most of the sites of all types. None of the vegetation units stand out strongly as having disproportionately large percentages of sites with milling.

Table 42. Percentages of Sites with Milling Features or Artifacts, of Sites with Bedrock Mortars, and of Other Locations, by Vegetation Units

	Sites with Milling (n = 608)	Sites with Bedrock Mortars (n = 394)	All Sites (n = 1,362)	Study Region	NADB Areas
Badlands/Mudhill Forbs	0.8	1.4	0.7	1.0	0.2
Desert Saltbush Scrub	0.5	0.5	0.6	0.6	1.2
Mixed Desert Scrub	10.7	15.8	10.4	7.1	3.3
Sonoran Desert (Creosote Bush) Scrub	8.9	9.5	8.4	19.0	4.6
Cheesebush (Burrowbush)	0.2	0.5	0.1	0.0	0.0
Sonoran Mixed Woody Scrub	2.1	0.5	7.3	5.9	5.2
Sonoran Mixed Woody and Succulent Scrub	1.0	0.5	1.8	0.7	0.9
Southern Riparian Scrub	0.7	0.5	0.4	0.5	0.9
Desert Dry Wash Woodland	0.5	0.5	0.3	0.5	0.1
Mesquite Bosque	--	--	0.2	0.2	0.4
Pinyon and Juniper Woodland	5.8	3.2	7.8	2.9	3.4
Sagebrush Scrub	0.2	---	0.1	0.2	0.4
Upper Sonoran Subshrub Scrub	7.6	6.8	9.1	2.9	4.4
Upper Sonoran Mixed Chaparral	5.1	8.1	4.0	13.0	20.5
Upper Sonoran Ceanothus Chaparral	0.2	0.5	0.1	0.1	0.0
Chamise Chaparral	--	--	0.1	0.3	0.7
Granitic Chamise Chaparral	0.3	--	0.8	0.7	0.9
Red Shank Chaparral	6.3	5.4	5.6	6.1	6.1
Semi-Desert Chaparral	39.8	33.0	35.5	30.1	36.7
Cismontane Alkali Marsh	0.7	0.9	0.4	0.4	1.2
Cismontane Woodland	2.0	4.5	1.2	0.8	1.6

	Sites with Milling (n = 608)	Sites with Bedrock Mortars (n = 394)	All Sites (n = 1,362)	Study Region	NADB Areas
Coastal Scrub	3.8	3.6	2.4	4.0	2.3
Wetlands and Meadows	0.3	0.9	0.1	0.3	0.7
Riparian Forests	0.3	0.9	0.2	0.1	0.1
Valley and Foothill Grassland	0.3	0.5	0.1	0.1	0.4
Disturbed Habitat	2.1	2.3	2.2	2.7	4.0

Table 42 also presents the percentages of sites with bedrock mortars in these same vegetation units. Although mortars have multiple uses that are attested ethnographically, they have generally been considered to be strongly associated with acorn processing. Vegetation units that have disproportionately large percentages of bedrock mortars include mixed desert scrub and cismontane woodland, but these units account for only a small proportion of the recorded sites with mortars. As in the case of milling features and artifacts in general, the evidence seems to suggest that these processing activities were not strongly tied to particular resource procurement areas. In the case of mortars, the features may have been used to process acorns from more highly valued oak species, particularly black oak, that grew at higher-elevation sites to the northwest of the Jacumba/McCain Valley region.

A second test of the use of bedrock mortars for acorn processing is based on the distances of sites with mortars from relatively reliable water sources. Acorn processing had important requirements for water to leach out the bitter tannin from the ground acorn meal. The statistical evidence that shows an association between mortars and sites located relatively close to water sources has been discussed above.

Spatial Organization of Lithic Reduction Activities

Survey-level data have identified quarrying activity, but they have generally provided only limited information concerning the organization of subsequent lithic reduction activity in tool-finishing workshops or concerning areas devoted to tool maintenance and reworking.

Forty-one sites have been identified as containing lithic quarries, of which 28 have been typed as quarry/workshop sites and 13 have been assigned to other types, including habitation bases (n = 3), temporary camps (n = 4), biotic resource extraction/processing sites (n = 3), and artifact scatters (n = 3). At the 28 typed quarry/workshop sites that contain quarries, other remains that were reported in addition to lithic wastes (cores and debitage) and percussing stones (n = 8 sites) include flaked stone tools (n = 11), ground stone tools (n = 3), pottery (n = 3), bedrock milling (n = 1), hearths/pits (n = 2), and charcoal (n = 1). Although the contemporaneity of the quarry work and other activities at these sites cannot be assumed, this evidence suggests that quarry areas did not constitute rigorously segregated elements within the prehistoric landscapes.

As indicated above, the largest number of quarries are reported in areas underlain by granitic bedrock, which was a potential source of quartz from dikes (Table 43). In proportion to the representation of geologic units within the study region, quarries are substantially overrepresented in areas underlain by Miocene volcanic and sedimentary rocks, which provided a superior source of material for flaked lithic artifacts. A large majority of quarries that were classified by the form of the source rock are cobble/pebble quarries (n = 28), rather than bedrock/boulder quarries (n = 4).

Table 43. Percentages of Lithic Quarries and Workshops in Geological Settings

	Quarries (n = 41)	Workshops * (n = 204)	All Sites (n = 1,362)	Region	NADB Areas
Metamorphic Rock	9.8	7.8	7.0	17.9	4.4
Granitic Rock	48.8	65.2	75.2	72.5	80.9
Miocene Volcanic Rock	12.2	2.0	3.7	1.6	2.8
Miocene Sedimentary Rock	22.0	6.4	4.4	1.6	2.8
Older Quaternary Alluvium	2.4	2.9	1.6	1.5	1.7
Younger Quaternary Alluvium	4.9	15.7	8.1	4.9	7.3

* Defined here as sites reporting more than 25 lithic wastes but lacking quarries.

Distinguishing lithic workshops is more problematical. For purpose of this analysis, lithic workshops have been taken to include all sites reporting more than 25 lithic wastes but lacking quarries. A total of 204 sites meet these criteria. The definition evidently encompasses many sites whose primary function was something other than to serve as lithic workshops, and it excludes lithic workshops at sites that also contained quarries, but it may nonetheless be a useful category. These 204 sites with lithic workshops include sites that were typed as habitation bases (n = 19), temporary camps (n = 75), biotic resource extraction/processing sites (n = 32), lithic quarry/workshops (n = 11), a trail, and artifact scatters (n = 66).

Lithic workshops are less strongly concentrated than quarries in areas of Miocene volcanic and sedimentary rocks, and they are notably common in areas of younger Quaternary alluvium. Proximity to a geological source was evidently a less important consideration in the selection of locations for workshop activity.

RESEARCH DOMAIN – IDEOLOGY

Although much of prehistoric archaeology is concerned with evidence for utilitarian activities such as resource procurement and processing, settlement, mobility, exchange, and social organization, other important elements of the archaeological landscape relate to nonutilitarian matters. Some clues to the ideological meaning of these remains are available in the region's twentieth-century ethnographic accounts. However, as far as may be possible, these interpretations need to be tested against and elaborated through a critical evaluation of archaeological evidence.

Rock Art

Twenty-two sites in the Jacumba/McCain Valley region have been recorded as containing petroglyphs, and 35 sites contain pictographs; three of these sites have both petroglyphs and pictographs. Although the numbers of sites are small, a consideration of their geological, hydrological, and social or functional settings is of considerable interest.

Table 44 suggests some apparent patterns in rock art's geological settings that are interesting and not entirely as might have been predicted.

