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Archaeological Settlement Dynamics on the South Side of Santa Cruz Island

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Abstract. Auger probing and limited excavation of 22 archaeological sites in Coches Prietos drainage, on the south shore of Santa Cruz Island, has provided a preliminary look at the dynamics of settlement from the Early period into the period of historic contact. Based on the presence of burials, bead-making detritus, shell density, and site content, nearly all of the sites appear to be habitations, often small, single family occupations. The drainage was occupied from the Early period onward but there was a significant increase in site density at the end of the Middle period, about A.D. 1150–1300, with many small rock shelters initially occupied at this time. These findings are related to various factors that influenced the development of the complex socio-political organization which characterized the Chumash at the time of European contact.

Keywords: Santa Cruz Island; Chumash; Middle period; Late period; settlement patterns; terrestrial resources; marine resources.

Introduction

When the first Spanish explorers arrived off the California coast, they found a thriving population of seafaring people living in large permanent villages on the mainland and on the off-shore islands. The inhabitants of the island were almost entirely marine-adapted hunters and gatherers but, by the time the Spanish arrived, they had developed a complex society with wealth and status differences, hereditary chiefs, manufacturing specialists, inter-village political organizations, and shell bead money. Travelling in large canoes called *Tomols,* made of split log planks drilled and lashed together, their traders and fisher men made trips all up and down the coast and even as far as San Nicolas Island, some 65 mi out to sea. Chumash trade items such as shell beads and pendants have been found as far east as Arizona and New Mexico.

Presented here is a brief summary of some of the results of field work in Coches Prietos drainage, on the south side of Santa Cruz Island (Fig. 1). Twenty-two sites were systematically probed, using a bucket-type auger, and 5 of these also were tested by small unit excavations. The purpose was to try to determine some of the factors that influenced settlement and the development of the complex society on the island by focusing on the patterns found within a single large drainage. I will discuss some of the major factors that influenced settlement dynamics over the island as a whole and within the study area, mainly during the Middle (ca. 1300 B.C.–A.D. 1150) and the Late (A.D. 1150–) periods.

Terrestrial Resources as Settlement Determinants

Subsequent to the demise of the pygmy mammoths in the late Pleistocene, there were no native land mammals of economic significance on the island. Arnold (1991) estimates that terrestrial mammals provided less than 1% of the islander's diet in the middens she examined, and identifiable terrestrial fauna was extremely rare in the Coches Prietos midden samples. Fox, small rodents, and domestic dog provided the only terrestrial meat sources. It is highly unlikely that human settlement patterns would have been significantly affected by distributions of these animals.

Figure 2 shows the present-day distributions of coastal sage scrub, chaparral and oak woodland on the central part of the island. The latter includes stands of poplar, and ironwood mixed in with oak, but does not include isolated ironwood groves. Timbrook (1984) listed 156 plant species recorded as being used in one way or another by the ethno-historic Chumash. Of these, only 91, or 58%, are presently found on Santa Cruz Island. Almost half of the useful plants known to the Chumash were not found on the island, and many of those that were found available only in limited quantities and at widely scattered locations. Island vegetation communities tend to be found in a mosaic of small patches determined by slope, aspect, water and other local physiographic conditions. Large stands of any particular plant are extremely rare.

