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ALLUVIAL HISTORY AND HUMAN PREHISTORY IN POZO CANYON, SANTA CRUZ ISLAND, CALIFORNIA

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Abstract—A survey in Pozo Canyon on Santa Cruz Island resulted in the discovery of 40 strata of archaeological deposits exposed on the faces of arroyo walls. These exposures result from entrenchment and lateral expansion of the stream channel during the historic period, most likely as a result of increased runoff intensity related to livestock overgrazing. The archaeological strata are distributed among 18 localities along a 2.4 km length of the canyon extending upstream from its mouth at the ocean. All consist of marine shells, mainly California mussel. Variation in stratum characteristics probably reflects degree of disturbance when covered with alluvium and the amount and placement of shells originally deposited by prehistoric people. Strata range in age over a span of 4500 years, the latest occupation being near the beginning of the historic period. The buried archaeological strata reveal that alluvium was accumulating on the bottom of the canyon over at least the last 4800 years and that the canyon bottom was utilized extensively by prehistoric occupants of the island.

INTRODUCTION

Santa Cruz Island is one of four northern Channel Islands located between 20 and 44 km offshore from the south-facing Santa Barbara County coast. It is the largest of the Channel Islands, with an area of 249 km^2, and also the most topographically and environmentally complex. At the beginning of European colonization of California, the island was occupied by Chumash people, who lived in 11 coastal villages. Site deposits on the island are known to date as early as 8700 cal BP (Glassow 2002) and as late as the terminal occupation of the historically documented Chumash people during the first two decades of the nineteenth century (Johnson 1982; Arnold 2001).

The island is an ideal location for investigating the relationship between geomorphic and soil-formation processes on the one hand and prehistoric human occupation on the other. Prehistoric habitation sites are abundant on the island, with the total number estimated to be between 2500 and 3000, and they are relatively evenly distributed throughout the island. A large number of the sites have deposits buried within alluvial or aeolian sediments, indicating geomorphic conditions different from today's. Sediments have a high degree of stratigraphic integrity because they have not been affected by bioturbation via rodent burrowing, which is widespread on the adjacent mainland. Disturbance from tree-throw is restricted to those parts of the island with arboreal vegetation, mainly north-facing slopes and bottoms of ravines and canyons. Other types of bioturbation appear to have had minimal impact, given the typically distinct boundaries between alluvial units, the existence of pedogenesis at the top of many of these units, and intact pebble lines.

Our research focused on the floodplain at the base of Pozo Canyon, located in the southwestern sector of the island (Fig. 1). Prehistoric site deposits are exposed along the arroyo walls of this canyon as horizontal distributions of marine shells, predominantly of California mussel (*Mytilus californianus*). They occur at different elevations above the channel and have varying thickness and density. Rarely are other types of cultural remains present. At the outset, our research had two principal objectives. The first was to determine the relationship between use of the canyon bottom by

