

PREHISTORIC SETTLEMENT PATTERN OF OTAY MESA,
SAN DIEGO COUNTY, CALIFORNIA

Mary Robbins-Wade
Affinis
839 Jamacha Road
El Cajon, CA 92019

ABSTRACT

An important factor in understanding the behavioral system of a hunting and gathering society is recognition and explanation of patterns of site distribution. Recent archaeological information from the Otay Mesa area of southwestern San Diego County is suitable to examine this research domain. Distribution of site types in relation to specific resources was analyzed in order to develop a predicted settlement pattern for Otay Mesa. Essential and desirable non-essential resources considered in the study included water, preferred lithic raw material, plant resources, and animals. The results of archaeological work on Otay Mesa were compared with the proposed settlement pattern.

INTRODUCTION

An important factor in understanding the behavioral system of a hunting and gathering society is recognition and explanation of patterns of site distribution. Recent archaeological information from the Otay Mesa area of southwestern San Diego County is suitable to examine how prehistoric societies viewed the local environment in terms of exploitation strategies, including placement of relatively long-term settlements, shorter-term habitation sites, and locations of resource procurement and processing activities.

A major development of recent archaeological and ethno-archaeological research has been the emergence of a body of theory of hunter-gatherer subsistence and settlement systems. Using this theoretical foundation, information on the physical and biological environment of Otay Mesa, and archaeological and ethnohistorical information regarding the Native American inhabitants of the San Diego region, a settlement pattern was proposed for the Otay Mesa area.

Distribution of site types in relation to specific resources was analyzed in order to develop a settlement pattern for the mesa. Essential resources and desirable non-essential resources considered in the study included water, lithic material in the form of Santiago Peak Volcanics, plant resources, and animals.

Definitions of site types were based on Binford's (1980) description of a forager-collector continuum among hunter-gatherers.

Based on radiometric dating, obsidian source and hydration analysis, and temporally diagnostic artifact types, Otay Mesa appears to have been used mainly between 7,000 and 2,000 years ago; however, chronometric data have come from only 13 of the almost 200 sites recorded on the mesa¹. Most of the archaeological sites recorded are lithic scatters that lack diagnostic artifacts and material suitable for chronometric analysis.

Using information on site types, chronology, and the physical and biological environment, a settlement pattern was developed for Otay Mesa. The predicted pattern was compared with data from the almost 200 sites recorded on the mesa. This study did not attempt to analyze a complete subsistence/settlement system. Rather, it focused on settlement patterning on Otay Mesa, one component of a larger overall system.