Table 44. Percentages of Rock Art Sites in Geological Settings

	Petroglyph Sites (n = 22)	Pictograph Sites (n = 35)	All Sites (n = 1,362)	Study Region	NADB Areas
Metamorphic Rock	--	20.0	7.0	17.9	4.4
Granitic Rock	73.9	65.7	75.2	72.5	80.9
Miocene Volcanic Rock	--	2.9	3.7	1.6	2.8
Miocene Sedimentary Rock	--	--	4.4	1.6	2.8
Older Quaternary Alluvium	--	--	1.6	1.5	1.7
Younger Quaternary Alluvium	26.1	11.4	8.1	4.9	7.3

It would be expected that the rock panels that were likely to have been favored for petroglyphs would include surfaces that were not too hard, in order to facilitate working, and that were strongly patinated, to maximize the visual distinction between natural and pecked surfaces. These factors may explain the presence of petroglyphs in areas of younger Quaternary alluvium, where rocks are often strongly patinated, and their absence in areas of metamorphic rock, which is often hard and relatively resistant to patination. Although an avoidance of Miocene volcanic rock, Miocene sedimentary rock, and older Quaternary alluvium would not have been predicted, the small sample of petroglyph sites and the small portion of the study region represented by these rock types may be sufficient to account for the anomalies. The strong although not disproportionate representation of petroglyphs in granitic areas would perhaps not have been predicted, in light of the rock's typically hard surfaces and low susceptibility to patination.

The painting of pictographs would likely have been most visually effective when it was done on panels of light-colored, hard rock, and their preservation would also have been favored by hard rock surfaces that were relatively immune to weathering. From this perspective, the comparatively weak representation of areas of granitic rock in this sample of pictograph sites seems anomalous, as does the strong representation of areas of metamorphic rock and younger quaternary alluvium.

Minor (1975) noted in passing that it had sometimes been reported that petroglyph sites were associated with springs, and indeed an association of large rock art complexes with springs, tanks, and other water sources has been well documented in the Colorado Desert. Some of the best known are White Tanks (Hedges and Haymann 1993), McCoy Springs (McCarthy 1993), and Corn Springs, as well as numerous locations along the lower Colorado and Gila rivers (Hedges 2013). Table 45 summarizes information on the spatial relationships of rock art sites to springs. No particularly strong associations are observed, apart from the associations arising as a result of the usual occurrence of rock art and cupules at habitation bases or temporary camps that have spatial associations with springs.

Table 45. Distances of Sites with Rock Art or Cupules from Mapped Springs

	No. of Sites	Mean Distance to a Spring (ft.)	% of Sites within 1,000 ft. of a Spring
Sites with Petroglyphs	23	10,793	8.7
Sites with Pictographs	35	6,326	11.4
Sites with Cupules	26	5,908	11.5
Habitation Bases / Temporary Camps	338	6,728	6.8
All Sites	1,362	7,653	3.7

Table 46 shows the frequencies of rock art sites by site type. It has sometimes been suggested that rock art would have been regarded prehistorically as a “sacred” activity. If so, the evidence suggests that sacredness did not involve any spatial separation from more mundane activities. The majority of sites with rock art (45 out of 55, or 81.8 percent) are classified as habitation bases or temporary camps. Additionally, some of the rock art sites classified as spiritual/ceremonial sites (n = 9) also contained ground stone artifacts and bedrock milling (n = 1 site), percussing stones (n = 1; notably, this is a pictograph site rather than a petroglyph site), lithic waste (n = 2), and pottery (n = 4).

Table 46. Sites with Petroglyphs and Pictographs, by Site Type

	Sites with Petroglyphs		Sites with Pictographs		All Sites	
	n	%	n	%	n	%
Habitation Bases	3	13.0	6	17.1	44	3.2
Temporary Camps	16	69.6	23	65.7	294	21.6
Biotic Resource Extraction/Processing Sites	1	4.3	--	--	374	27.5
Lithic Quarries/Workshops	--	--	--	--	54	4.0
Spiritual/Ceremonial Sites	3	13.0	6	17.1	21	1.5
Trails	--	--	--	--	11	0.8
Cleared Circle/Rock Ring Sites	--	--	--	--	6	0.5
Artifact Scatters	--	--	--	--	494	36.3
Pot Drops	--	--	--	--	53	3.9
Others	--	--	--	--	11	0.8

Cupules

The origins or functions of cupules at archaeological sites in California has long been a matter of uncertainty. Some suggestions have been based on ethnographic testimony, while others have been based on archaeological associations or, perhaps, the investigators’ pure speculations. Some of the suggested functions are utilitarian, while others are nonutilitarian. Possible utilitarian functions have included uses as anvils for cracking nuts or hulling acorns (Hedges 1980; True 1993), small mortars for preparing paint (Hedges 1980), and trail or territorial boundary markers (DuBois 1908; Patencio 1943). Alternative functions that would have been rooted in ideology include controlling the weather (Heizer 1953), catching rainwater for ritual use (Parkman 1992, 1993), helping women become pregnant (Aginsky 1939; Barrett 1952; Loeb 1926), use in puberty rites (Chace 1964; DuBois 1908; Hedges 1976), marking a death (Ewing 1948), use in hunting magic (Heizer and Baumhoff 1962; von Werlhof 1965), and use as star constellation maps (Hedges 1980).

Cupules have been reported at 26 sites in the study region. The site types involved are summarized in Table 47. The statistics suggest several patterns bearing on the function or functions of the cupules. These features are disproportionately represented at habitation bases, but are underrepresented at biotic resource extraction/processing sites. Arguing in support of their hunting magic hypothesis, Heizer and Baumhoff (1962) and von Werlhof (1965) observed that cupules in the Great Basin were associated with game trails rather than with habitation sites. Such a pattern clearly does not hold true in the present region. Similarly, the suggestions of cupules functioning as trail or boundary markers is not supported here; none of the cupule

sites contain trails, and the predominance of habitation sites and temporary camps as cupule locations makes the use of the features as territorial markers implausible.

Table 47. Frequencies of Sites Containing Cupules and Other Bedrock Milling Features, by Site Type

	Cupule Sites		Sites with Non-Cupule Bedrock Milling Features		All Sites	
	n	%	n	%	n	%
Habitation Bases	12	46.2	40	8.6	44	0.8
Temporary Camps	9	34.6	230	49.7	294	3.2
Biotic Resource Extraction/Processing Sites	3	11.5	188	40.6	374	21.6
Lithic Quarries/Workshops	--	--	1	0.2	54	27.5
Spiritual/Ceremonial Sites	2	7.7	2	0.4	21	4.0
Artifact Scatters	--	--	2	0.4	494	0.4

Table 48 compares selected site types having cupules only among their bedrock milling features, having only non-cupule bedrock milling features, and having both types of features. The figures indicate that cupules rarely occur at such sites without other milling features also being present. This pattern may add a little support to the utilitarian hypotheses concerning cupule function.

Table 48. Frequencies of Associations between Cupules and Other Bedrock Milling Features at Selected Site Types

	Only Cupules		Both Cupules and Other Bedrock Milling Features		Only Other Bedrock Milling Features	
	n	%	n	%	n	%
Habitation Bases	--	--	12	30.0	28	70.0
Temporary Camps	1	0.4	8	3.5	222	96.1
Biotic Resource Extraction/Processing Sites	1	0.5	2	1.1	186	98.4

The setting of the great majority of cupule sites in habitation bases, temporary camps, and resource extraction/procurement sites might argue for a utilitarian rather than ideological function for the features. However, as noted above, most petroglyph and pictograph sites also occur in these same utilitarian contexts, whereas in the case of rock art serving a nonutilitarian function seems to be beyond challenge.

Cupules have sometimes been considered to be a variant form of petroglyphs. If that interpretation is correct, it is unclear whether the expectation would be that cupules would tend to occur together with petroglyphs, or that their distributions would be complementary and distinct. As noted above, the distributions of petroglyphs and pictographs are largely distinct, with only three out of 55 rock art sites containing both varieties. In the case of cupules and petroglyphs, only two out of 45 sites share both kinds of features; these distributions are also found to be largely distinct. Whether the distinctness is attributable to differences in function or to complementarity is uncertain.

Pavement Clearings and Rock Alignments

In southern California, some pavement clearings and rock alignments fairly certainly served nonutilitarian, ideological functions. These include geoglyphs or intaglios, such as the Blythe geoglyphs on the Colorado River, and possibly astronomical alignment markers (but for a skeptical view of the latter, see Laylander 2007). However, these categories may also include features that were created for utilitarian purposes, for instance as “sleeping circles” and to support shelters.