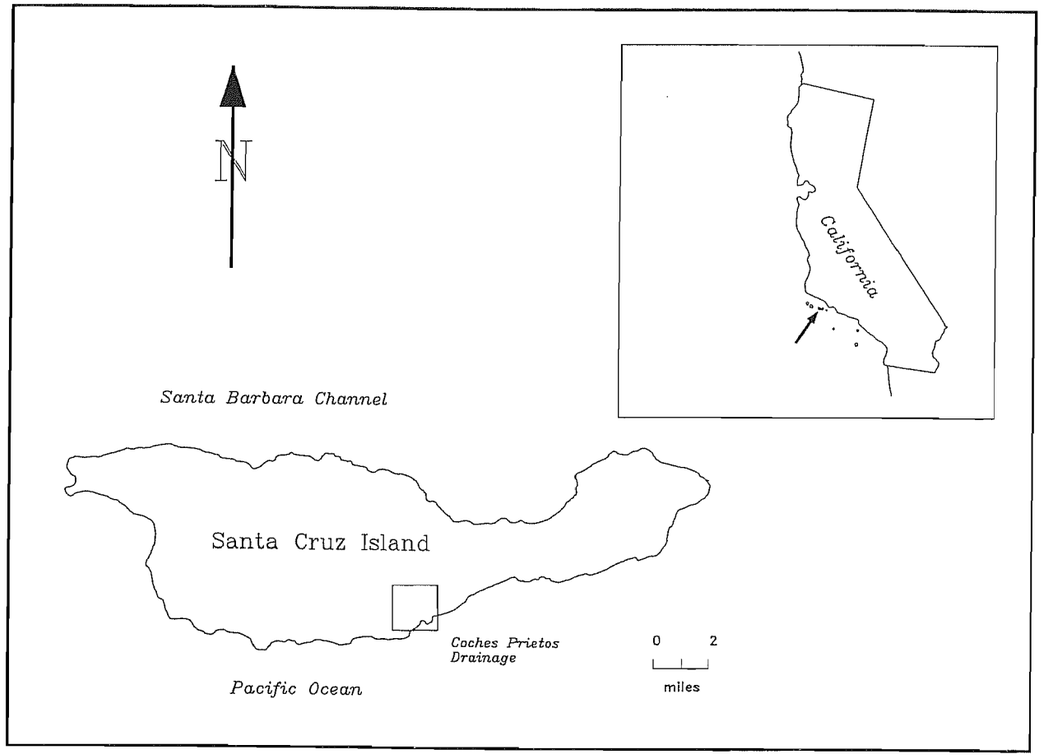

Figure 1. Project location.

Prior to the introduction of domestic animals, the island probably supported more widespread brushland vegetation (Minnich 1980). Coastal sage shrub appears to have been reduced significantly by grazing pressure, as have chaparral and pine woodlands (Brumbaugh 1980; Minnich 1980).

The coastal sage scrub and chaparral communities contain a significant proportion (30 and 31 species, respectively) of the ethno-historically significant plant species on the island. It is thus likely that many plant resources were somewhat more widely available prehistorically than the present vegetation distribution might suggest. However, because these communities are closely tied to topographic and environmental variables, it is likely that their spatial distributions would have been similar to that seen today.

Superimposed on Figure 2 is a circle with a radius of approximately 2 hr walking time, centered over SCrI-1, at the mouth of Coches Prietos Canyon. It can easily be seen that someone foraging within 2 hr of this site would have access to patches of all of the major vegetation communities on the island. Indeed, there are few places on the island where this would not be the case. Given the patchy and dispersed nature of the terrestrial resource environment, it is unlikely that the prehistoric inhabitants would have chosen to locate habitations mainly on the basis of plant distributions. No matter where the islanders chose to live they would be within easy reach of nearly all available terrestrial resources, none of which occurred in large or dense enough patches to support a group for any length of time. At least during Middle and Late periods terrestrial resources primarily influenced the prehistoric islander's choices by their scarcity, causing them to seek elsewhere for significant proportions of their food and other requirements.

Physiographic Determinants of Settlement

The marine resources of the Santa Cruz Island are concentrated in a narrow band between the tide line and the outer edge of the kelp forests. Within this zone the distribution of fish, sea mammals, and shellfish is somewhat patchy, with the highest biomass available in areas