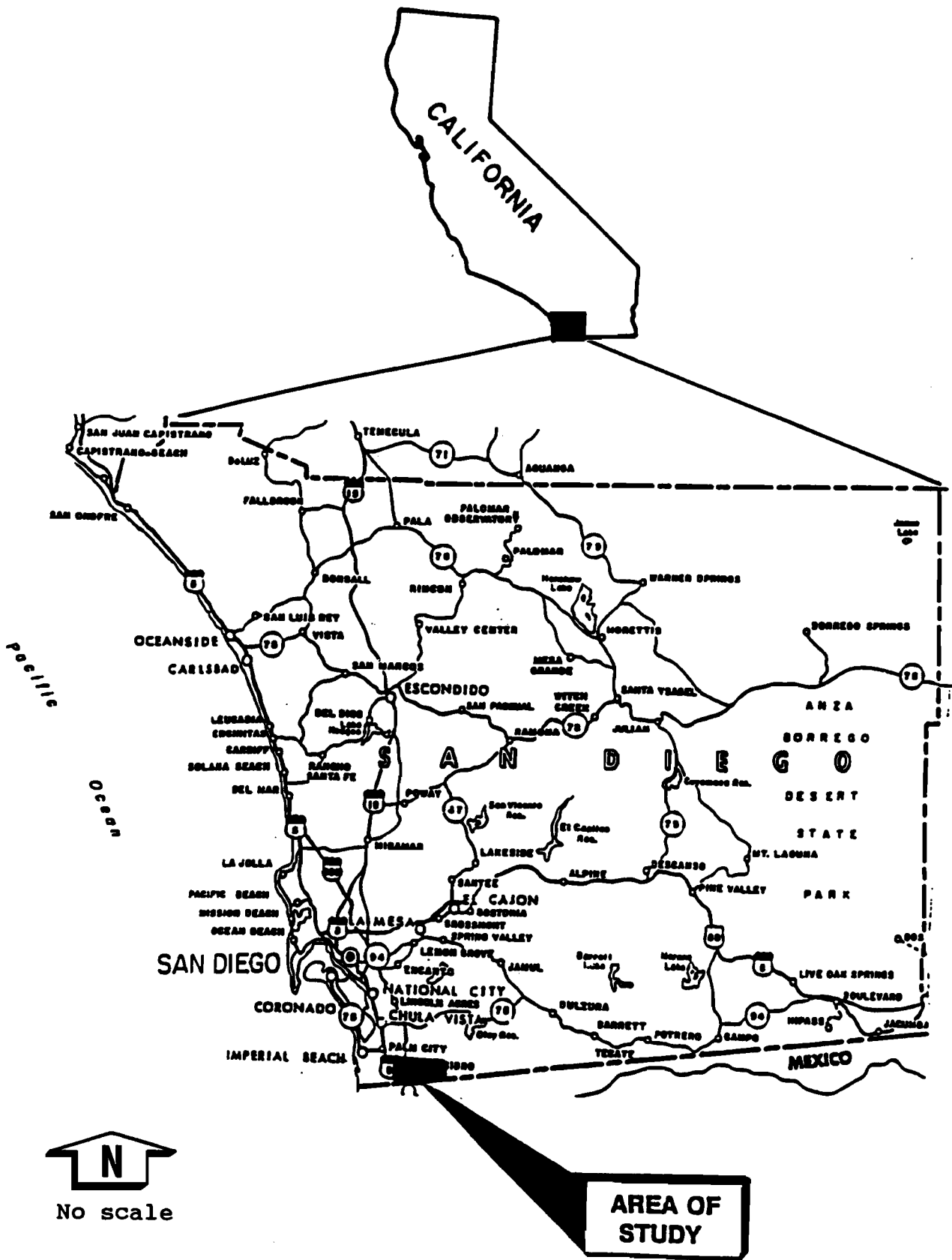
LOCATION AND CHARACTERISTICS OF STUDY AREA

Otay Mesa is located in the extreme southwestern corner of San Diego County (Figure 1). The mesa covers over 5,700 hectares, measuring about 13 km east-west and between 4 and 5 km north-south (Figures 2 and 3). It extends from the base of the foothills on the east to within 10 km of the present-day open coast. The more sheltered San Diego Bay is located just 8 km to the northwest. The mesa is bounded on the north and south by the Otay and Tijuana Rivers respectively.

Otay Mesa lies within the coastal plains physiographic province, but the east end is at the juncture of the coastal plains and foothills provinces (Griner and Pryde 1976). Otay Mesa consists of a series of flat terrace remnants dissected by deep canyons. Elevation ranges from about 90 m above sea level on the western portion to 180 m at the base of the foothills.

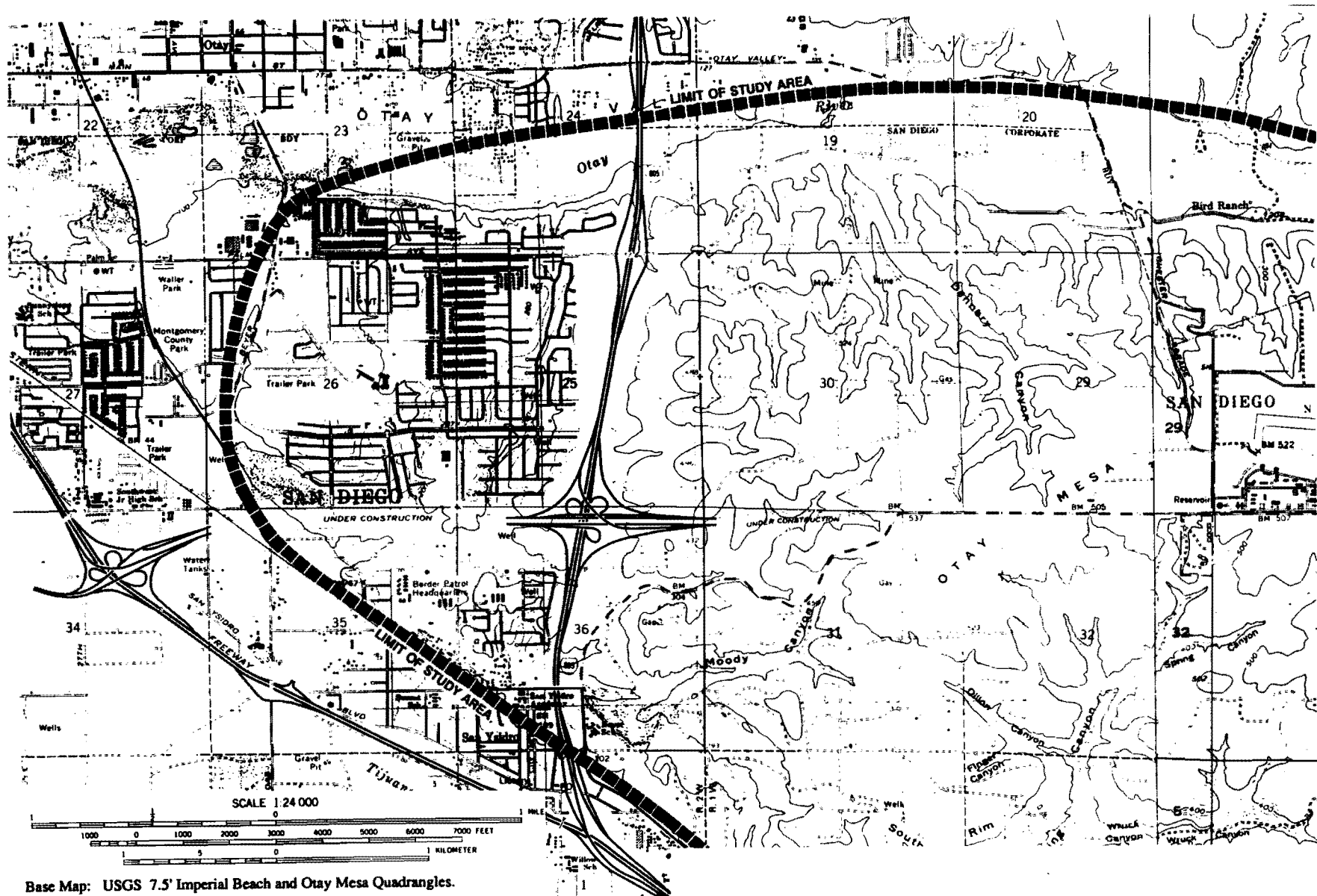
The far eastern end of the mesa abuts the San Ysidro Mountains, which are composed of the Jurassic Santiago Peak Volcanics. This formation is abundantly represented by the fine-grained green metavolcanic material locally called felsite. This material was very much preferred by the inhabitants of the San Diego region due to its superb workability. The fine grain size and general lack of inclusions facilitate predictable fractures when this stone is used for tool manufacture. Nodules and large cobbles of Santiago Peak Volcanics occur across Otay Mesa.