Two sites with pavement clearings (SDI-1258 and SDI-6657) are documented in the Jacumba/McCain Valley GIS. (Additional archaeological site records that reported pavement clearings were excluded from the Jacumba/McCain Valley and Ocotillo GIS because the “features” were interpreted as more likely to be natural, noncultural phenomena.) Interestingly, neither of the two sites is in a geological setting of older Quaternary alluvium; SDI-1258 is in an area of Miocene volcanic rock, and SDI-6657 is in a granitic area. SDI-1258 is typed as a cleared circle/rock ring site; it was reported by Bob Begole as containing “more than 42” cleared circles, although this was likely the result of counting naturally deflated rodent burrows and vegetation clearings. SDI-6657 is typed as a temporary camp, with a single “sleeping circle.”

Rock alignments have been reported at seven sites, located in areas of granitic rock ($n = 6$) and Miocene volcanic rock ($n = 1$). The sites containing these features were typed as temporary camps ($n = 4$), a habitation base, an artifact scatter, and a site (SDI-4458) classified as “other,” with only the alignment. Slopes are variable, ranging from only 7° to as steep as 72° .

Human Burials

Human cremations were reported at 22 sites. Of the 10 sites where the number of cremations was specified, six reported a single cremation each, one reported two cremations, one reported at least three cremations, one reported four cremations, and one (a large habitation base) reported at least 13 cremations. Site types containing cremations included habitation bases ($n = 8$), temporary camps ($n = 7$), a biotic resources extraction/processing site, and spiritual/ceremonial sites (identified as such because of cremations) ($n = 6$). At the six spiritual/ceremonial sites, additional elements that were reported included ground stone tools ($n = 3$ sites), flaked stone tools ($n = 3$), percussing stones ($n = 1$), lithic wastes ($n = 4$), pottery ($n = 6$), bedrock milling ($n = 1$), roasting pits ($n = 1$), non-human bone ($n = 1$), shell ($n = 2$), and midden soil ($n = 1$). It seems clear that the disposal of cremations in the study region was not occurring in organized cemeteries, nor were cremations being separated from more utilitarian remains (cf. Laylander 2011). No areas were identified as containing the features in which the cremation burning was performed or as being caches of cremated remains. Spatially discrete cremation clusters have been documented outside of the project area, for instance in Mason Valley on the desert floor and in Cuyamaca Rancho State Park in the mountains.

Nonutilitarian Objects

A variety of special artifact types were recorded at the region’s sites. These include “spirit sticks” ($n = 18$ sites), ceramic pipe fragments ($n = 7$), ceramic figurines ($n = 4$), a possible ceramic rattle fragment ($n = 1$), a ceramic bead ($n = 1$), seed beads ($n = 1$), shell beads ($n = 3$), a shell ornament ($n = 1$), arrowshaft straighteners ($n = 4$), and a gourd rattle ($n = 1$). Pipe fragments, figurines, rattles, beads, and ornaments evidently represent nonutilitarian activities. “Spirit sticks” or “prayer sticks” are branches that have been found in rock shelters, often propped up in ways that seem to attest to human activity.

COMPARISONS WITH THE OCOTILLO REGION

The simultaneous preparation of prehistoric archaeological landscape studies of the adjacent Jacumba/McCain Valley and Ocotillo regions, using a shared GIS database, has made possible an integrated

analysis of both regions. This section considers specific topics on which the Ocotillo landscape analysis may either confirm or contrast with the findings of the Jacumba/McCain Valley analysis.

Geographical Contexts

The areas of the Jacumba/McCain Valley and Ocotillo regions are similar in size: approximately 544 and 530 km², respectively. The portions of the regions that were addressed by NADB reports are also similar, although somewhat greater in the Ocotillo region: 137 km² (25.8 percent) for the Ocotillo region, as against 123 km² (22.6 percent) for the Jacumba/McCain Valley region.

As a consequence of the way in which the two regions were defined, they differ markedly in elevations. In the Jacumba/McCain Valley region, the range of elevations is between 1,495 and 5,349 ft. above mean sea level, with a median elevation of 3,329 ft. In the Ocotillo region, the corresponding range is 169-2,376 ft., and the median is 720 ft. In the Jacumba/McCain Valley region, NADB areas are on average distinctly higher in elevation than the region as a whole, whereas in the Ocotillo region the NADB areas are distinctly lower.

Slopes in the Jacumba/McCain Valley region tend to be steeper than those in the Ocotillo region, as noted above. Only 14.8 percent of the former region has slopes of less than 10°, while 39.7 percent of the Ocotillo region has slopes of less than 10°. However, the biases in aspect toward the northeast are similar in the two region.

Geologically, the two regions are quite distinct. While more than 90 percent of the Jacumba/McCain Valley region is underlain by granitic and metamorphic rock, the majority of the Ocotillo region lies in areas of Quaternary alluvium.

Climatically and hydrologically, both regions are relatively arid. Summer temperatures are distinctly higher and annual rainfall is distinctly lower in the Ocotillo region. Mapped springs and reported *tinajas* are only present in the Jacumba/McCain Valley region, whereas third-order or higher drainages are more extensive in the downstream areas of the Ocotillo region.

In response to elevation and climate, in particular, different vegetation units characterize the two regions. Whereas chaparral prevails across a majority of the Jacumba/McCain Valley region, the Ocotillo region is dominated by creosote scrub.

Archaeological Site Types and Attributes

Table 49 summarizes the percentages of sites in the two regions having particular attributes. Notable contrasts are the higher frequencies of trails and of sites with cairns and other rock features in the Ocotillo region, and the lower frequencies of sites with pottery, milling features and milling artifacts, and midden.

Table 49. Relative Frequencies of Site Attributes in the Jacumba/McCain Valley and Ocotillo Regions

Attribute	Percent of Sites with Attribute	
	Jacumba/McCain Valley (n = 1,362)	Ocotillo (n = 957)
AP2 – Lithic Scatter	78.3	77.8
AP2-a – Ground Stone	27.3	13.5
AP2-b – Flaked Stone Tool	25.6	30.7
AP2-c – Percussing Stone	14.2	29.0

Attribute	Percent of Sites with Attribute	
	Jacumba/McCain Valley (n = 1,362)	Ocotillo (n = 957)
AP2-d – Lithic Waste	77.4	72.8
AP2-e – Obsidian	7.3	1.5
AP3 – Ceramic Scatter	52.3	28.6
AP4 – Bedrock Milling	36.0	4.4
AP4-a – Bedrock Mortar	16.2	1.9
AP4-b – Cupule	1.9	--
AP4-c – Other Bedrock Milling	28.9	2.9
AP5 – Petroglyph	1.7	0.5
AP6 – Pictograph	2.6	0.2
AP7 – Architectural Feature	1.4	1.3
AP8 – Cairn/Rock Feature	4.3	18.7
AP8-a – Rock Alignment	0.5	2.9
AP8-b – Cairn	2.2	8.0
AP8-c – Rock Ring	1.2	5.9
AP8-d – Pavement Clearing	0.1	7.5
AP9 – Burial	1.6	1.9
AP9-a – Inhumation	--	0.1
AP9-b – Cremation	1.6	1.8
AP10 – Cache	1.1	0.1
AP11 – Hearth/Pit	18.3	21.6
AP12 – Quarry	3.0	1.5
AP13 – Trail	2.8	11.4
AP14 – Rock Shelter/Cave	8.4	2.3
AP16 – Other	19.4	8.6
AP16-a – Vertebrate Faunal Remains	5.4	3.6
AP16-b – Invertebrate Faunal Remains	1.8	1.0
AP16-c – Floral Remains	4.3	4.8
AP16-d – Midden Soil	10.1	1.0
AP16-e – Bone Artifacts	0.5	0.4
AP16-f – Special Items	2.6	1.4

Table 50 summarizes the proportions of sites in the two regions that are assigned to various site types. Ocotillo contains notably higher percentages of lithic quarry/workshop sites, trails, and cleared circle/rock

ring sites, but notably lower proportions of habitation bases, temporary camps, and biotic resource extraction/processing sites.