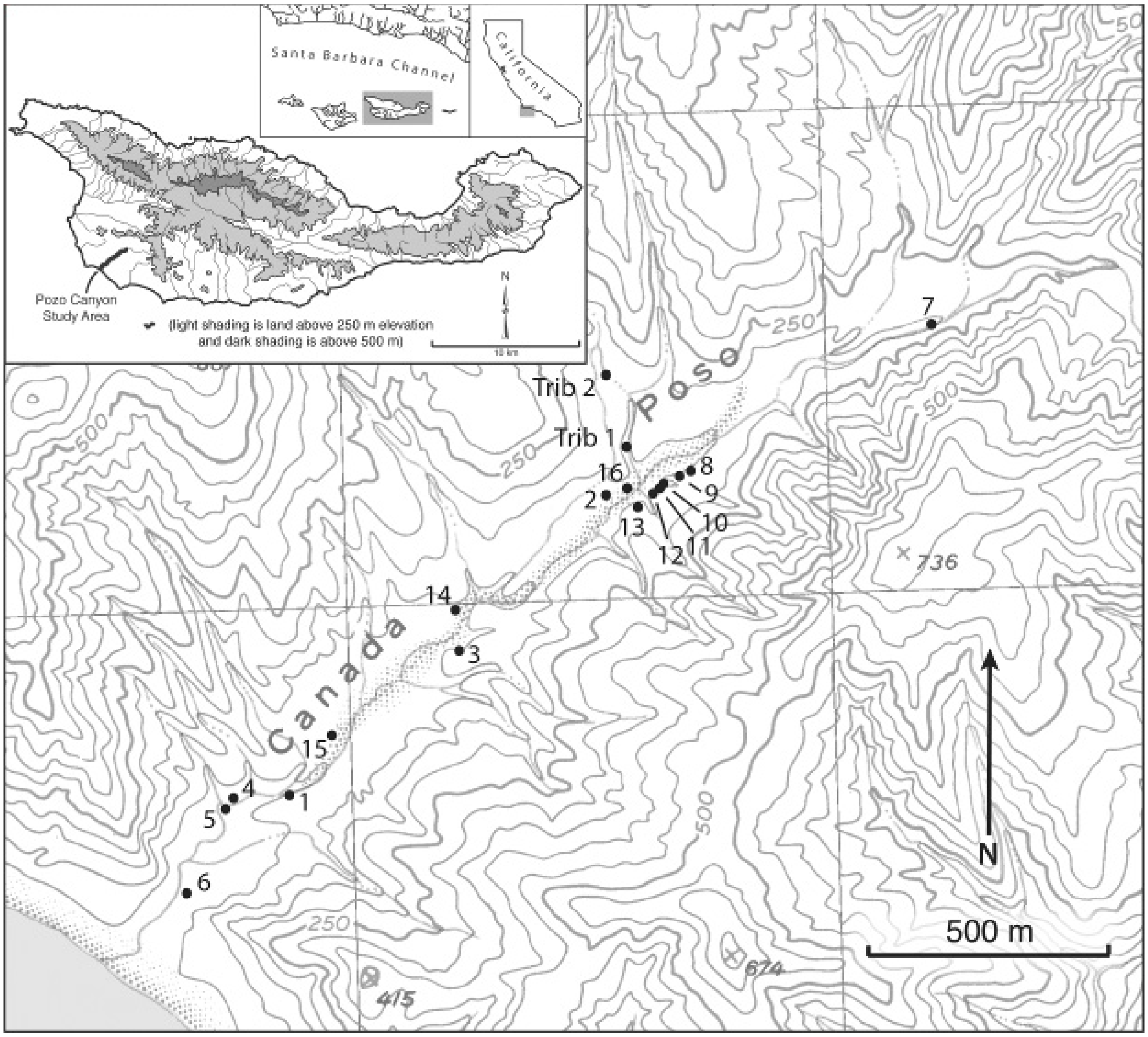

Figure 1. Location of study area and distribution of sites. Only the two sites within the tributary have their prefixes.

prehistoric peoples and the accumulation of alluvial sediments. Was prehistoric use of the canyon floodplain concentrated during particular intervals of time? If so, did these intervals correlate with specific environmental characteristics reflected in the nature and accumulation rate of the sediments? The second objective was to identify any patterning in the geographic distribution of the prehistoric sites that may correlate with geomorphic features, thus providing clues about prehistoric land use. In the course of fieldwork, a third objective was added, as a result of recognizing that historic alluvium occurred at many locations along the length of canyon surveyed. We wished to gain insight into the nature of the historic erosion and alluvial accumulation on the floodplain and the implications for understanding these processes during the prehistoric era.

Pozo Canyon has a gentle gradient and relatively broad floodplain bisected by an entrenched stream channel. Water flows in the channel only during the winter wet season, although perennial surface water is present in the lowermost 150–200 m of its length. Vertical arroyo walls are present along one or both sides of the channel throughout most of its length, and they decrease in height from about 6 m on the upstream end to between 1 and 2 m near the canyon mouth. Today, the floodplain terraces above either side of the active channel are covered with grasslands and coastal-sage scrub. Chaparral occurs on gentle slopes at the terrace-hillslope margins. The incised active channel contains linear groves of willow, sometimes forming dense thickets. No truly arboreal species are present on the terraces or along the channel. The slopes above the terraces have undergone extensive gullying and sheet erosion, more so than is typical of the island, because of the erodible nature of the soils formed on the clay shale bedrock of the Canada Formation through which much of the canyon is incised (Diblee 2001). The bulk of this erosion occurred during the period of sheep and cattle ranching on the island, which began in the mid-nineteenth century and ended in 1987 (Junak et al. 1995, 35).

Alluvial sediments exposed along arroyo walls vary in texture from coarse sand to clay loam. Localized lenses of pebbles also occur, and a few rock fragments in some of these reach the size of cobbles. Alluvial units typically are flat-lying or nearly so. Infilled channels are rare and are less than 3 m deep. Although distinct intervals of sedimentation and soil development can be discerned along the arroyo, stratigraphic variation in color and texture is not always pronounced. Throughout much of the study area the uppermost stratum of sediments is relatively lighter in color and sometimes laminated, and the division between it and underlying sediments is sharp. These sediments were deposited during the historic period and are a product of intense sheep grazing during the late nineteenth and early twentieth centuries (Brumbaugh 1983). Such capping sediments exist at many locations on the island (Brumbaugh 1983, 108–114). Another indication of historic sedimentation is the presence of abundant large cobbles and stones in the active stream channels. These are largely absent in the alluvium exposed on the arroyo walls. The relatively larger size of these rock fragments is indicative of the higher velocity and volume of streamflow during the historic period.

The prevalence of California mussel shells in the archaeological deposits exposed along the canyon's arroyo walls is not surprising, given that mussel shells typically are the most abundant cultural constituent of prehistoric habitation deposits throughout the island, both along the coast and in the farthest reaches of the interior. Although occupation is known to extend back to 8700 cal BP, most habitation sites for which chronological information exists date after 6000 cal BP. The great majority of recorded habitation sites are located on ridge tops, along the coastal margin, or on marine terraces near watercourses. Consequently, the presence of buried archaeological deposits within the alluvium of Pozo Canyon is of special interest to understanding prehistoric settlement systems.

METHODS

The study of the alluvial deposits in Pozo Canyon and the archaeological strata they contain was part of a larger project concerned with assessing the potential for collaborative research involving archaeology and soil science. The project started with a reconnaissance of several localities on western Santa Cruz Island, and two were selected for investigation, one being lower Pozo Canyon and the other in Cañada Christi (Ballantyne 2006). We selected Pozo Canyon because the initial reconnaissance in 2003 revealed that several buried archaeological deposits were exposed on arroyo walls. During this reconnaissance, three sites were documented, and mussel shells were collected from each for radiocarbon dating. In 2004 we carried out a systematic survey of all arroyo wall exposures in the lower portion of Pozo Canyon to record characteristics of each occurrence of archaeological deposits and to collect additional samples for radiocarbon dates. The survey extended 2.4 km upstream to a point approximately 300 m beyond the last arroyo wall exposure, and it included a tributary with extensive arroyo walls. We recorded 18 sites, two of which were in the tributary. Each was given a numerical designation and a prefix based on whether it was along the main channel (Pozo) or the tributary (Trib). A visit to Pozo Canyon by the senior author and three graduate students in the summer of 2006 resulted in the discovery of one additional site, Pozo 16, and an additional, deeper archaeological stratum at Trib 1.