Water is seasonally available in a number of canyons that dissect Otay Mesa. Three main plant associations have been mapped. Chaparral and coastal chaparral scrub occur on north- and west-facing slopes of canyons and in canyon bottoms. Coastal



No scale

Figure 1. Location of study area.



Base Map: USGS 7.5' Imperial Beach and Otay Mesa Quadrangles.

Figure 2. Location of study area on USGS 7.5' Imperial Beach and Otay Mesa quadrangles (western portion)

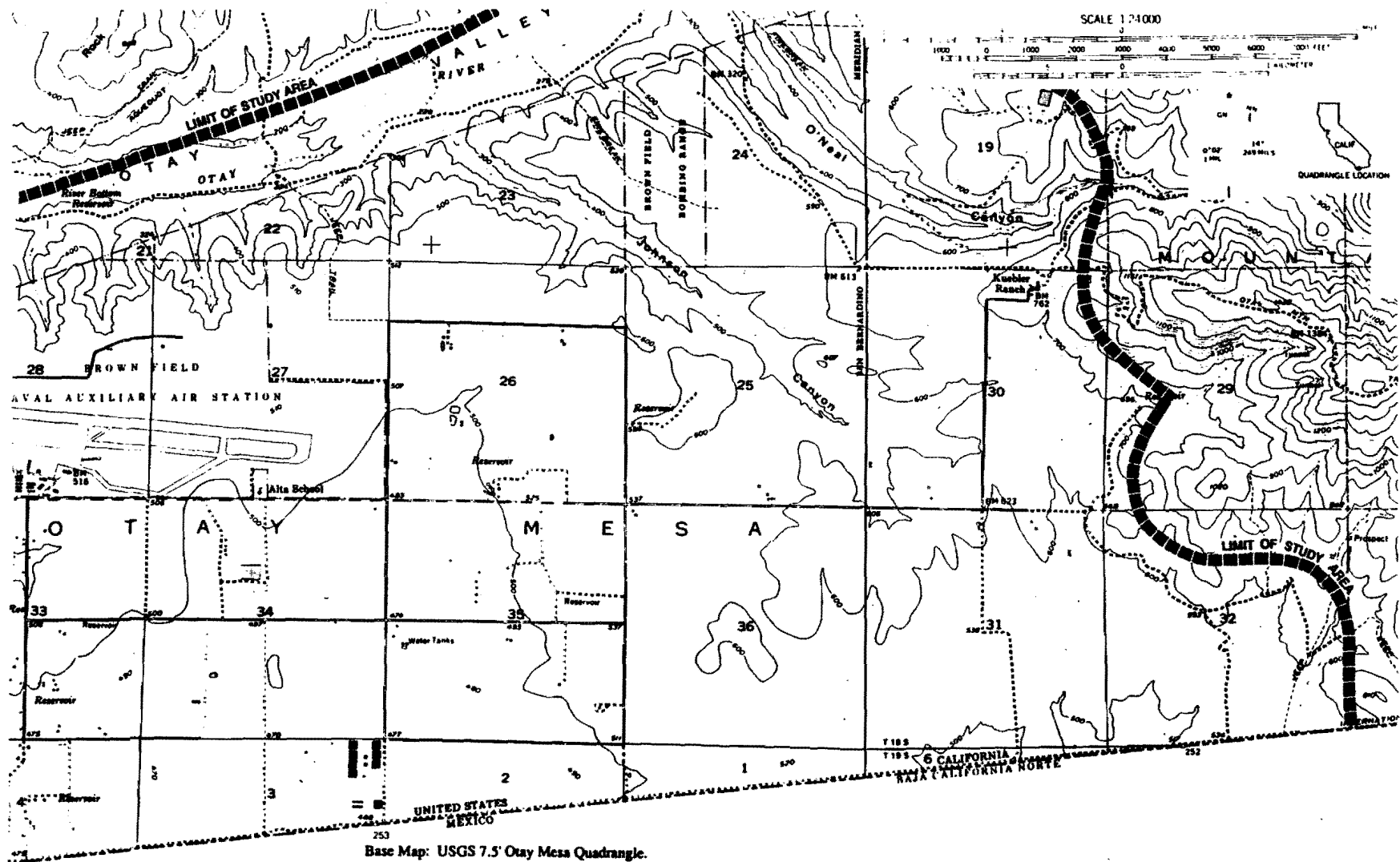


Figure 3. Location of study area on USGS 7.5' Otay Mesa quadrangle (eastern portion)

sage scrub is found on the drier south- and east-facing slopes and on relatively undisturbed areas of the mesa top. Grasslands dominate the majority of the mesa top.

These vegetation communities support a number of wildlife species. Small mammals, deer, reptiles, and numerous bird species are found in the area.

RESOURCE DISTRIBUTION AND ITS AFFECT ON SITE PLACEMENT

The uneven distribution of resources in the environment and the effect of this distribution on settlement location is a primary consideration in settlement pattern analysis. As Jochim emphasized, "if a particular factor is uniformly distributed in space, then it should exert no 'pull' on settlement location" (Jochim 1976:52). It initially appears that the situation on Otay Mesa is such that the only resources which would exert a "pull" on settlement location are water and lithic raw material. The plant resources considered important based on ethnographic analogy were widely distributed in the grassland, coastal sage scrub, and chaparral communities of Otay Mesa. Therefore, location of these resources would not tend to condition placement of camps; one could obtain them virtually anywhere on the mesa.