Table 50. Relative Frequencies of Site Types in the Jacumba/McCain Valley and Ocotillo Regions

Site Type	Percent of Sites Assigned to Type	
	Jacumba/McCain Valley (n = 1,362)	Ocotillo (n = 957)
Habitation Base	3.2	0.5
Temporary Camp	21.6	9.9
Travel Camp	--	0.1
Biotic Resource Extraction/Processing Site	27.5	16.2
Lithic Quarry and/or Workshop	4.0	22.7
Milling Implement Quarry and/or Production Site	--	0.1
Spiritual/Ceremonial Site	1.5	3.6
Trail	0.8	6.4
Cleared Circle/Rock Ring Site	0.5	5.0
Artifact Scatter	36.3	30.1
Pot Drop	3.9	4.2
Other	0.8	1.3

A previous section identified two major problems with the site typology as a tool for analyzing the Jacumba/McCain Valley archaeological landscapes: the indefinite intergrading of site types, and the inadequacy of type assignments in representing the distribution of remains from particular activity sets of interest. These problems are equally manifested in the analysis of Ocotillo site types.

Chronology

The chronological information from available radiocarbon dating in the Jacumba/McCain Valley region, although still very limited, is much more extensive than that for the Ocotillo region. However, there is no reason at present to think that the prehistoric occupational spans in the two regions were not similar

As discussed above, an attempt was made to distinguish settlement patterns for pre-ceramic and ceramic-period sites on the basis of the presence or absence of pottery at substantial, multi-activity sites in the Jacumba/McCain Valley region. The effort was largely unsuccessful, because these two chronological categories, accounting for 30 and 110 sites, respectively, were closely similar in their other characteristics. The same was found to be true in the Ocotillo region with its smaller sample of non-ceramic (n = 20) and ceramic (n = 25) substantial, multi-activity sites.

Settlement

As noted above, elevations are generally higher in the Jacumba/McCain Valley region than in the Ocotillo region. In the former region, sites, habitation bases, and temporary camps tend to be located at lower elevations than the regional median, although less so than for the portions of the region in NADB areas. In

contrast, in the Ocotillo region, although sites in general occur at lower elevations, habitation bases and temporary camps are situated at higher elevations.

One contrast between the two regions is that sites in the Jacumba/McCain Valley region show a bias in favor of southerly aspects, while sites in the Ocotillo region show a bias in the opposite direction, away from southerly aspects. A likely explanation is that the added sunlight and heat resulting from a southerly aspect were valued in the somewhat cooler upland region but were avoided in the hot lowlands.

In the Jacumba/McCain Valley region, an unexpected but slight tendency has been noted above for sites to be located farther from possible water sources (springs, perennial creeks, or third-order or higher drainages) than were random points within the region. This pattern was not repeated in the Ocotillo region, where sites were reported as closer to possible water sources than were random points, although the absolute distances involved were greater than those in the Jacumba/McCain Valley region.

For the Ocotillo region, substantially fewer habitation bases ($n = 5$) and temporary camps ($n = 95$) are reported than in the Jacumba/McCain Valley region ($n = 44$ and 294 , respectively), although the sizes of the areas for the two regions are similar. This gives mean densities of one habitation site per 1.6 km^2 for the Jacumba/McCain Valley region and one per 5.3 km^2 for the Ocotillo region. The mean spacing between habitation sites is on the order of 0.7 km in the Jacumba/McCain Valley region and 0.4 in the Ocotillo region. Despite these differences, the generalization concerning the proliferation of habitation sites holds true for both regions.

Mobility and Exchange

Obsidian is present at fewer of the Ocotillo sites (1.5 percent) than at Jacumba/McCain Valley sites (7.3 percent), and a smaller proportion of the Ocotillo sites report substantial amounts of the material. This is the case despite the Ocotillo region's location significantly closer to the most likely source of the material at Obsidian Butte, and it reinforces the observation above, that obsidian is more frequent in the Jacumba/McCain Valley region at sites that are more distant from the material source.

As discussed above, in the Jacumba/McCain Valley region, buff ware pottery was found to be more frequent at lower-elevation sites that had pottery (1,561-3,326 ft.; 58.8 percent) as against higher-elevation sites (3,331-5,045 ft.; 38.9 percent). Within the Ocotillo region, the pattern was repeated, with 55.5 percent of lower-elevation sites (189-717 ft.) but only 47.7 percent of higher-elevation sites (724-1,432 ft.) having buff ware. However, in an interregional comparative context, these figures indicate that the decline in buff ware with elevation was not consistent. The proportion of sites with buff ware in the upper half of the Ocotillo region was lower than the proportion of buff ware in the lower half of the Jacumba/McCain Valley region.

In the Ocotillo region, as in the Jacumba/McCain Valley region, most of the marine shell taxa that were assignable to a specific coast pertained to the Pacific Coast, although one genus at an Ocotillo site, *Murex*, was particular to the Gulf of California. Two Ocotillo sites reported the freshwater mussel *Anodonta*, associated with the shores of Lake Cahuilla, which was not represented at the Jacumba/McCain Valley sites.

In both regions, sites with marine shell occur more commonly than other sites at locations farther away from San Diego Bay and closer than other sites to the Gulf of California, despite the fact that shells identifiable to a particular source more frequently came from the Pacific Ocean rather than the Gulf of California. When the two regions are grouped together, the pattern is repeated (Table 51). Sites with shell tend to be farther from San Diego Bay than all sites or habitation bases and temporary camps, and closer than those sites to the Gulf of California (Fisher's exact test values of 0.6050, 0.0019, 0.3059, and 0.0053,

respectively; values that are significant for comparisons with habitation bases and temporary camps but not for all sites).

Table 51. Frequency of Sites with Shell, by Distances from San Diego Bay and the Gulf of California

	Distance to San Diego Bay				Distance to Gulf of California			
	< 93.0 km		> 93.0 km		< 176.0 km		> 176.0 km	
	n	%	n	%	n	%	n	%
All Sites	1,159	50.0	1,159	50.0	1,153	49.7	1,165	50.3
Habitation Bases / Temporary Camps	310	70.8	128	29.2	150	34.2	288	65.8
Sites with Shell	15	44.1	19	55.9	20	58.8	14	41.2

Resource Use and Technology

Vertebrate faunal remains showed a tendency to occur more frequently at lower-elevation sites within the Jacumba/McCain Valley region, as discussed above. That tendency was found to be statistically significant with respect to habitation bases and temporary camps, but not for all sites considered together. In the Ocotillo region, such remains also tended to be more frequently present at lower-elevation sites, although not to a statistically significant degree. However, when the two regions are considered together, any patterning is even less clear, because vertebrate faunal remains were reported less frequently at Ocotillo sites (Table 52). For all sites, the pattern is reversed, with sites having faunal bone being proportionately more common at higher elevations, while the opposite is true with respect specifically to habitation bases and temporary camps. Neither of these patterns is statistically significant (Fisher's exact test values of 0.1077 and 0.5512, respectively).

Table 52. Sites with Vertebrate Faunal Remains, by Elevation below and above the Two Region's Median Elevation (1,600 ft.)

	Sites below 1,600 ft.		Sites above 1,600 ft.	
	n	%	n	%
All Sites				
With Vertebrate Faunal Remains	36	33.6	71	66.4
Without Vertebrate Faunal Remains	928	42.0	1,284	58.0
Habitation Bases / Temporary Camps				
With Vertebrate Faunal Remains	20	26.0	57	74.0
Without Vertebrate Faunal Remains	81	22.4	280	77.6

Ideology

Sites with rock art are far less common in the Ocotillo region (n = 7) than in the Jacumba/McCain Valley region (n = 57). This mirrors the fact that most rock art in both regions occurs in areas of granitic or metamorphic rock, and that those rock types are far more common in the Jacumba/McCain Valley region

(90.4 percent of the area) than in the Ocotillo region (17.6 percent). The predominance of temporary camps as locations for rock art is further supported by the Ocotillo region's evidence.