Documentation of each archaeological site entailed recording UTM coordinates obtained with a GPS receiver; height of arroyo wall; number of archaeological strata; and position, character, and thickness of each archaeological stratum. We also plotted the location of each site on a USGS topographic map and photographed the arroyo wall where the strata occurred. All field records are housed in the Department of Anthropology, University of California, Santa Barbara.

Many segments of the arroyo walls were coated with a thin scum of deposits resulting from rainfall runoff. This scum partly obscured divisions between packets and may have resulted in missing some archaeological strata. However, even at locations where the scum coating was relatively continuous (e.g., at site Trib 1), archaeological strata could be discerned. In such situations we selectively scraped away the scum with a trowel in order to clarify the extent of archaeological strata and determine packet characteristics.

Four sites—Pozo 1, Pozo 3, Pozo 7, and Trib 1 (Figs. 2–5)—were selected for more intensive documentation and collection of shell samples for radiocarbon dating. These were sites with more than two archaeological strata (Fig. 6), and they were spaced relatively evenly through the study area. Shell samples for radiocarbon dating also were collected from two other sites. The date from one of these, Trib 2, complements those pertaining to nearby Trib 1. The other date, from Pozo 16, held the potential to document the earliest visible alluvial deposits, given its location only 10–20 cm above an active channel of the current floodplain. At each of the four sites with multiple archaeological strata, we drew a profile of the arroyo wall that showed major stratigraphic divisions, referred to as "packets." A packet is a distinct alluvial unit. Weak soil development, in the form of organic matter staining

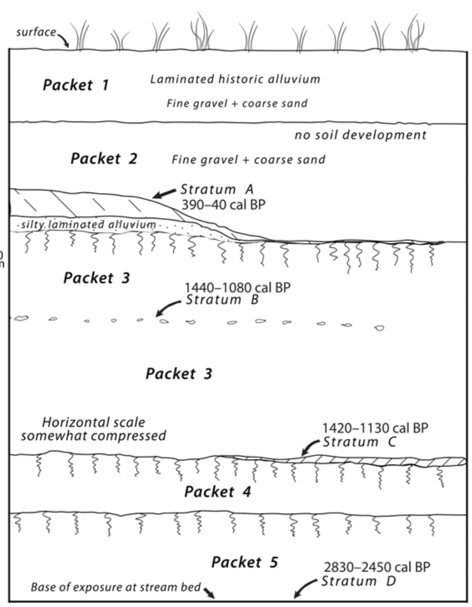

Figure 2. Profile drawing of Pozo 1.

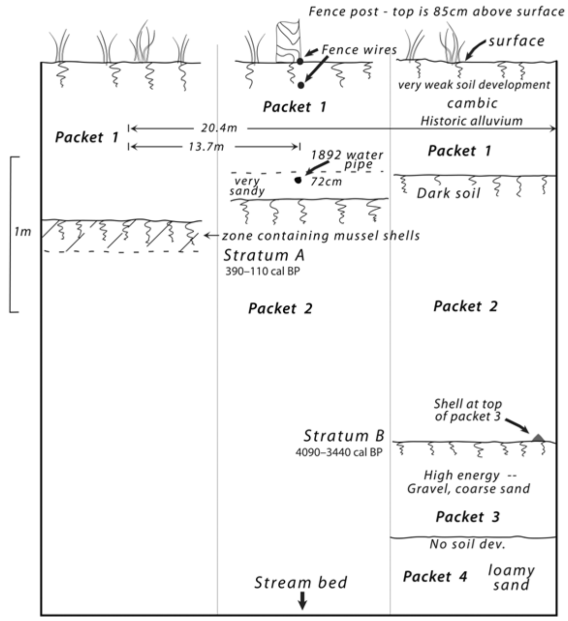

Figure 3. Profile drawing of Pozo 3.

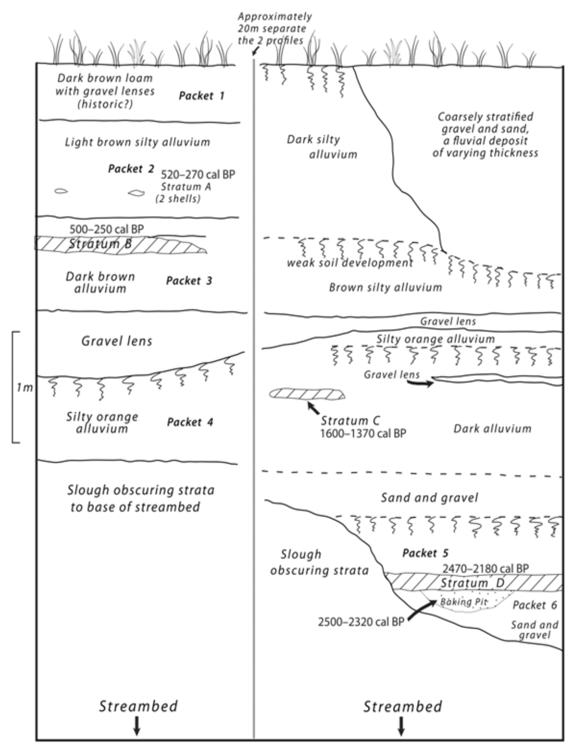

Figure 4. Profile drawing of Pozo 7.

and slight structure formation, often is discernible at the top of a packet. However, packets are distinguished principally on the basis of variation in color and texture even though minor variation of this sort may also occur within a packet. Also plotted on the profile drawings was the location of each archaeological stratum and positions from which samples were collected. We also photographed each site from which a radiocarbon sample was collected.