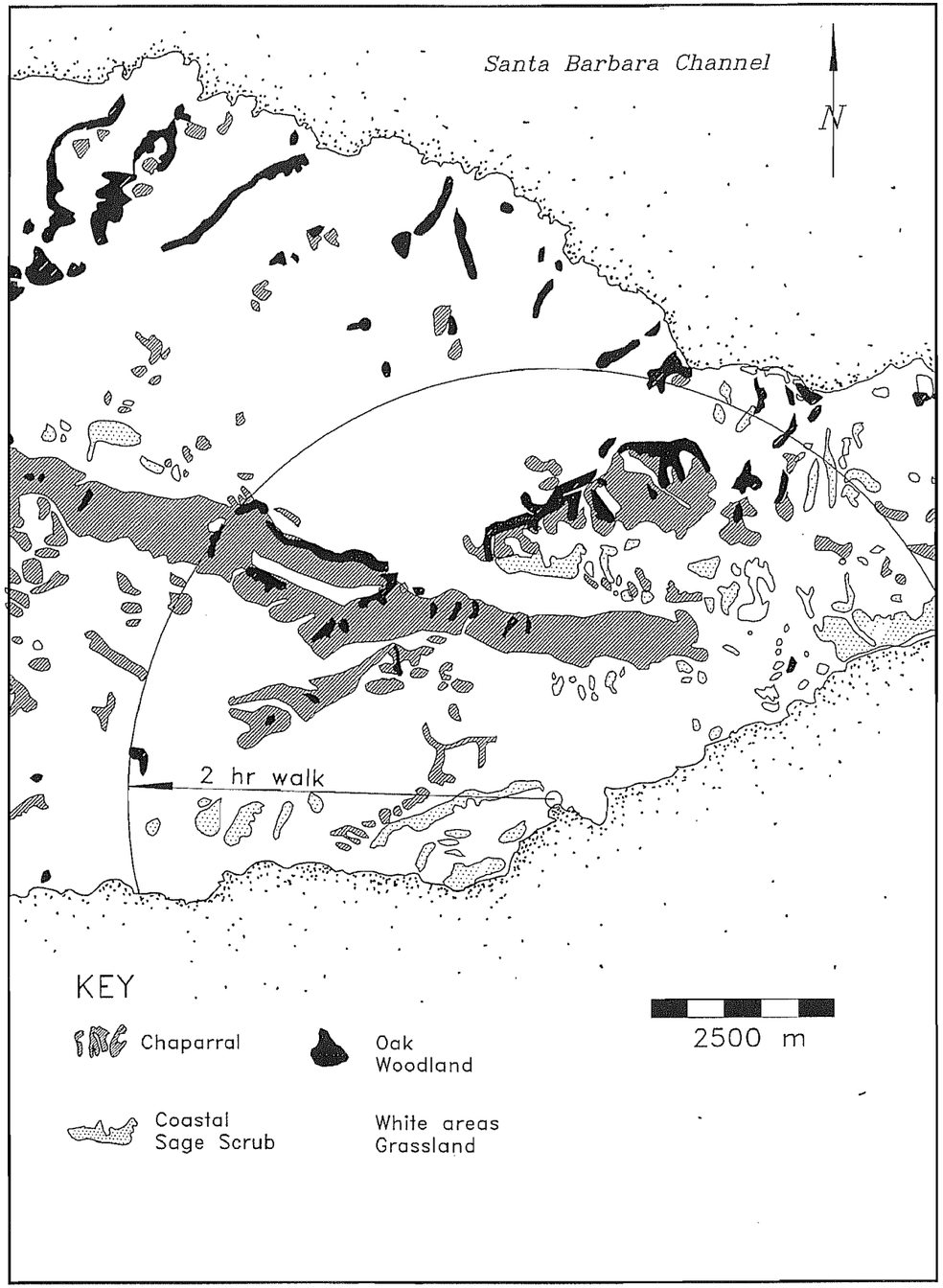

Figure 2. Vegetation distributions on central Santa Cruz Island.

where the kelp forms over rocky substrate (Ebeling et al. 1980). The available biomass is, however, considerably higher in this zone than along similar areas of the mainland. These resources could be accessed from the shore or from small reed boats or rafts. Large, open water fish were readily accessible only from the *Tomols*. Early explorers' accounts (Landberg 1975) tell of Chumash fishermen catching large quantities of Yellowtail and Bonito in the channel. Critical to obtaining all of these resources, of course, is access to the shoreline and the ocean.

The south coast of the island is extremely rugged, with rocky headlands and very steep slopes leading down to the shore. In most areas the only relatively easy access to the ocean is at points where streams have cut down to the coast. Many of these streams form narrow canyons with small beaches at their mouths. A few others, such as Coches Prietos and Willows, have cut extensive canyons that have larger beaches and areas of relatively level open ground in their bottoms. These large canyons provide not only access to the ocean but space for larger villages to develop. In addition, on the south shore, fresh water is available from streams and springs in the bottoms of the canyons. Prehistoric shell middens can be found at the mouths of all of the larger canyons on this shore and at many of the smaller ones as well, and small middens are found along the stream courses well inland.