Interestingly, although 26 sites in the Jacumba/McCain Valley region reported the presence of cupules, none of the Ocotillo sites were reported to contain such features.

Ocotillo sites far more commonly contained pavement clearings ($n = 72$) and rock alignments ($n = 28$) than did Jacumba/McCain Valley sites ($n = 2$ and $n = 7$, respectively). The Ocotillo features occurred predominantly in areas of alluvium (69.4 percent of pavement clearings and 75.0 percent of rock alignments), which makes up 54.1 percent of the Ocotillo region but only 6.4 percent of the Jacumba/McCain Valley region.

Cremations occur in similar frequencies in the two regions. A single inhumation ("Yuha Man") has been reported from the Ocotillo region. No areas recognized as cremation processing areas, special cemeteries, or cremation caches have been reported in either region.

OTHER INTERREGIONAL COMPARISONS

In addition to the Ocotillo landscape analysis, which has been integrated with the present study, several previous regional studies have addressed prehistoric settlement patterns or landscapes either within or in the general vicinity of the Jacumba/McCain Valley study region. The methods and findings of those studies are briefly noted below, followed by some comparative comments.

Eastern San Diego County (Cook and Fulmer 1980)

John R. Cook and Scott G. Fulmer (1980) edited a Class II study for the BLM that addressed prehistoric cultural landscapes in the McCain Valley Study Area. That study area encompassed an extensive strip of eastern San Diego County. Fieldwork included a statistically random sample of $1/4$ -by- $1/2$ -mi. (400-by-800-m) survey transects within seven discontinuous blocks of land, including San Ysidro, San Felipe, Banner-Julian, Oriflamme, Vallecitos-Canebrake, McCain Valley, and Table Mountain. The McCain Valley and Table Mountain blocks lie within the present study region.

Sample areas were stratified within four landform categories: mountain, mountain valley, desert valley, and canyon. Associations were evaluated between archaeological sites and variables in the natural environment, including physiographic setting (flat, base of slope, canyon, knoll, and ridge), geological formation (five plutonic formations, two Quaternary alluvial formations, metasedimentary formations, and Miocene volcanics), vegetation (based on field observations of plant genera), and hydrology (distance to rank-ordered streams, springs, and seeps).

For the archaeological sites,

A series of descriptive type classes was defined based on the distribution of specific artifact components and aggregates (flaked lithics, pottery, milling), features (roasting pits, rockshelters, rock walls or circles), and artifact densities as they varied within the sample. Modifications of the existing BLM type classification system were necessary as it does not explicitly define or control for the possible range of material components occurring within each class [Cook and Fulmer 1980:53-54].

Statistical analyses addressed the observed densities of site types within the study region as a whole and within the seven blocks, the associations between artifact classes and site types, and the association of site types with variables in the natural environment. In the analysis, 22 site types were defined:

1. temporary camp (flaked lithics, pottery, milling)
2. large sherd/lithic scatter ($\geq 1,000 \text{ m}^2$)
3. small sherd/lithic scatter ($< 1,000 \text{ m}^2$)
4. large, light lithic scatter ($\geq 1,000 \text{ m}^2$)
5. small, dense lithic scatter ($< 1,000 \text{ m}^2$)
6. small, light lithic scatter ($< 1,000 \text{ m}^2$)
7. isolated chipped stone
8. ground stone (milling), sherds
9. ground stone (milling) only
10. rubs (milling) only
11. sherd scatter ($n > 10$)
12. isolated sherd ($n < 10$)
13. roasting pit with no artifacts or one artifact
14. roasting pit with rubs and/or sherds
15. rock shelter with sherds, lithics, milling (at least two of three)
16. rock shelter with sherds or lithics
17. rock shelter with ceremonial functions (pictograph, spirit stick)
18. pictograph
19. rock wall feature
20. ground stone (milling), chipped stone
21. cupules
22. rock circle feature

The frequencies of sites with particular elements were tabulated by site type. Elements included:

1. midden
2. shell
3. bone
4. core, hammer stone
5. flaked lithic tool
6. debitage
7. obsidian
8. pottery
9. buff ware
10. ground stone
11. bedrock milling
12. mortar
13. cupule
14. pictograph
15. house depression
16. Rock feature
17. Roasting pit, etc.

The analyses also evaluated the associations between site types and dimensions of their natural contexts. Those dimensions included geology, slope, landform, and vegetation. The relation of site locations to water sources was tested in various ways. In general, it was found that survey transects containing temporary camps were closer to Rank 2 or higher streams (i.e., drainages below the confluence of two or more initial streams) than transects lacking temporary camps. Considering site types, it was also found that temporary

camp and milling stations were closer to Rank 2 or higher streams, and that roasting pits were farther away from such drainages, than were the remainder of site types.

Table Mountain (May 1980, 1987)

The 1,798-acre (7.3-km²) Table Mountain Archaeological District is adjacent to Jacumba Valley, within the Jacumba/McCain Valley study region. Ronald V. May (1980, 1987) conducted archaeological surveys that documented 124 sites within the district. He analyzed the landscape associations between prehistoric site types (base camps or permanent villages, campsites, flaking stations, workshops, roasting pits, and quarries), site components (flaking station, workshop, roasting pit, quarry, pottery, cairn, milling station, rock shelter, prayer stick, rock art, and trail), and dimensions of the natural landscape, including geology (Southern California Batholith, Table Mountain Formation gravels, Jacumba Volcanics, Table Mountain Mesa, and alluvial sand) and vegetation community (agave/yucca, juniper, mesquite/cat's claw, leafy shrubs, and grass).

In conclusion, May defined three major "micro-environments" at Table Mountain with patterned associations of archaeological sites. Micro-Environment A, containing villages and campsites, was

located along colluvial fans and in alluvial collecting basins adjacent to well-watered drainages at the base of gray granite hills of the Southern California Batholith. The overall dominant vegetation is the Agave/Yucca Community. Water courses are generally very moist and lush in tall juniper, leafy shrubs, and dense grasses. Mesquite/Cat's Claw Communities are also found at high water tables or spring areas [May 1987:98].

Micro-Environment B contained roasting pits, quarries, and flaking stations. The sites

were placed atop gravel covered terraces and ridges in the Table Mountain Formation Gravels. This environment also includes the Jacumba Volcanic region on the mesas of Table Mountain. The dominant vegetation is the Agave/Yucca Community which seems to have been the primary functional association of the roasting pits and associated processing activity areas. Only a few stunted juniper plants will be found in adjacent water sources [May 1987:98-99].

Micro-Environment C included workshops and roasting pits, which

are invariably found at geological contact areas where the Table Mountain Formation Gravels lie tangent to Jacumba Volcanics or the Southern California Batholith. The dominant vegetation is the Agave/Yucca Community. This micro-environment is characteristically devoid of other vegetation, except in nearby Micro-Environment A washes [May 1987:99].

Southwestern San Diego County (Christenson 1990)

Lynne E. Christenson (1990) examined prehistoric settlement patterns within an extensive region of about 4,800 km² in southwestern San Diego County. She drew a 20-percent random sample of existing site records that were assignable to the late prehistoric period. Christenson's study area lay entirely to the west of the present study region, but it included the mountains physiographic province of the San Diego area as far east as Cottonwood Valley.

Site types used in her analysis included large habitation site, small habitation site, large processing site, small processing site, large lithic scatter, small lithic scatter, rock alignment, quarry, rock shelter, rock art site, cache site, and other. Composite site types include large lithic scatters and rock alignments, small lithic

scatters and rock shelters, large habitation sites/rock alignments, large processing sites/rock alignments, small habitation sites/rock alignments, small processing sites/rock alignments, small processing sites/rock art, a small processing site/rock shelter, a quarry/rock alignment, large habitation sites/rock shelters/rock alignments, a large habitation site/rock art, a small habitation site/rock shelter, a large processing site/rock shelter, and a large processing site/rock art.