The distribution of plant resources on Otay Mesa was not truly homogeneous, of course, and it would have conditioned site location to a certain extent. The majority of the plants occurring on the mesa that are thought to have been used occur in at least two different plant communities. While most of the plant resources used could be found across much of the mesa top, a few could only be found on the canyon slopes or in the canyon bottoms.

Jochim has noted that transitional areas between habitats (ecotones) are generally more productive and have a greater species diversity than a single habitat alone (Jochim 1981). Christenson (1990) and Shackley (1980) have noted that Late period habitation sites tend to be located in ecotones. Canyon rims on Otay Mesa fill the criteria of ecotones in that they are the transitional areas between grassland, coastal sage scrub, and chaparral communities. Presently, grassland is found across much of the mesa, with pockets of coastal sage scrub. Coastal sage scrub also occurs on drier, south- and east-facing slopes, while chaparral is found on north- and west-facing slopes. Canyon rims, and particularly heads of canyons, present a situation in which diverse habitats come together. These ecotones would be expected to be preferred locations for residential bases and temporary field camps.

Animal resources are also rather evenly distributed across the mesa. "Rabbits are ubiquitous in San Diego County" (Christenson 1990:244), but there are slight differences in habitat among the various rabbit species. Jackrabbits tend to be

found in open or semi-open areas, not in thick chaparral or forested regions (Bond 1977). Brush rabbits prefer thick chaparral, and cottontails "never penetrate far into the chaparral" (Bond 1977:234). Cottontails make use of burrows, but brush rabbits do not (Bond 1977). Other small mammals, such as squirrels, woodrats, and pocket gophers, have been identified in archaeological contexts and are found throughout the habitats which are found on Otay Mesa. Deer and pronghorns were also numerous during prehistoric times, although they are not well-represented archaeologically (Christenson 1990). Because these animals are not migratory, they would have provided a food resource available on a daily basis. Nevertheless, an aboriginal preference for one species over another may have conditioned site placement to be within easy access of the preferred habitat of that species. Ecotones would present an opportunity to exploit both open and brushy habitats.

Ecotones occur in 2 contexts on Otay Mesa. At the eastern end of the mesa is the juncture of the coastal plains and the foothills physiographic provinces. The grassland and coastal sage scrub communities of the mesa are found along with the mixed chaparral of the foothills. The higher elevations and steeper slopes of the foothills support various plant species not found on the mesa itself. This habitat supports a diversity of wildlife that differs from that of the mesa.

The second ecotone context on Otay Mesa is canyon rims and particularly the heads of canyons. Differential occurrence of plant taxa, such as along streams, on slopes, or in flat open areas, is also important to note. Canyon head locations offer relatively easy access to these diverse habitats from one central location. Access to varying habitats not only allows exploitation of diverse plant resources but of animal resources that make use of the different habitats as well.

Canyon head locations meet another important need in settlement location: proximity to water. Water is presently found only in the large canyons that dissect the mesa. While water may have been available in some form on the mesa top at times during prehistory, there are not sufficient data to predict where reliable water sources would have been located. But we can say with reasonable certainty that water was available in the canyons. The proximity of permanent or reliable seasonal water sources constitute a "pull" for settlement placement along canyon rims or on benches within the canyons. There may also have been springs at canyon heads, but there is insufficient information to support this suggestion.

Outcrops of Santiago Peak Volcanics at the eastern end of Otay Mesa constituted a reliable source of a highly preferred lithic raw material, and this important resource created a "pull" on aspects of settlement location. Therefore, residential camps would be expected in areas where water and plant and animal resources occur in proximity to outcrops of this raw material.

The area where the mesa abuts the foothills comprises an ecotone with easy access to Santiago Peak Volcanics, and canyons and canyons rims in this area provided excellent settlement locations. At the eastern end of the mesa in areas not suitable for habitation due to lack of water, we would expect only "locations" of lithic procurement and processing.

Based on all of these factors, we would expect to find residential bases in areas with easy access to various resources, especially water. Temporary field camps would be expected in proximity to water in areas where lithic resources or certain plant resources could be easily exploited, but outside the sedentary exploitation area of a residential base (10 km is the distance suggested by Binford [1982]). "Locations" of resource procurement and processing would be expected anywhere on the mesa that is within the exploitation territory of a residential base. Task groups using such "locations" would return to the base camp daily, so these sites would be within easy walking distance of a residential base.

PREDICTED SETTLEMENT PATTERN

Based on the factors described above, differential site placement would be expected as follows:

Residential Bases

These settlement types would be found on canyon rims, on benches in canyons, canyon floors, or at canyon heads to make use of water and the juncture of diverse habitats. On eastern Otay Mesa, they would be expected to occur on canyon rims and along drainages at the base of the foothills to make use of water, diverse habitats, and outcrops of Santiago Peak Volcanics.

Field Camps

These would have similar placements to residential bases with respect to water, but placed for exploitation of 1 or a few specific resources, located at too great a distance from the residential base to be easily reached within a single day. Due to the relatively homogeneous nature of plant and animal resources on Otay Mesa, it is expected that most field camps could be associated with residential bases at some distance from the mesa, probably located on the coast or in the foothills. The exception to this would be field camps used for the exploitation of lithic resources on the eastern end of the mesa. Task groups from residential bases at the western portion of the mesa may have traveled to the far eastern end for lithic quarrying and processing activities that would have kept them away from the base camp for up to several days.