Sixteen radiocarbon dates were obtained (Table 1). All but one of the dates were derived from marine shell, either California mussel or black abalone (*Haliotis cracherodii*). If no single shell was large enough for a radiometric date, several fragments from the stratum comprised the sample. Funding was not sufficient for AMS dating. As the dates were derived from marine shell, they were corrected for the marine reservoir effect (Delta R=225±35).

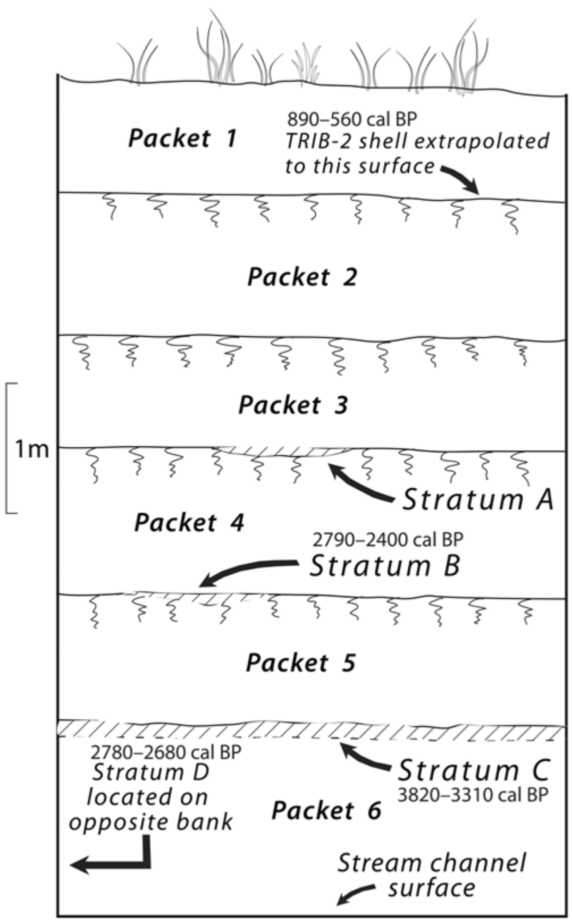

Figure 5. Profile drawing of Trib 1.

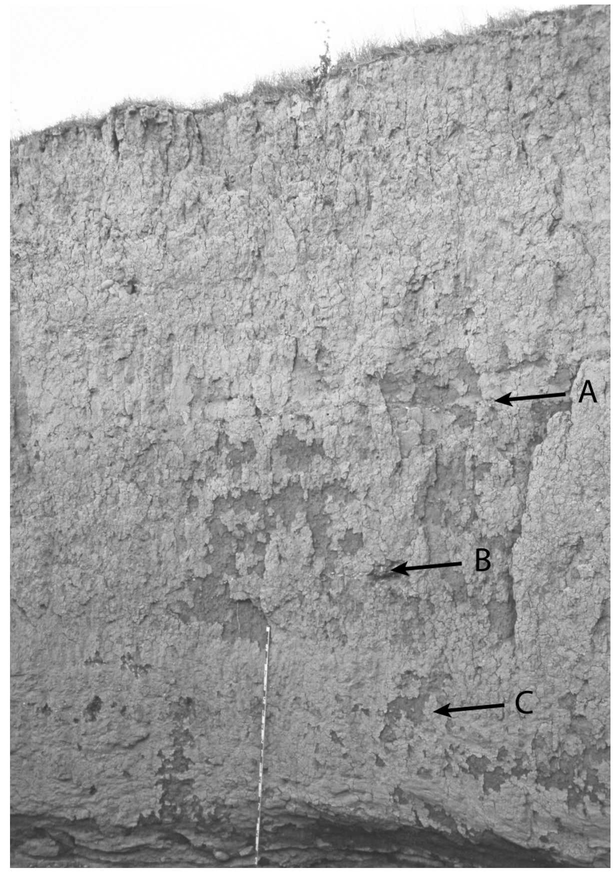

Figure 6. Trib 1 as an example of a site with multiple strata (A, B, C). Pole is 2 m long.

RESULTS

The 18 sites identified (Fig. 1) have a collective total of 40 archaeological strata (Table 2). Seven types of archaeological strata were defined on the basis of thickness of the stratum and dispersion of shell. The breadth of the strata generally is less than 10 m, but in most cases the horizontal extent of a stratum was difficult to follow because of truncation of the arroyo wall, slough against the base of the wall, coatings of dried mud on the wall, or thick vegetation. In the descriptions below, the number of strata within each type is given after each type name.

Low-density middens (16): Thicknesses vary from 5 to 20 cm. Shells in these strata vary in density, but none has a shell density comparable to that of the dense middens of coastal residential bases. These strata most likely are composed of shells at or close to where they were deposited prehistorically.