To evaluate the environmental patterning, data on the 438 prehistoric sites within the study area were compared with corresponding information on 438 randomly selected non-site data points within the same area. Environmental variables that were considered included elevation, nearest water type, water distance, current and inferred prehistoric vegetation, soil type, geology, slope, topography, and landform.

Christenson proposed several conclusions concerning associations between environmental variables and site/non-site locations. Elevations were not found to differ significantly between sites and non-sites. Average slope was found to be lower at sites (15.8 percent, or 9.0°) than at non-site locations (24.0 percent, or 13.5°). Water was closer to sites (135 m) than to non-site locations (262 m). Among water types, sites were more frequently associated with springs than were non-site locations, and less frequently associated with rivers. Among current vegetation communities, sites were more frequently associated with coniferous forest, grassland, riparian, and southern oak woodland than were non-site locations, and less frequently with chaparral and coastal sage scrub. Among landforms, sites were more frequently associated with valley areas than were non-site locations, and less frequently associated with hillsides.

Differences in the associations between particular site types and environmental variables were also noted. Lithic scatters were found at lower mean elevations than habitation and processing sites. Locations of large habitation sites were somewhat flatter than those for small habitation sites and processing sites. The distance to water was least for large habitation sites and greatest for rock alignments.

San Diego County (Pasahow 1995)

Edward J. Pasahow (1995) used existing data on 9,788 archaeological sites in or immediately adjacent to San Diego County for a GIS analysis. Three major “ecological zones” were distinguished in the analysis: coastal, cismontane, and desert. Other environmental variables included elevation and proximity to streams.

Attributes that were assigned to prehistoric archaeological sites included lithic scatter, ceramic scatter, bedrock milling feature, petroglyph, pictograph, architectural feature, stone feature, burial, cache, hearth/pit, quarry, lineal feature, rock shelter/cave, habitation debris, marine shell, ground stone, and faunal remains. The dating of the sites’ initial recording either before or after 1980 was considered. Another key variable that were considered was the areas of the sites (0-300 m², 300-1,000 m², 1,000-5,000 m², and > 5,000 m²). Broad patterning in the geographical distribution of sites and the associations between different site attributes were examined.

Cuyamaca Rancho (Shackley 1980)

In a landscape study on a much smaller scale, M. Steven Shackley (1980) addressed recorded archaeological village sites within Cuyamaca Rancho State Park in central San Diego County, northwest of the present study region. Shackley’s study focused on the association of three main upland village complexes with six biotic communities and the ecotones between those communities. The biotic communities, delineated on the basis of field observations, included grassland, manzanita chaparral, mixed chaparral, mixed coniferous forest, oak woodland, and riparian woodland.

According to Shackley (1980:48-49),

The village sites of Jauquapin on East Mesa, SDI-863 and 1018, the village complex of Mitaragui in Green Valley, SDI-857 and 858, and the village of Pilcha on West Mesa, SDI-913, were all found on contact lines between at least two biotic communities.... SDI-863 was the only site located between only two communities; the remainder were directly involved with three biotic regimes. Even though SDI-863 was positioned between only two, nowhere was an additional community farther than one-half mile away from any site.

Cuyamaca Rancho (Tsunoda 2006)

A second and more intensive study of site distribution patterns in Cuyamaca Rancho State Park was completed for a Master's thesis by Koji Tsunoda (2006). The study was based on a GIS analysis using the existing records for 365 sites. Residential sites (villages and camps) that lacked pottery being excluded as likely pre-dating the late prehistoric period. Nine site types were distinguished: village sites, small camps, temporary camps, seed grinding stations, artifact scatters, quarry sites, special task sites (e.g., rock art, rock circles), caches, and isolates. The overall density of sites in the park was calculated as 3.7 sites per km². Considering habitation sites alone (village sites, small camps, and temporary camps), this would imply a density of 1.2 habitation sites per km².

Tsunoda examined the associations of archaeological sites with the variables of distance to nearest water source, on-site vegetation, elevation, slope, and aspect. The densities of sites within the various environmental settings, rather than merely absolute numbers of sites in those settings, were considered.

Water sources included lakes, streams, creeks, and spring, and their distances from sites were analyzed in 100-m intervals. The highest density of sites was found in locations less than 100 m from the nearest water source.

The analysis of vegetation associations was based on 10 plant communities within Cuyamaca Rancho State Park: upland grassland, montane meadow, mixed chaparral, chaparral complex, montane chaparral, pine-oak woodland, pine phase, oak phase, mixed conifer forest, and riparian woodland. Sites were most numerous in woodland areas, but occurred most densely in areas of upland grassland and montane meadow. In chaparral, sites were fairly numerous, but the density of sites in these extensive areas was low.

Elevations within Cuyamaca Rancho State Park range between about 3,400 and 6,500 ft. above sea level. The distribution of archaeological sites was analyzed in 300-ft. intervals. Site frequencies and site densities were both highest in the middling ranges of 4,000-4,300 ft. and 4,600-4,900 ft.

The slopes of site locations were classified in four ranges: 0-10°, 11-20°, 21-30°, and > 30°. Sites were most common in areas with slopes of greater than 30°, but because those areas accounted for about 68 percent of the park area, the density of sites in those areas was lower than in flatter areas.

With respect to aspect, the most favored site settings were classified as flat, followed by locations with south or east aspects.

Laguna Mountain (Graham 1981)

William R. Graham (1981) reported and analyzed the results of a systematic archaeological survey of the 8,000-acre Laguna Mountain Recreation Area in the mountains of central San Diego County, to the northwest of the Jacumba/McCain Valley region. At 112 sites, Graham examined the relationships between archaeological and environmental variables. The archaeological variables examined were site type, including habitation, extraction, and processing sites; site area; the presence/absence of midden, milling,

flaked lithic waste, flaked lithic tools, pottery, Lower Colorado buff ware, mortars, basins, and slicks; the numbers of mortar, basins, and slicks; and estimates of the amounts of flaked lithics and pottery. Environmental variables included landform, slope, geological formation, vegetation community, nearest water feature type, and distances from meadow edge, nearest permanent spring, and nearest stream.

To evaluate the associations, “estimates of the area sampled for each category within geology, vegetation, and slope of the terrain” were made (Graham 1981:122). The data for habitation and processing sites indicated that those sites were at relatively flat locations, concentrated in areas with alluvial and granitic/tonalite rather than hybrid gneiss/granodiorite-quartz tonalite geology, and in grassland areas rather than in brush land and mixed vegetation areas. Too few extraction sites were included in the sample to be conclusive, but the data suggested that those sites followed contrary patterns from the other two types with regard to geology and vegetation associations.

Other environmental variables that were analyzed included the relative associations of the different site types with landform, nearest water source type, and distance to stream, spring, and meadow edge. Correlations between site type and landform were not pronounced; habitation sites perhaps tended to favor ridge/saddle/apex and meadow edge locations, while processing sites were found on mid-slopes and in meadows, and extraction sites at ridge/saddle/apex locations. The data also indicated no more than weak preferential associations between site type and nearest water source; habitation sites showed some bias in favor of permanent springs, while processing sites and extraction sites slightly favored good streams. Measurements of distances to streams, springs, and meadow edges showed that habitation and processing sites were closer to these locations than were extraction sites.

Corral Canyon (Laylander and Christenson 1988)

Don Laylander and Lynne E. Christenson (1989) reported systematic archaeological survey and site testing results for the 1,800-acre Corral Canyon Prehistoric Archaeological District in the mountains province of central San Diego County, to the west of the present study region. They offered observations on site densities and the relationships between site type (large habitation site, small habitation site, lithic scatter, ceramic scatter, milling station, rock ring, cairn, or rock wall), and environmental variables, including landform (valley, hillside, ridge, or upland), biotic communities, and distance to the nearest mapped drainage.

Several conclusions concerning prehistoric archaeological landscapes emerged from the study. Limitations to the validity of site typology were noted, for instance in the distinctions drawn between “large habitation sites and “temporary camps,” and between “temporary camps” and “milling stations.” With respect to variables in the natural environment, sites, and in particular habitation sites, were found to be strongly concentrated in the valleys, in association with drainages. With respect to an idealized settlement pattern, anomalies were noted in the clustering of habitation sites and milling stations.