"Locations"

These could have occurred anywhere on the mesa. The relatively homogeneous distribution of plant and animal resources would have allowed task groups to venture out daily to gather and

process resources that were not found in the immediate vicinity of the residential base. The presence of volcanic materials in cobble and block form across the mesa would have provided for expedient tool manufacture at a processing "location". Proximity to water was not a necessary condition of site placement.

COMPARISON OF RECORDED SITES WITH PROPOSED PATTERN

A total of 196 sites has been recorded in the study area, including 184 sites on Otay Mesa (including the canyons that dissect the mesa), 11 sites in Otay Valley in proximity to the mesa, and 1 site which covers a portion of the mesa and extends down into the valley.

Four of these sites could be assigned to the Late period based on diagnostic artifacts and, in one case, a radiocarbon date. The main occupation and use of Otay Mesa was during the Early period, so these Late sites were not included in the analysis. Isolates were also excluded. The sites included in the settlement analysis were 12 residential bases, 21 field camps, and 131 locations (Figures 4 and 5; Table 1).

Table 1. Distribution of site types and grouped physical locales.

Site Type	Locale												Total
	cyn rim	cyn head	mesa top	bench terrace	valley	slopes bottom	mesa, rim	mesa, head	rim, slope	other			
Res Base	1	3	0	0	2	2	0	0	2	2	0	0	12
	8%	25%	0%	0%	17%	17%	0%	0%	17%	17%	0%	0%	100%
Field Camp	5	1	5	3	1	1	1	1	1	1	0	1	21
	24%	5%	24%	14%	5%	5%	5%	5%	5%	5%	0%	5%	100%
Location	18	5	33	9	1	6	0	19	18	0	7	15	131
	14%	4%	25%	7%	1%	5%	0%	14%	14%	0%	5%	12%	100%
Total	24	9	38	12	4	9	1	20	21	3	7	16	164
	15%	6%	23%	7%	2%	6%	1%	12%	13%	2%	4%	10%	100%

Of the 12 residential bases included in the analysis only 2 (SDi-10,452 and SDi-11,376, both located in Otay Valley) are located very far from canyon heads or rims (Figure 6). This suggests that this site type tended to be situated at the intersection of 2 or more ecological zones in contrast to the areas of more redundant and limited resources found across the interior of the mesa.

At the 12 residential bases the minimum distance from water

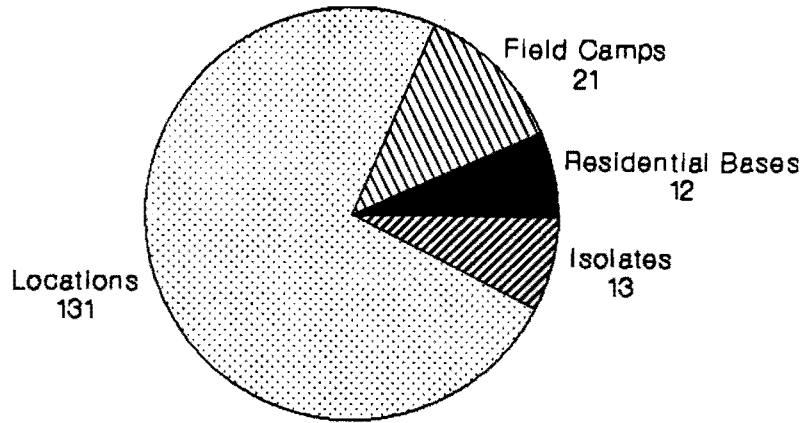


Figure 4. Site type: Otay Mesa.

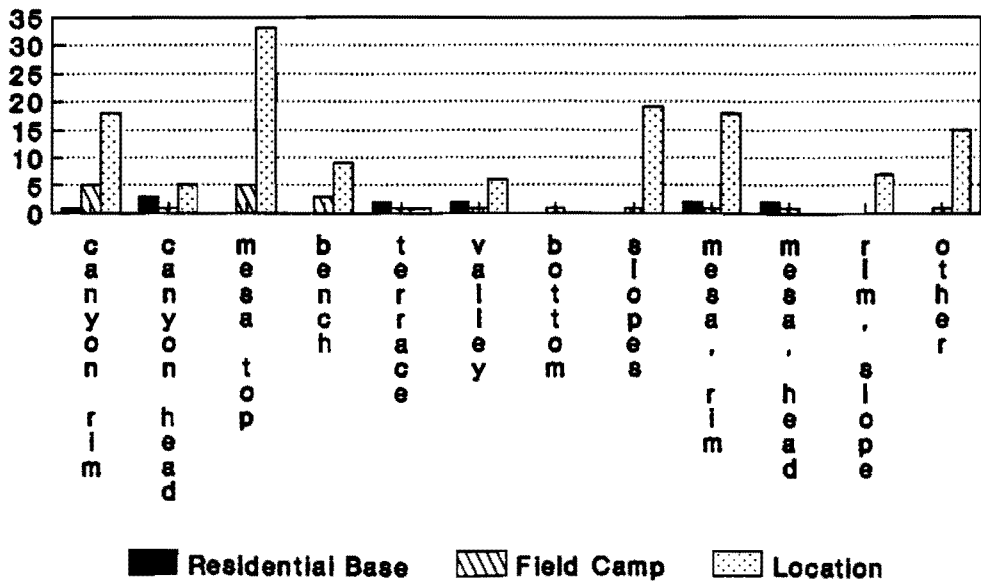


Figure 5. All site types: physical locales.

is 0 m, while the maximum distance is 280 m, and the mean distance to water is 92 m. The mean distance to Santiago Peak Volcanics outcrops is 5,811 m, with a minimum of 0 m and a maximum of 8,995 m.