Thin bands of dispersed shells (9): These strata are 10–15 cm thick, and the density of shells is much

Table 1. Radiocarbon dates.

Lab no.	Locality & depth below surface	Material[1]	C-14 age BP	Conv.age BP	Cal. age BC/AD& 1s interval	Cal. age BP& 1s interval
Beta-185929	Pozo1, Strat A	Several *Mytilus ca.* shells	370±70	790±70	AD 1560(1700)1910	390(250)40
Beta-185930	Pozo 1, Strat B	Several *Mytilus ca.* shells	1500±70	1940±80	AD 510(680)870	1440(1270)1080
Beta-185931	Pozo 1, Strat C	Several *Mytilus ca.* shells	1510±70	1950±70	AD 530(670)820	1420(1280)1130
Beta-185932	Pozo 1, Strat D	Several *Mytilus ca.* shells	2690±60	3130±70	880(760)500 BC	2830(2710)2450
Beta-194823	Pozo 3 Strat A	1 *Haliotis cracherodii* shell	400±50	830±50	AD 1560(1680)1840	390(270)110
Beta-194824	Pozo 3, Strat B	1 *Mytilus ca.* shell	3620±120	4030±120	2140(1790)1480 BC	4090(3740)3440
Beta-194825	Pozo 7, Strat A	1 *Haliotis cracherodii* shell	560±70	990±70	AD 1430(1520)1680	520(430)270
Beta-194826	Pozo 7, Strat B	5 *Mytilus ca.* shells	540±70	950±70	AD 1450(1560)1700	500(390)250
Beta-194827	Pozo 7, Strat C	5 *Mytilus ca.* shells	1750±40	2160±40	AD 350(450)580	1600(1500)1370
Beta-194829	Pozo 7, Strat D, midden above baking pit	Approx. 15 pcs. *Mytilus ca.* shell	2460±50	2870±50	520(380)230 BC	2470(2330)2180
Beta-194828	Pozo 7, Strat D, baking pit	Approx. 20 pcs. wood charcoal	2310±60	2360±60	550(400)360 BC	2500(2350)2320
Beta 234561	Pozo 16	Approx. 100 *Mytilus ca.* shells	4320±60	4730±60	2860(2820)2650 BC	4810(4770)4600
Beta-185933	Trib 1, Strat B	Several *Mytilus ca.* and *Septifer bifurcatus* shells	2680±70	3110±70	840(750)450 BC	2790(2700)2400
Beta-185934	Trib 1, Strat C	Several *Mytilus ca.* and *Septifer bifurcatus* shells	3440±100	3860±100	1870(1600)1360 BC	3820(3540)3310
Beta 234562	Trib 1, Strat D	8 *Mytilus ca.* and 1 *Haliotis cracerodii* shells	2740±70	3170±70	830(780)730 BC	2780(2730)2680
Beta-194822	Trib 2, 70 cm below surface	1 *Haliotis cracherodii* shell	950±70	1380±70	AD 1060(1260)1390	890(690)560

[1]Mytilus ca. = Mytilus californianus.

Table 2. Location of sites and depth, thickness, and vertical position of archaeological strata.

				Archaeo. stratum depth:max. thickness (cm)			
Site	UTM (Zone 11)[1]	Wall height (m)	Hist. alluv. thickness (cm)	A	B	C	D
Pozo 1	0235914E, 3763615N	2.0	25	49:8	93:L[2]	140:L	190:10
Pozo 2	0236538E, 3764218N	5.5	none	280:L	330:L	430:L	—
Pozo 3	0236210E, 3763899N	3.5	70-100	100:20	240:I[3]	—	—
Pozo 4	0235847E, 3763613N	1.8	50	60:L	130:15	—	—
Pozo 5	0235826E, 3763593N	2.2	65-80	120:10D[4]	—	—	—
Pozo 6	0235636E, 3763399N	2.2	50	120:L	—	—	—
Pozo 7	0237193E, 3764577N	6.0	50	110:10	150:10	290:15	450:20
Pozo 8	0236770E, 3764291N	5.2	40	150:15D	440:10D	460:L	—
Pozo 9	0236690E, 3764255N	5.5	40	300:100V[5]	—	—	—
Pozo 10	0236683E, 3764235N	7.4	unclear	470:5	—	—	—
Pozo 11	0236663E, 3764215N	5.2	140	235:10D	275:10D	—	—
Pozo 12	0236634E, 3764211N	2.6	none	120:15D	150:10	175:L	195:10D
Pozo 13	0236552E, 3764157N	5.1	none	2.8:15D	460:15	—	—
Pozo 14	0236222E, 3763983N	2.4	15	150:L	175:L	—	—
Pozo 15	0235915E, 3763650N	1.7	20	50:5	—	—	—
Pozo 16	0236593E, 3764242N	5.5[6]	None	600[6]:5			
Trib 1	0236576E, 3764297N	6.5	none	285:5	400:5	500:15D	600[7]:3
Trib 2	0236570E, 3764476N	5.3	none	70:I	—	—	—

[1]With respect to the 1927 North American Datum.

[2]L = line of dispersed shells.

[3]I = individual shell.

[4]D = dispersed shells within a depth interval.

[5]V = lenses of varying density.

[6]Sample location in streambed about 30 m from an arroyo wall near the location of Pozo 2. Both wall height and stratum depth estimated.

[7]From the opposite bank of the streambed; depth estimated.

lower than in low-density middens. These may represent the margins of strata of the first type, or they may be shells displaced by continual sheetwash from a nearby midden.