A somewhat different pattern can be seen on the north shore, from approximately Prisoners Harbor west. Here the drainages are deeply incised into the bedrock and form very steep or vertically sided canyons, with only the narrow stream bed in the bottom. Near the coast these drainages are cut into relatively level benches that are perched above the ocean on top of sheer cliffs. In addition, in some of these drainages the major springs are found at quite high elevations, and for much of the year most of the water in the drainages is found nearer their head. For example, 1 very large spring is found at an elevation of 750 ft above Cueva Valdaze, and flowing water was noted in drainages at elevations of 1,750 ft in midsummer.

On the north shore, the sites are found on the flat benches well above the ocean. They are clustered near the lower ends of the canyons, which provide the access to the shore. There also is a series of relatively large middens located on saddles or benches at considerable elevations above the ocean. These are found at elevations as high as 1,550 ft and contain dense shell and artifacts. They are probably sited to take advantage of the water available at these elevations.

Although most terrestrial food resources probably did not directly pattern the locations of settlements, 1 resource on the island apparently did. Arnold (1985, 1987) has reported on a series of villages on the north shore, from about Prisoners Harbor to China Harbor, sited in order to have and control access to the cherts that outcropped there. From the Late Middle period onward, these sites were occupied by people engaged in the specialized quarrying of chert and/or the production of microblades for trade. In this case, the inhabitants were exploiting a single high-value resource found only in 1 small area. This contrasts with the situation for most of the other terrestrial resources, which were scattered in small patches over the whole island.

Coches Prietos Drainage

The fieldwork took place in Coches Prietos Canyon near the center of the south side of the island. It is a relatively large north-to-south trending drainage encompassing several vegetation communities and a number of topographic situations. At its southern end is a well-protected, horseshoe-shaped bay with imposing rocky headlands on both sides of the entrance.

From the beach to the head of the drainage, the straight line distance is approximately 3 km. The upper end of Coches Prietos is on the south side of the ridge, which divides the central valley from the south shore, at an elevation of 980 ft. In general, the terrain is quite rugged, mainly made up of projecting ridges separated by steep sided canyons. On the higher elevations the Santa Cruz Island schists weather to produce relatively rounded ridges with a distinctive red soil. Lower down, within the Blanca formation, the terrain is much more rugged, with common outcrops, steep slopes, and vertical cliffs. The lower courses of the tributaries tend to be incised into the underlying bedrock. Numerous small overhangs and rock shelters have formed along the steep sides of the canyons thus produced, and a number of these were occupied in antiquity.

Presently, grassland covers the largest percentage of the drainage system. The exceptions are the relatively extensive riparian zones along the major streams and oak woodlands on some of the north-facing slopes. Today, introduced European annual grasses tend to dominate the ground cover in nearly all areas.

Fresh water is found year round at most places all along the lower portions of the main stream channel and on 2 of the major tributaries. Even during the late summer during a major drought water was noted flowing in these drainages. During times of normal precipitation, there is fresh water available along the main drainage for nearly its entire length and in springs and seeps at numerous other places.

Coches Prietos Archaeological Sites

Twelve of the 39 recorded sites in the drainage have rock shelters associated with them. The majority of the shelters are small, with less than 1 m of vertical clearance, but several have evidence of significant occupation. The 3 shelters with only minimal occupation are all relatively large but are located on slopes some distance from permanent water and are somewhat inaccessible. Essentially, every overhang within easy access to water was occupied at least briefly.

Based on several lines of evidence, it appears that the majority of the sites in the drainage were habitations. In many cases, they appear to represent small, short-term occupations by a small group, probably a single family unit. A few of the sites, however, show evidence of long-term occupation by larger groups of people. Some of the sites on the high ridge crest may, however, represent more specialized activity areas.

Density of cultural material provides some measure of the intensity of utilization of a particular location. The maximum shell density was more than 100 g/1000 cm^3 in all except 4 sites and more than 500 g/1000 cm^3 in 2 of the larger middens. This is comparable with the densities reported from coastal village sites on other parts of the island and on the mainland and other California islands (Glassow 1980). The lowest shell densities were found on the ridgetop sites, between Coches and the Central Valley, some of which were mainly lithic scatters with little or no shell noted. All of the sites located along the drainages have moderate to dense middens containing shell, fish and mammal bone, artifacts, and debitage. This suggests that they were places of residence, rather than short-term activity loci.

The case for habitation is further strengthened by the presence of human remains in at least 7 of the sites, from the mouth of the canyon to the ridge crest. At least 3 of

Table 1. Radiocarbon dates from Coches Prietos Drainage.