The placement of field camps tends to parallel that of the residential bases, with 14 of the 21 sites located in proximity to ecotones (Figure 7). This is not surprising since, in general, even short stays would be better served by a varied mix of plant and animal resources. In addition, these locations tend to be closer to water than locales on the interior of the mesa.

Five of the field camps are located on the mesa top away from canyon edges, 1 is in Otay Valley, and 1 is on a canyon bottom (Figure 7). It is probable that these less varied locales represent seasonal exploitation of 1 or more particular resources in a single ecozone. Unfortunately, it is not possible to predict with accuracy what specific plant resources occurred at a particular site locale, but some general suggestions can be made. Several species, such as wild gourd (Cucurbita foetidissima), jimson weed (Datura meteloides), clover (Trifolium sp.), and several grasses, tend to occur in the valley grassland community and, thus, would be expected more frequently on the mesa top away from the canyon edges. Willows (Salix sp.), cottonwood (Populus fremontii), and sycamore (Platanus racemosa) are generally found along streams, so these species would be expected to occur in the river valley or in drainage bottoms. Exploitation of these resources occurring outside ecotone settings could account for the siting of specific field camps.

The minimum distance to water from field camps is 0 m, and the maximum distance is 1,160 m. The mean distance to water is 193 m, over 2 times greater than the average distance from residential bases to water. Field camps also average a greater distance from metavolcanic outcrops than do the residential bases, with a mean of 8,168 m as opposed to 5,811 m. The minimum distance from field camps to Santiago Peak Volcanic outcrops is 0 m, and the maximum distance is 12,650 m.

The 131 "locations" of resource procurement and processing show a much greater diversity of locales than do either residential bases or field camps, but mesa top (away from the canyon edge) locations are the most numerous (Figure 8). Canyon rim and mesa/rim locales each account for 14% (n=18) of the "locations". In contrast to the 2 former site types, however, a number of "locations" occur on slopes of canyons or on valley slopes. In fact, slope locales are the second most numerous, comprising slightly more "locations" than either canyon rim or mesa/rim locales. The physical locales of these procurement/processing sites are given in Table 1 and illustrated in Figure 8. Four of the "locations" occurring on the mesa top and along canyon rims are found in proximity to the foothills.

"Locations" (including quarries, lithic workshops, and plant

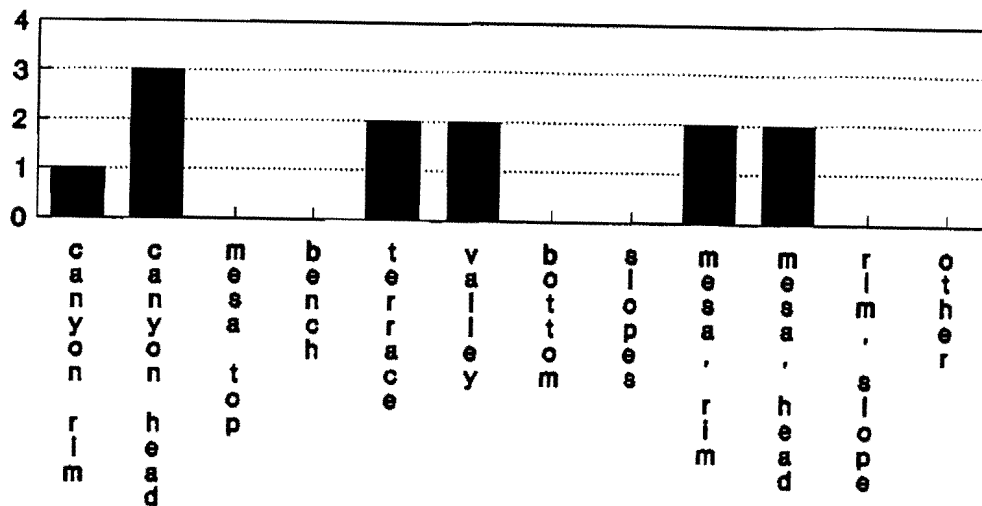


Figure 6. Residential base: physical locales.

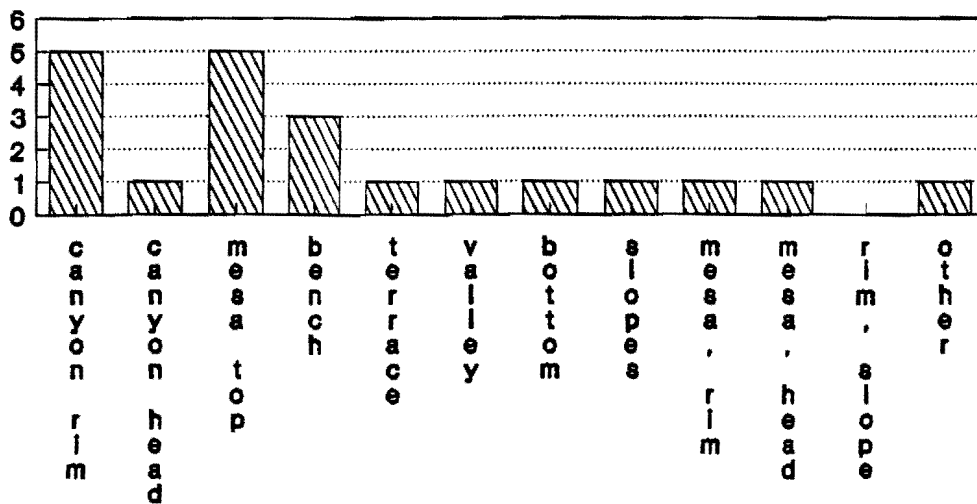


Figure 7. Field camps: physical locales.

and animal procurement and processing sites) occur an average distance of 323 m from water sources, ranging from 0 m to 2,250 m. The maximum distance of 2,250 m is approximately 8 times the maximum distance to water from residential bases and almost twice as great as the maximum distance from field camps. In terms of proximity to volcanic outcrops, the mean distance from "locations" is 6,034 m, with a minimum of 0 m and a maximum of 12,120 m.