Thick band of dispersed shells (1): One stratum is a variant of the previous type. It consists of isolated shells within a band about 100 cm thick.

Band of varying thickness (1): This is another variant. The one stratum in this category contains shell lenses of varying thickness within a band about 100 cm thick. It differs from the one above in containing relatively distinct lenses of shell as well as some isolated shells.

Horizontal lines of dispersed shells (11): In comparison to the types above, the strata assigned to this type have no apparent thickness. They are probably displaced shells from a nearby midden. Each appears to be the result of one alluvial event, or very few events over a short period of time.

Individual shells (2): These are shells isolated from others at the same depth. They may have been discarded by prehistoric occupants, but they could just as easily have been transported by birds that scavenged a shellfish from the coast (see Erlandson and Moss 2001).

Baking pit: A baking pit (pit oven) is bisected roughly in half by the arroyo wall. It is 0.8 m wide and 25 cm deep, and it contains abundant chunks of wood charcoal and fire-affected rocks within a matrix of dark gray deposits. Occurring at the base of Pozo 7, this is the only cultural feature encountered during the survey (Fig. 7). A midden stratum lies directly above the pit, and radiocarbon dates from this stratum and the pit indicate that they are probably coeval (Table 1). The pit and the stratum are counted as one archaeological stratum.

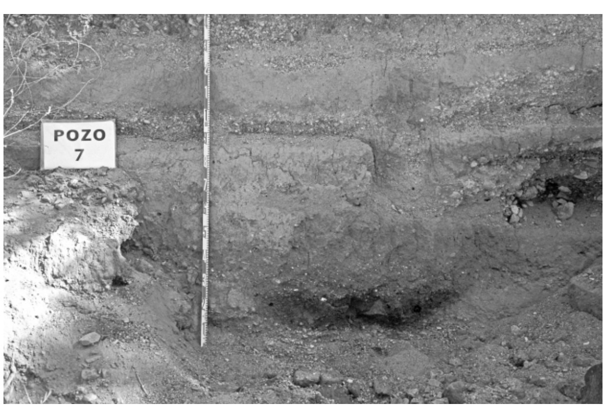

Figure 7. Baking pit near the base of the Pozo 7 profile. Scale's minimum divisions are centimeters.

Alluvial deposition in Pozo Canyon is a product of fluvial processes along the main channel and its tributaries as well as sheetwash and debris flow down adjacent hillsides. The prevailing brownish color (2.5 Y 4/2, 10 YR 4/3) of the prehistoric alluvium exposed on the arroyo walls indicates that aggradation was slow enough to allow soil development to affect in varying degrees all alluvial deposits or alternatively that the source of accumulating alluvium was mainly developed soils eroded from localities within the watershed. The lack of alluvial packets extending throughout the length of the study area is testament to the complexity of alluvial processes.

The relatively distinct boundaries between alluvial packets represent ground surfaces that existed for a period of time before another increment of alluviation occurred. The time interval may have been very short, perhaps only a year, or long enough for some degree of soil development to occur, probably decades or centuries. The number of packets at a site ranged between four and six, and the thickness of packets correlates roughly with the height of arroyo walls. Although packets cannot be correlated between sites, it seems possible that approximately six major episodes of alluvial deposition occurred within the 4500-year interval represented by the suite of radiocarbon dates.

The historic alluvium at the top of the profiles throughout major portions of the canyon represents the last period of deposition. Its light color (10 YR 7/4) compared to the immediately underlying floodplain deposits (10 YR 4/3) is a result of being derived from extensive recent gullying on adjacent hillsides. This gullying cut deeply through hillslope soils with thin A-horizons into the lighter-colored underlying horizons. A significantly greater proportion of the historic alluvium was derived directly from hills and deposited on the floodplain as coalescent alluvial/colluvial fans than was the case in prehistoric times, when the majority of the alluvium was derived from the watershed as a whole and deposited via fluvial processes. The removal of vegetation through overgrazing and the subsequent lowering of infiltration capacity and the increase in overland flow are thought to be driving this shift in the dominant depositional process within the watershed. The presence of this capping sediment, not only in Pozo Canyon but at many other locations on the island, implies that many canyon-bottom sites dating to the late prehistoric and protohistoric period—sites that would have been exposed at the beginning of the historic period—cannot be observed unless they have been exposed by later erosion.

Although California mussel is by far the dominant taxon represented among the shellfish remains comprising the archaeological strata, shells of other taxa are present. These include black abalone, platform mussel (*Septifer bifurcatus*), limpets (probably most being *Achmaea* spp.), and sea urchin (*Stronglyocentrotus* spp.). Because identification of shellfish taxa is based on rapid visual observation of the exposures on the arroyo walls, it is likely that other taxa also are present in relatively minor amounts. The same may be said about other cultural constituents that often occur in island site deposits. Fish and sea mammal bones and stone flakes derived from knapping may be sparingly present in some of the strata, but they were not recognized during the survey.

The archaeological strata appear to be the result of archaeological items, specifically shells, moving short transport distances as alluvium covered them. The large size of many fragments (some being nearly complete mussel valves), their unweathered appearance, the areal discreteness of the strata, and the concentration of shell fragments comprising each strata all imply short transport distances. In addition, the fine-grained character of the overlying sediments indicates low-energy deposition that favors minimal disturbance to archaeological deposits. Indeed, geoarchaeologists have recognized that archaeological deposits may remain largely intact while being covered with fine-grained sediments deposited under low-energy conditions (Waters 1992, 128, 138–140; Rapp and Hill 2006, 69, 75, 76).