Davies Valley (Wells 1977)

Helen Wells (1977) conducted a sample survey in Davies Valley, in the Yuha Desert in southeastern Imperial County (see also Bastian 1977). The study area lay within the Ocotillo region, immediately to the east of the Jacumba/McCain Valley region. Wells’s study area was analyzed according to 10 environmental units, based on landform and on distance from drainages. The investigation involved two stages of surveys within quadrats, each of which was $\frac{1}{16}$ of a 1-mi.² section (40 acres or 0.16 km²). The first stage consisted of 48 survey quadrats, distributed in the environmental units approximately in proportion to the frequency of those units in the study area. The second stage of 48 quadrats was focused on the two environmental units that had identified the highest densities of sites in the first stage. Eight site types and five isolated feature types were distinguished, excluding “low-density finds” (i.e., isolates). Site frequencies were analyzed in terms of the hydrological and physiographic variables.

Sites were found to be most abundant on upland surfaces with less than 10 percent slope. The operation of distance to water as a factor in site locations was found to be more ambiguous.

West Mesa (Gallegos 1980)

Dennis Gallegos (1980) reported sample surveys in Imperial County's East and West Mesas, including the southeastern portion of the present Ocotillo study region. Variables addressed in the study included site densities, distances from the Lake Cahuilla shoreline and from Pinto Wash, elevation, site area, site type, and the presence or absence of pottery and lithics. Among the 51 sites that were identified, types that Gallegos distinguished included temporary camps, milling stations, lithic scatters, pottery scatters, and trails. The density of sites was 22.3 per km², including 9.0 temporary camps per km².

Most of Gallegos's statistical tests were not able to confirm more than weak patterning. Exceptions were that temporary camps tended to be associated with the Lake Cahuilla shoreline; lithic scatters, with Pinto Wash; and milling stations, pottery loci, and trails, with non-shoreline, non-wash locations.

COMPARISONS IN METHODS

One of the previous studies (May 1980, 1987) addressed an area lying entirely within the Jacumba/McCain Valley region, and two of them (Cook and Fulmer 1980; Pasahow 1995) addressed areas partially overlapping portions of the region. One of the studies (Wells 1977) concerned an area within the Ocotillo region, and another overlapped it (Gallegos 1980). The remaining five studies (Christenson 1990; Graham 1981; Laylander and Christenson 1988; Shackley 1980; Tsunoda 2006) were focused on areas outside of but in the general vicinity of the present study regions.

Three of the previous studies addressed substantially larger areas than the present region (Christenson 1990; Cook and Fulmer 1980; Pasahow 1995); the other studies addressed smaller areas (Gallegos 1980; Graham 1981; Laylander and Christenson 1988; Shackley 1980; Tsunoda 2006; Wells 1977). The numbers of archaeological sites ranged from only a few (e.g., Laylander and Christenson 1988; Shackley 1980; Wells 1977) up to substantially larger numbers than those in the present study (e.g., Pasahow 1995).

Table 53 summarizes the ways in which cultural resource records were collected, the manner in which sites were classified, the ways in which information on the natural environment was collected, and the variables in the natural environment that were addressed. Because the majority of the studies date back more than two decades, GIS software was not available for most of the analyses, the exceptions being the more recent studies by Pasahow (1995) and Tsunoda (2006).

Table 53. Methods Used in Regional Landscape Studies

	Present Study	Cook and Fulmer 1980	May 1980, 1987	Christenson 1990	Pasahow 1995	Shackley 1980	Tsunoda 2006	Graham 1981	Laylander and Christenson 1988b	Wells 1977	Gallegos 1980
Basis of Cultural Resource Information											
Substantially Complete Surveys			X			X	X	X	X		
Statistical Sample Surveys		X								X	X
Available Previous Records	X			X	X						
Characterization of Sites											
By Site Types	X	X	X	X		X	X	X	X	X	X
By Site Attributes	X	X	X		X			X			X
Basis of Environmental Information											
Field Observations		X	X			X		X		X	
Regional Mapping	X	X		X	X		X	X		X	X
Comparisons with Environmental Factors											
Among Archaeological Sites	X	X	X	X	X	X		X	X		X
With a Regional Environmental Sample	X	X		X				X	X	X	
Environmental Variables Evaluated											
Landform		X		X				X		X	
Elevation	X			X	X		X				X
Slope	X	X		X			X	X			
Aspect	X						X				
Geology	X	X	X	X				X			
Soils	X			X							
Hydrology	X	X		X	X		X	X	X	X	X
Vegetation	X	X	X	X		X	X	X			

COMPARISONS OF FINDINGS CONCERNING ARCHAEOLOGICAL LANDSCAPE

Some of the previous studies offer findings that either support or contrast with those of the present study. A few of these are briefly identified and discussed below.

Correlations with Elements of the Natural Environment

In broad terms, Tsunoda's GIS study at Cuyamaca found that site locations were correlated with relatively close proximity to water sources, with moderate slopes, and with southern and eastern aspects, as was found in the Jacumba/McCain Valley region. Chaparral areas, although extensive, contained low site densities, as was also found in the present study region.

In the specific instance of site slope, Cook and Fulmer's (1980) results for eastern San Diego County showed a significant tendency for temporary camps to be situated in flatter locations than other site types (Table 54). A statistically significant difference of this sort was not found for habitation bases and temporary camps in the Jacumba/McCain Valley region. A statistically significant difference in the opposite direction, with habitation sites located on steeper slopes, was found in the Ocotillo region.

Table 54. Slopes Greater or Less than 10 Percent at Habitation Sites and Other Sites, in the Cook and Fulmer (1980) and Present Studies

	Slope 0-10% (0-5.7°)		Slope > 10% (> 5.7°)	
	n	%	n	%
<i>Cook and Fulmer 1980</i>				
Temporary Camps	12	41.4	17	58.6
Other Sites	22	15.4	121	84.6
<i>Jacumba/McCain Valley Study</i>				
Habitation Sites	25	7.4	313	92.6
Other Sites	81	6.7	1,137	93.3
<i>Ocotillo Study</i>				
Habitation Sites	24	24.0	76	76.0
Other Sites	324	37.8	533	62.2

Cook and Fulmer 1980: Fisher's exact test value = 0.0036 (significant)

Jacumba/McCain Valley study: Fisher's exact test value = 0.6263 (not significant).

Ocotillo study: Fisher's exact test value = 0.0061 (significant)

Site Densities

The densities in which habitation sites have been recorded have varied considerably among the regions and studies (Table 55). Much of this variability may be attributable to such factors as differences in the completeness of the inventories, edge effects from the use of small survey sample transects, and possible differences in the site type definitions and their applications, as well as contrasts in the attractiveness and productivity of the regions, as in the cases of the mountain meadows and the Lake Cahuilla shoreline. However, the general point of a substantial proliferation of "redundant" habitation bases, discussed above, is amply confirmed.

Table 55. Densities of Habitation Sites

		Area of Sample (km ²)	Habitation Sites as % of All Sites	Habitation Sites per km ²
Jacumba/McCain Valley	Study Region	544	24.8	0.6
	NADB Areas	123	22.1	2.0
Ocotillo	Study Region	530	10.4	0.2
	NADB Areas	137	13.2	0.4
Eastern San Diego County (Cook and Fulmer 1980)	McCain Valley	10.2	16.9	5.8
	Table Mountain	2.2		17.6
Table Mountain (May 1987)		7.3	29.8	5.1
Southwestern San Diego County (Christenson 1990)		n/a	27.1	0.1
Cuyamaca (Tsunoda 2006)		94.6	34.6	1.2
Laguna Mountain (Graham 1981)		32.4	25.0	0.9
Corral Canyon (Laylander and Christenson 1988b)		7.3	32.6	2.1
Davies Valley (Wells 1977)		15.4	14.3	0.5
West Mesa (Gallegos 1980)		8.7	24.5	9.1

Another comparison of interest concerns the numbers and densities of isolated roasting pits (Cook and Fulmer's Type 14). This category accounted for 50.3 percent of the recorded sites in the Cook and Fulmer (1980) study, with densities of 23.5 such sites per km² in the McCain Valley area and 35.1 sites per km² in the Table Mountain area. The corresponding figures for the present study (for selected hearth/pit sites, as those were defined above) are 11.5 percent of sites, 0.29 sites per km² in the study region, and 0.80 sites per km² for NADB areas. The markedly lower relative frequencies and densities of these features in the present study may be explicable, at least in part, by incomplete recognition and documentation of such features during many of the previous archaeological surveys in the region.