It is interesting to note that, similar to residential bases and field camps, almost two-thirds (n=85, 65%) of the "locations" were sited in proximity to ecotones, either canyon locales or at the juncture of the mesa and the foothills.

STATISTICAL SIGNIFICANCE OF RESULTS

The chi-square test was used to assess the null hypothesis: "There is no difference in physical location among site types." The null hypothesis could also be stated: "Site type is independent of physical location." Due to low frequencies in several cells, the statistical results of this test were not meaningful.

In an attempt to arrive at more meaningful statistical conclusions, physical location types were lumped into three categories: mesa top (including mesa top, canyon rim, and canyon head locales, and combinations of these), valley/bench/terrace, and other (including slopes and any locales not fitting the two main categories). Bench, terrace, and valley locales were included in one category, because several archaeologists have suggested that sites on the mesa top itself represent use during an earlier time period than sites in the canyons and valleys. Residential bases and field camps were then combined as one site type and compared with "locations". These data are presented in Table 2 and illustrated in Figure 9.

Table 2. Distribution of grouped site types and greouped physical locates.

Site Type	mesa top/ cyn edge	terrace/valley/ cyn bench	slopes/ other	Total
Habitation	21 (64%)	10 (30%)	2 (6%)	33 (100%)
Location	74 (56%)	16 (12%)	41 (31%)	131 (100%)
Total	95 (57%)	26 (16%)	43 (26%)	164 (100)%

The chi-square test was again used to assess significance. As the result of this test, the null hypothesis was rejected at

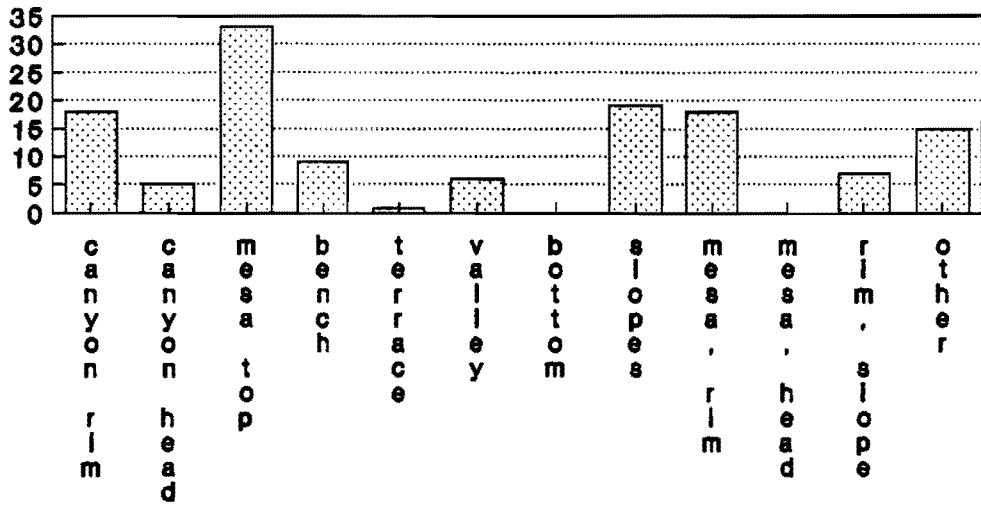


Figure 8. Procurement locations: physical locales.

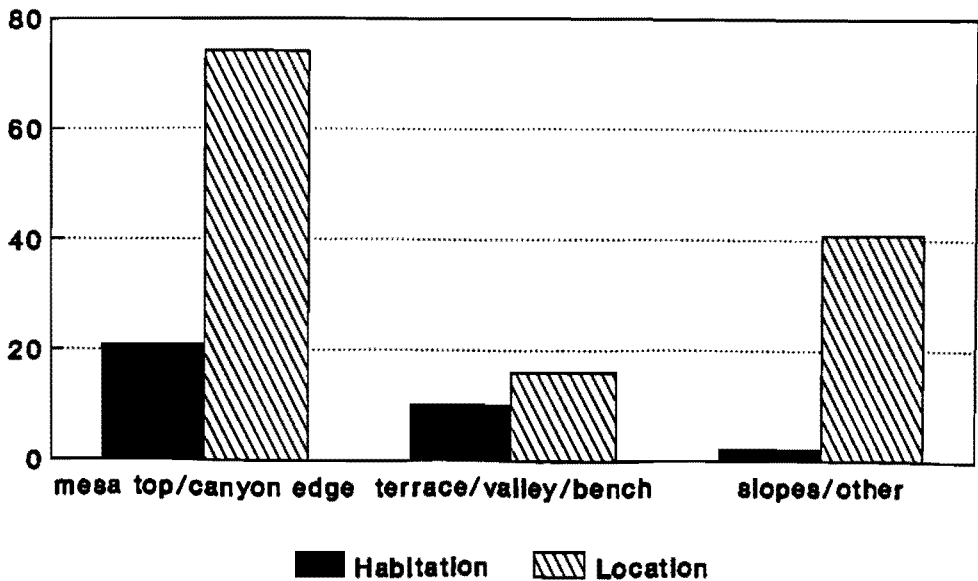


Figure 9. Site types (habitation vs. "location"): physical locales.

the .01 level of significance. That is, there is a significant difference in placement between habitation sites (residential base and field camps) and "locations". While the overall sample size is still small, only 1 cell in the matrix had a frequency smaller than 5.