With regard to the different types of archaeological strata, the low-density middens appear to be at or very close to where they were deposited by prehistoric inhabitants. The horizontal lines and various types of bands of dispersed shells appear to be a product of continual alluvial deposition that included removal of shells from a nearby prehistoric site. It is also worth noting that capping with alluvium actually may have increased the preservation of archaeological constituents, as has been noted at certain buried sites on the mainland (Erlandson 2007).

Each archaeological stratum associated with a radiocarbon date gives the maximum age of the ground surface when it was at a particular elevation relative to the current elevation of the stream channel (or to modern sea level). It is possible that an archaeological stratum resided on a former ground surface for several centuries before it was covered with alluvium. Weak soil development at the top of some alluvial packets implies that land surfaces remained stable for such lengths of time. However, many packets lack evidence of soil development, implying that time intervals were relatively short.

Multiple radiocarbon dates were obtained for sites Pozo 1, Pozo 3, Pozo 7, and Trib 1. These are in expected order by depth, although a pair of dates for Pozo 1 is essentially identical as is also the case with a pair for Pozo 7. Apparently each of these pairs is the result of two episodes of deposition from the same archaeological deposit located nearby. Only the date for archaeological stratum D at Trib 1 appears anomalous with regard to vertical relationship with other dates for archaeological strata at a site. This date pertains to deposits exposed along a low bank on the opposite side of the stream channel from the arroyo wall where strata A through C are located. The date for stratum D is close to that for stratum B, located approximately 2.5 m higher in vertical elevation. Because stratum D is separated from strata A through C by a horizontal distance of approximately 3 m, it is reasonable to suspect that a slope existed between the locations of strata B and D, the latter being the result of sloughing from the surface represented by the former. Because the modern stream channel has removed the intervening deposits, this possibility cannot be assessed.

The nature of the archaeological sites represented by the archaeological strata is difficult to ascertain. The limited breadth of the strata implies that sites are small in area, although the transport of site deposits may have been limited to only a portion of the site. The low-density middens, such as those occurring at Pozo 1 and 7, appear to be at or close to the location where site inhabitants deposited food refuse, specifically shells, and their thickness and breadth therefore are most likely to be indicative of actual site characteristics. Their thickness being 20 cm or less, and their breadth apparently being less than 10 m, indicates that they were camp sites or day-use localities as opposed to main residential bases, and the characteristics of the bands of low-density shells also are consistent with this interpretation. Some of the camp sites may have been occupied for only a period of days or parts of a day, although some of those represented by deposits 10 to 20 cm thick suggest repeated occupation over a period of years or decades based on chronologies of stratified sites elsewhere on the island. If any of the archaeological strata were derived from principal residential bases, their breadth and thickness should be greater, and a greater diversity of faunal remains, including fish and sea mammal bones, should be present.

Many other buried archaeological deposits may exist in the alluvium filling the bottom of Pozo Canyon. Considering that the arroyo walls are, in a sense, narrow transects through the alluvial deposits, the 40 strata are likely a small fraction, the total number possibly being in the hundreds. Furthermore, archaeological deposits may be buried below the level of the current stream channel, the gradient of which is largely governed by current sea level. In a tributary of Cañada Christi, located 3 km north of Pozo Canyon, a midden stratum exposed at the level of its wash dates to 5720 cal BP (Ballantyne 2006, 42), but even earlier archaeological deposits may exist at greater depths in both drainages.

All but 3 of the 18 sites fall within 2 clusters, one located a short distance from the mouth of the canyon and the other near the largest tributary (with 2 branches) within the study area (Fig. 1). The downcanyon cluster is adjacent to the location of a former wetland, indicated by distinctive remnant soil properties including clear redoximorphic features. This wetland undoubtedly would have harbored a variety of plant resources useful to the prehistoric inhabitants of the island. The upcanyon cluster is much tighter, and it consists of the largest concentration of both sites (9) and archaeological strata (21) (Fig. 1; Table 2). This cluster may be a product of one or more factors. First, the arroyo walls are higher and more extensive in the vicinity of the cluster, providing more opportunity for archaeological strata to be seen. Second, the floodplain is broader at this location than anywhere else within the canyon, and consequently vegetation communities are more extensive. These communities may have provided various plant resources, resulting in a greater intensity of human activity. Third, the confluence of the main channel of Pozo Canyon and a major tributary may have been a reliable location of fresh water during the dry season. Today, no surface water exists at this location during summer months, but it may have been present prior to stream entrenchment and degradation of the watershed's water-holding capacity. In weighing these possibilities, the latter two are most plausible: either plant resources or fresh water attracted people to this locality. The greater area of arroyo wall exposures at this location is not as strong a possibility because relatively extensive exposures extend downcanyon of the cluster, yet archaeological strata are absent.

The 16 radiocarbon dates span approximately 4500 years of prehistory. Although this number of dates is too small to discern fluctuation in intensity of Pozo Canyon occupation, five clusters are apparent, the earliest of which is represented by just one date (Table 3). These clusters span an interval of time from the latter part of the Early period to the end of Late period with respect to King's (1990, 28) chronology. None of the clusters matches the few confidently defined date clusters recognized among all radiocarbon dates obtained from Santa Cruz Island sites, aside from the slightly larger number of dates falling within the period between 700 and 250 cal BP. During this time interval prehistoric

Table 3. Radiocarbon date clusters and their correlation with King's chronology.