Site number	Sample number	Radiocarbon age BP	Calibrated age (1 Σ)	Provenience
SCrI-1	UCR 394	[a] 2,470 ± 30	800–400 BC	CS 123–131 cm
SCrI-1	UCR 395	[a] <150		CS 7–23 cm
SCrI-3	BETA 42499	1,390 ± 90	AD 576–684	AT-6, 77–98 cm
SCrI-4	BETA 42500	11,120 ± 50	—[b]	AT-6, 80–96 cm
SCrI-9	BETA 37166	4,840 ± 90	3180–2600 BC	EU-1, 30–40 cm
SCrI-10	BETA 37163	2,670 ± 70	899–796 BC	EU-2, 80–90 cm
SCrI-10	BETA 37164	2,730 ± 60	971–827 BC	EU-1, 30–40 cm
SCrI-10	BETA 42501	2,690 ± 110	972–790 BC	EU-2, 40–60 cm
SCrI-11	BETA 37160	1,250 ± 50	AD 681–855	EU-2, 70–80 cm
SCrI-11	BETA 37161	30 ± 60	AD 1712–1955	EU-1, 10–20 cm
SCrI-11	BETA 37162	460 ± 70	AD 1412–1465	EU-1, 30–35 cm
SCrI-18	BETA 42502	1,130 ± 50	AD 782–982	AT-3, 22–40 cm
SCrI-36	BETA 37165	4,480 ± 80	2740–2130 BC	EU-10, 10–20 cm
RP-3	BETA 42498	620 ± 60	AD 1282–1405	EU-1, 30–40 cm

[a] From Glassow 1980:82–83.
[b] Sample probably contaminated by asphaltum.

Samples calibrated using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program Revision 1.3 (1987).