SOME CONCLUSIONS

The larger region within which the East County Substation Project was located – encompassing McCain, Jewell, and Jacumba valleys, portions of the Jacumba and In-Ko-Pah mountains, and portions of Carrizo and In-Ko-Pah gorges – presents a varied and, at times, dramatic landscape. The prehistoric cultural landscapes of this region were also very far from uniform, as attested by archaeological evidence that is available from more than 1,500 prehistoric sites and isolates. The archaeological records afford preliminary insights into the ways in which the region's prehistoric inhabitants perceived and responded to those landscapes.

The distribution of the region's recorded sites is uneven. Sites are concentrated in Jacumba Valley and its northern environs, in the eastern portion of McCain Valley, and in In-Ko-Pah Gorge. Their distribution is most sparse in Carrizo Gorge and the rugged slopes of the In-Ko-Pah and Jacumba ranges adjacent to the gorge, as well as in the portion of the Jacumba Mountains lying in the southeastern corner of the study region. This patterning at least in part reflects the distribution of intensive archaeological inventory work within or away from particular settings. However, it is likely that it also attests to prehistoric land-use decisions, favoring well-watered valleys, where major staple food resources were most reliably found, as well as convenient routes of travel within and beyond the region.

Analysis of the archaeological GIS data has provided a number of insights concerning the region's prehistoric landscapes that have been discussed in previous sections. They may be briefly reviewed here. First, a few methodological conclusions may be cited:

- The results suggest the importance of using a site attribute analysis rather than relying entirely on a site typology in the investigation of regional prehistoric archaeological landscapes. Site typologies may be useful within some contexts, but are likely to be misleading in other contexts, including landscape analysis.
- The value of testing the environmental characteristics of archaeological site locations against the characteristics of the study region as a whole, and not merely looking at inter-site patterning in these dimensions, is evident.
- In cases in which the regional coverage of archaeological inventory work is incomplete and does not represent statistically valid sampling, the biases which those circumstances may have introduced into the regional picture need to be considered. One way to do this may be to consider the subset of the region that has been addressed by National Archaeological Database (NADB) reports.
- The choices that are made concerning which variables in the natural environment to examine in a GIS context is likely to be at least in part opportunistic. The physiographic variables of elevation, slope, and aspect are easily generated by a GIS, but they may have limited interpretive value. Landform as a variable may be more attractive for possible direct interpretive value, but documenting landforms in an objective, systematic manner is considerably more difficult. Data on geology, hydrology, and vegetation are generally available in GIS format, but their categorization may be complex, and the presence of such variables specifically at site locations may not give an adequate picture of the accessibility of the resources they contain from those locations. Soils mapping, when it is available, may offer some insights into biases introduced by site formation processes, and, perhaps, it may be a foundation for paleo-vegetation reconstruction.
- The results of the present study suggest that the documentation of prehistoric isolates contributes little if anything to the understanding of prehistoric archaeological landscapes, at least at this level of analysis. It remains to be seen whether other approaches can realize substantial interpretive value from isolates and their spatial distributions.

Additional conclusions from the GIS study relate to some of the characteristics of prehistoric archaeological landscapes in the region:

- Chronological control is problematic in this sort of study, because direct dating of sites is very sparse and chronologically diagnostic artifacts are few. An attempt to distinguish the landscape characteristics of pre-ceramic and ceramic-period sites was generally inconclusive, either because the criteria used to distinguish the two sets of sites were not effective or because landscape use was similar in both periods.
- With respect to physiographic variables in site location choices, regional patterning is, on the whole, fairly weak or ambiguous. Sites tended to be located at relatively lower locations than points within the region as a whole; this was true not only for complex habitation sites but for sites in general. It might have been predicted that preferred site locations would have favored low slopes and perhaps southern aspects, but the evidence that emerges on these points is not clear. Site choices seemed to show some preference for relatively low slopes, but not for the absolutely flat valley bottoms. There are several possible reasons for this. Settlements on open flat ground might be less defensible than those on slopes. Slope locations might offer better visibility of game movements. Valley bottoms might retain surface water after rainfall, making habitation undesirable.

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- Geologically, sites with quarrying activity are overrepresented in areas associated with Miocene volcanic rock, as would be expected. Bedrock milling is overrepresented in the granitic areas which dominate the regional geology, also as would be expected.
 - Given the importance of water, it is perhaps surprising that sites, including habitation sites, do not show a bias in favor of locations closer to its most likely sources at springs, perennial streams, and higher-order drainages. There is a disproportionate representation of habitation sites within 300 m of such sources, but those sites represent only a small fraction of the total numbers of habitation sites. Sites containing bedrock mortars do show a bias in favor of locations closer to water sources, tending to confirm those features' primary use in acorn processing, which requires water for leaching. Sites that likely represent agave roasting features show a bias toward locations away from water sources. This may be attributed to the locations where agave and fuel were available and where large holes could be easily dug.
 - With respect to vegetation communities, sites are overrepresented in areas of Pinyon-Juniper Woodland, Upper Sonoran Subshrub Scrub, Mixed Desert Scrub, and Sonoran Mixed Woody Scrub. These are communities with some of the most important staple food resources, such as pinyon nuts, agave, and a higher diversity and density of cactus species. Sites are underrepresented in areas of Upper Sonoran Mixed Chaparral. Although this is a vegetation community in which burning would have improved productivity and access for prehistoric peoples, if allowed to reach climax, mixed chaparral would have proven less desirable. Archaeological sampling problems also exist for these areas, in that archaeological surveys are difficult and sites are concealed under dense vegetation. Earth oven features are overrepresented in vegetation communities that include a substantial presence of agave, which supports the interpretation of most of those features as agave roasting pits.
 - Habitation sites are documented in densities that vastly exceed the minimum numbers that would have sufficed for a static, fixed settlement system. This indicates that prehistoric patterns in the use of this landscape were quite shifting and variable from year to year, or from century to century.
 - Evidence for interregional mobility and/or exchange, in the form of locally exotic lithic materials, ceramic types, and marine shell, is widespread, but it is not quantitatively impressive. This suggests that routes of trade and travel, extending both to the east and to the west, were open and in use, but that their products were probably not materially important for the survival of the communities that lived within the region. The evidence of their distribution also suggests that exotic items were not hoarded or otherwise controlled in a few places by a social elite but were general throughout the communities, which may have been relatively egalitarian.
 - Vertebrate faunal remains have been reported relatively infrequently at sites in the study region. This may merely reflect the imperfect survival or discovery of such remains on the surfaces of sites, or it may possibly indicate that plant resources played a more important role than animal resources in the subsistence and technology of groups living in this region.
 - Any suggestion that nonutilitarian features and artifacts pertained to a "sacred" category that separated them spatially from more secular, utilitarian activities is not supported by the evidence from the present study. Rock art, human burials, cupules, rock alignments, and other special items usually occur in association with habitation debris or other utilitarian remains. This conforms to ethnographic accounts of the integration of the material and esoteric aspects of daily life among the Yuman peoples of the region.

The GIS analysis of prehistoric archaeological landscapes in the Jacumba/McCain Valley region, along with other regional landscape studies, is contributing to an emerging picture of prehistoric lifeways that varied across space and through time in interesting and sometimes unexpected ways. As future studies extend the survey coverage and add more intensive site-specific investigations, this picture is certain to be refined and clarified. We expect that the synthesis provided here will benefit those future efforts. They will certainly benefit from regional approaches that are not constrained by international borders. An expanded database may be available in the future as a result of ongoing discussions between BLM and INAH to share information.

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