The chi-square test with the Yates correction was used to assess the null hypothesis: "There is no difference in setting (ecotone vs. non-ecotone) between habitation sites and 'locations'." The null hypothesis was not rejected, even at the .10 level of significance. That is, there is no significant difference in ecotone vs. non-ecotone setting between habitation sites and procurement/processing "locations". This was not expected, and it may be a function of the relative richness of the areas of transition between biotic zones; specific resources may be more abundant in ecotones than in other areas.

Locational variation between residential bases and field camps was also tested using chi-square. Three of the 6 cells had frequencies less than 5, so the statistical results are suspect, but it is interesting to note that the null hypothesis was not rejected even at the .10 level. That is, as stated above, physical locales of field camps tend to parallel those of residential bases.

Analysis of Variance (ANOVA) for distance to water by site type showed a statistically significant difference among site types. For the null hypothesis: "There is no difference among site types regarding distance to water", the null hypothesis was rejected at the .01 level using both chi-square and ANOVA analyses.

CONCLUSIONS

The data presented here support the settlement pattern proposed for Otay Mesa. Residential bases are located in proximity to water and in ecotonal settings. Of the 12 residential bases included in the analysis, 2 are located at the base of the foothills, within 150 m or less of the volcanic outcrops. Two are located on low terraces in Spring Canyon, and 2 are in Otay Valley. One site is located at the head of a long arm of Spring Canyon. The remaining 5 residential bases are all located in proximity to one another at the heads of Spring Canyon and Dennery Canyon and the intervening area. These 5 sites may have composed a large residential base complex, various portions of which were used at different times (seasonally and diachronically). Several other sites in the immediate vicinity have been classified as "locations" and probably functioned as part of the residential base complex.

Field camps are located at a slightly greater average distance from water than are residential bases, but the mean distance is still less than 200 m. Field camps on the eastern

part of the mesa are probably associated with exploitation of the Santiago Peak Volcanics bedrock. Field camps on other parts of the mesa probably represent areas to which task groups from residential bases on the coast traveled to exploit plant and lithic resources not available closer to home.

Most of the sites on Otay Mesa represent procurement and processing "locations" used by inhabitants of the residential bases on the mesa or those in nearby Otay Valley. While "locations" were found in areas suitable for exploitation of resources, proximity to water and a level surface area were not required.

Differential seasonal use of sites as "locations" and residential bases and the use of the same area over many years makes the archaeological record a confusing one. In addition, site disturbances in the form of agriculture and off-road vehicle use have affected archaeological site visibility and patterning as well as artifact assemblages.

Christenson (1990) noted that Late period sites mapped on the Otay Mesa, Imperial Beach, and National City U.S.G.S. 7.5' quadrangles occur in river valleys and large stream valleys, while Early period sites tend to be located on mesa tops or knolls. This is partially borne out by the present study. Three of the 5 sites on Otay Mesa which have produced radiometric evidence or temporally diagnostic artifacts tying them to the Late period are on low benches or terraces in Spring Canyon and Wruck Canyon. SDi-11,376, located in Otay Valley, yielded Late dates on 3 radiocarbon samples (McGowan 1977). Although McGowan feels there is an Early period component at the site as well, her report does not offer evidence to support this claim.

However, 13 of the 16 sites located on benches or terraces in canyons cannot be assigned to any chronologic period, and of the 9 sites within the study area located in Otay Valley, only SDi-11,376 can be ascribed to the Late period. SDi-10,452 has been recorded as an Early period site (Berryman 1986), and temporal ascription has not been determined for the 7 remaining sites.

One of the 2 sites on the mesa top dating to the Late period, SDi-6941, also produced evidence (radiometric and artifactual) of an Early period component.

While these data suggest a preference for valley and drainage locations during the Late period in contrast to mesa top (including canyon rim and canyon head) locations during the Early period, this may partially reflect the poor chronological control of archaeological sites, particularly in the case of "locations" and even field camps, which need not have produced temporally diagnostic ceramics or projectile points. Limited attribute studies of lithic artifacts from 2 sites on Otay Mesa showed no difference in lithic technology between the

Early period site and Late period site. Further studies of this kind are needed to determine methods for differentiating temporal period at sites with no datable material.

Because the chronology of the San Diego region is not well understood, it cannot be said with certainty which "locations" or field camps are associated with specific residential bases on or off the mesa. But this study gives regional archaeologists a basis for comparing data from sites across Otay Mesa and for integrating the mesa with other areas of San Diego. Additional research and better control of temporal developments will help to refine the proposed settlement pattern and aid in our reconstruction of prehistoric lifeways.

NOTE

1. Radiocarbon dates have been obtained from only 6 sites across the mesa. Of the 6 sites dated radiometrically, 5 date between 7,000 and 2,000 years ago, and 1 is dated at approximately 700 B.P. Three pieces of obsidian from sites on Otay Mesa have been traced to the Coso volcanic field. Two of these specimens underwent hydration analysis; 1 yielded an Early period date and 1 produced a Late period date. Ceramic sherds diagnostic of the Late period have been found at 5 sites on Otay Mesa, 3 of which are located on canyon benches below the level of the mesa top. A total of 11 temporally diagnostic bifaces have been recovered from 8 sites. Eight of these bifaces (representing 6 sites) are from Early complexes, and 3 are Late. Two of the sites with Late Prehistoric bifaces are located on benches in canyons. The third Late biface is from a site on the mesa at which 2 Early period bifaces were also found.

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