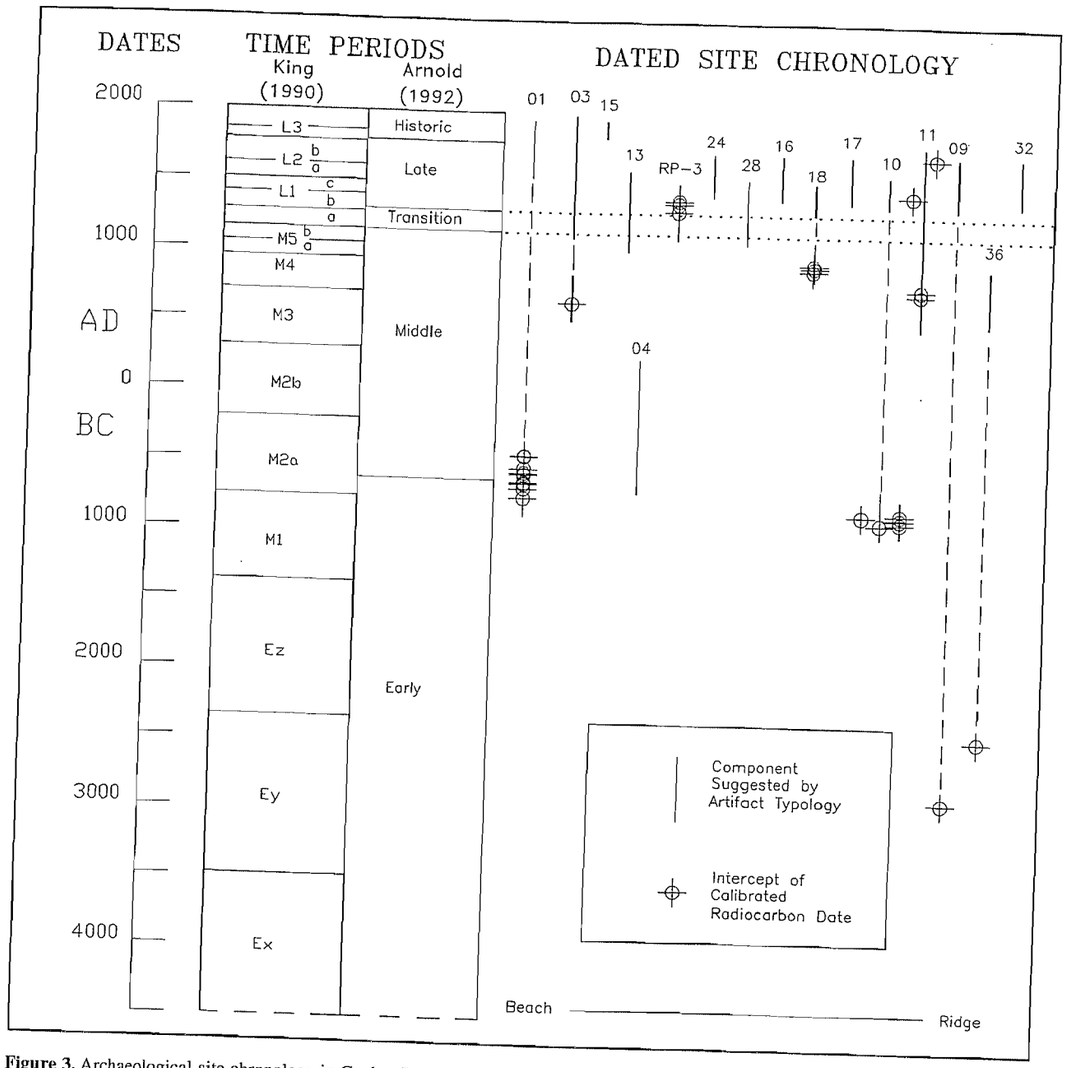

Figure 3. Archaeological site chronology in Coches Prietos Drainage.

the sites, 2 near the beach and one 2 km inland, had evidence of multiple burials. The presence of burials suggests that the locations were occupied long enough to be considered a home base.

Bead manufacture appears to have taken place in at least 13 of the sites. The number of bladelets and/or beads found at any 1 of these sites is extremely small when compared to the bead production localities described by Arnold (1992a, 1992b), but it is suggestive of widespread bead production at what might be considered a cottage industry level. This type of activity would be expected to occur in and around the living spaces rather than at some remote location.

Settlement chronology

Chronological data for the Coches Prietos sites comes from a series of 14 radiocarbon dates from 9 sites (Table 1), and from the identification of beads and bladelets from midden and surface collections. The bladelet chronology is based on Arnold (1985, 1987), who has confirmed the dating on some of the sites based on her examination of the bladelets. The chronology used here is from King (1990). The 2 earliest reliable dates are on mixed *Mytilus* sp. shell. A reservoir correction of 630 yr was applied to reach the calibrated age. All the other dates are on charcoal from auger sample (AT) or excavation unit (EU) floatation residue or from unit level collection. Calibrations were performed using the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program Revision 1.3 (1987). Figure 3 illustrates the chronology of settlement within the drainage. The sites are arranged from left to right in increasing distance from the beach.

The 2 earliest dates are both from sites on the divide between Coches and adjacent drainages. Both sites, SCrI-36 and SCrI-9, appear to fall within the Early period, Phase Ey, but both also have artifactual material that suggests a later occupation. The other sites on the ridge crest are mainly lithic scatters with little or no midden present.

Six sites were first occupied sometime during the Middle period. Only 1 of these does not show evidence of occupation into the Late period. The Middle period sites included all of the largest and densest middens found in the drainage. They included SCrI-1, the large midden at the beach, which was identified with the Historic period village of *Liam*, (Johnson 1988; Arnold 1990b), and SCrI-10, a large village site at the stream confluence approximately 2 km from the beach. Based on radio-carbon dating and artifact typology, both of these sites appear first to have been occupied during the early part of the Middle period (M1 and M2a). SCrI-1 appears to have been occupied almost continuously from that point on but, while the midden density suggests intensive occupation during the Middle period, SCrI-10 has only minimal evidence of use in the Late period. Also located near the main stream confluence is a large, west-facing rock shelter and midden. It is in a particularly desirable sheltered location with permanent water immediately in front of the opening. The midden apron at the site is over 1.5 m and has the highest shell density in the drainage; greater than 600 g/1000 cm^3. The earliest date for the site is 1250 ± 50 yr BP (Beta 37160), in the Middle period (M4). This sample was from the 70–80 cm level of a unit in the 1.5-m deep midden. It is likely that the site was first occupied considerably earlier than this date indicates. Two samples from units inside the shelter gave dates in the early part of the Late period and the Historic period, suggesting a long occupation for this spot. It is 1 of only 3 rock shelters that appear to have been occupied prior to the end of the Middle period.