Interval of group (cal BP)	No. of dates	King (1990) period	King (1990) phases
700-250	5	Late	L1a–L2b
1500-1200	3	Middle	M3–M4
2800-2300	5[1]	Early–Middle	Ez–M1
3800-3500	2	Early	Eyb
4800	1	Early	Eyb

[1]Two of these dates, from Trib 1, probably are of the same stratum.

population on the Channel Islands apparently was highest (Glassow 1999; Erlandson et al. 2001,18–19; Arnold 2001, 41; Kennett 2005, 115–116, 130–133, 159–168). Considering the breadth of each time interval, ranging between 300 and 500 years, the distribution of dates among the later three intervals appears relatively even. This implies that settlement on the canyon bottom was roughly at the same level of intensity during these intervals.

DISCUSSION AND CONCLUSION

The arroyo walls of Pozo Canyon display an impressive series of buried archaeological deposits unmatched in other drainages of the island with entrenched watercourses. The large number of archaeological deposits probably is due to the canyon's relatively flat gradient, a relatively high rate of alluvial accumulation over the last several thousand years, and a moderate streamflow during prehistoric winter storms. The dated archaeological strata span the latter portion of the middle Holocene and all of the late Holocene, during which island populations became increasingly dependent on marine resources and developed sophisticated technology for acquiring them (Kennett 2005).

The 40 archaeological strata demonstrate that groups of people used the floodplain of Pozo Canyon from at least 4800 cal BP to the end of Chumash occupation of the island in the early nineteenth century. Because the island lacks terrestrial mammals that would have been attractive sources of food (e.g., deer or rabbits), prehistoric peoples seeking inland resources would have been interested in either plants or fresh water. If perennial fresh water were available only near the mouth of the canyon, as it is today, then plant foods and materials most likely were the only attraction. The association between archaeological strata and the former wetland and the wider breadth of the canyon bottom supports this hypothesis, as these would have been the locations where seed-bearing and perhaps also bulb- or corm-bearing plants were likely to have been prevalent. A variety of seeds and bulbs or corms are known to have been important food resources among the island Chumash at the time of European contact (Timbrook 1993, 2007). The unentrenched channel also may have supported riparian vegetation, which may have yielded raw materials for house construction, basketweaving, and other industries.

Island inhabitants who created the archaeological strata within the Pozo Canyon alluvium most likely were residents of one of two large habitation sites located on either side of the canyon mouth. Each is over a hectare in area, and each has dense midden deposits 2 m or more in depth. One of these sites (CA-SCRI-474), on the northwestern side of the mouth, was investigated in 1928. This investigation included excavation of a cemetery (Olson 1930; Hoover 1971, 130–168). Circa 1990, Arnold (2001, 42–44) carried out a test excavation at this site. Radiocarbon dates from Arnold's investigation span a period between AD 418 and 1260 (Arnold 2001, 41); that is, most of the dates fall within the 1500–1200 cal BP time interval of Table 3. The other site (CA-SCRI-475), on the southeastern side of the mouth, has not been investigated, and the chronology of its occupation is unknown. Nonetheless, it is clear that neither site was a Chumash village inhabited at the beginning of the historic period. The archaeological strata dating after 500 cal BP were created by people living elsewhere on the island—for instance, at Morse Point 1.8 km southeast of the of Pozo Canyon mouth, where the historically documented community of *Shawa* was located (McLendon and Johnson 1999). Possibly both canyon-mouth sites have deposits associated with the three earlier time intervals indicated on Table 3, but more investigation would be necessary to ascertain this.

Of the approximately 800 documented archaeological sites on Santa Cruz Island, less than 10% are located within canyons, as opposed to ridges overlooking canyons and marine terraces along the coast. Fewer than 20 sites are truly on canyon bottoms, the precise number being difficult to ascertain on the basis of information recorded on site record forms. Only two other canyons, Cañada Christi and Cañada de los Sauces, are known to have extensive and relatively high arroyo wall exposures. Systematic archaeological survey to locate archaeological deposits along arroyo walls has taken place in these two canyons, but only 14 exposures have been located, and only one of these contains more than one archaeological stratum. The abundance in Pozo Canyon appears to be the result of a congruence of topographic circumstances. Only in this canyon is the floodplain bounded by hillslopes forming the canyon sides, without terraces or other relatively flat landforms elevated above the floodplain upon which prehistoric occupation could take place.

The 40 buried deposits in Pozo Canyon are testimony to the importance of canyon-bottom environments to the island's prehistoric inhabitants. In addition to Pozo Canyon and the other two canyons mentioned, other larger canyons on the island may have, or may have had, archaeological strata buried in their bottomland alluvium. The two most likely possibilities are Laguna Canyon and Cañada del Puerto, but neither has been subjected to archaeological survey. However, these two canyons are associated with the two largest watersheds on the island, and lateral cutting during historic times has removed much of the alluvium on the canyon bottoms, thus reducing the prospect of buried archaeological strata.

The lower prospects in some of the larger canyons on the island should not discourage concerted efforts to locate buried archaeological sites within canyon-bottom alluvium such as those in Pozo Canyon. Many may exist, and they will aid in filling an obvious gap in knowledge of island settlement systems. The sediments exposed on arroyo walls, both in Pozo Canyon and elsewhere, can yield significantly more information about environmental change than we were able to generate in the course of the Pozo Canyon research. Collaboration between archaeologists and soils scientists should continue.

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