Arnold (1991, 1992a, 1992b) proposes that the transition from the Middle to the Late period occurred between approximately A.D. 1150 and 1300 as a result of environmental stresses. No Coches Prietos sites produced C^{14} dates within this period, but 1 rock shelter produced a date near the end of the transition and had a bladelet assemblage which clearly indicated occupation during it (Arnold 1989, pers. comm.) Bladelet and/or bead assemblages from 4 additional sites also suggest possible utilization through the Middle/Late transition, but are based on very small samples.

While the data pertaining directly to the question of Middle/Late period transition dynamics are limited in the Coches Prietos sample, there is abundant evidence of profound change in the patterns of settlement at the end of the Middle period. Arnold (1990a, 1992b) notes that relatively few of the coastal sites in her sample show continuity of occupation through the Middle and Late periods. In the combined coastal and inland samples from Coches, only 1 dated Middle period site fails to show evidence of occupation in the Late period. The number of sites with datable material increases dramatically, however, after the end of the Middle period. Of the 16 sites for which there were at least some chronological data, only 2 did not have evidence suggesting Late period utilization. Eight sites appear to have been initially occupied at the end of the Middle period or later. These sites are found all the way up the drainage to the top of the ridge dividing Coches from the Central Valley. Rock shelters appear to have been popular with Late period home seekers. Five of the 8 newly occupied habitations had overhangs associated with them; most just large enough for an adult to sit up comfortably and 1 only had a narrow horizontal crack that was probably useful only for storage.

Three sites, all near the beach, had evidence of occupation into the Historic period. These included *Liam*, at the mouth of the canyon, the large midden on the opposite side of the creek, and a small shelter just behind the beach. The latter is identified as historic on the basis of a single melted glass bead found in the augering.

Summary

The limited and patchy distribution of terrestrial resources forced island inhabitants into a much more marine-oriented subsistence pattern than that of their mainland neighbors. The settlement pattern on the island was, therefore, tied primarily to access to marine resources rather than terrestrial.

Most of the previous archaeological work on Santa Cruz Island has concentrated on the large coastal middens. To some extent this may have skewed our perceptions of settlement on the island. Arnold (1992b) describes Late period communities as primarily coastal, sedentary, and averaging 50–250 persons per village. The evidence from Coches Prietos suggests that there may have been an additional component to Late period settlement that consisted of a number of outlying small sites occupied by 1 or more family units. These can be found

at nearly any point where fresh water was available and often made use of naturally occurring shelters. The continuity of occupation that seems to exist at the large coastal village at the mouth of the canyon suggests that some of these sites were occupied contemporaneously with it. This brings up the question of their relationship to that village. The inhabitants of many of the small sites appear to have been involved in the production of beads on a small scale, implying that they were not cut entirely out of the economic system. If the beads produced were for trade they must have had at least peripheral relations with the elites controlling the trade. This would imply that the settlement within the drainage was part of an at least loosely interconnected system.

The preliminary findings from Coches Prietos suggest that there is significant potential for examination of population and settlement dynamics in the examination of the small, rather unspectacular, sites located up-drainage from the coastal middens. The present analysis is still in progress and future work is contemplated.

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Confirmation of Middle Holocene Ocean Cooling Inferred from Stable Isotopic Analysis of Prehistoric Shells from Santa Cruz Island, California

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Abstract. Archaeological sites dating from 5,900 to 4,500 yr ago on the northern Channel Islands of southern California contain abundant shells of red abalone (*Haliotis rufescens*), a cool-water mollusk, and generally lack shells of black abalone (*H. cracherodii*), a warmer-water form. This implies the existence of cooler intertidal sea-water temperatures 5,900–4,500 yr ago during the accumulation of these deposits. This hypothesis has been tested using oxygen isotopic analyses of California mussel (*Mytilus californianus*) shells from a red- abalone midden on Santa Cruz Island and on modern shells from the adjacent intertidal zone. The study reveals that average intertidal water temperatures (~12.9° C) then were ~2.5° C cooler than today (~15.5° C). Analyses also suggest larger middle Holocene annual sea surface temperature differences and perhaps greater seasonal variability compared with today. Carbon isotopic fluctuations during shell growth in the modern *M. californianus* clearly record seasonal changes in the intensity of upwelling. Higher inferred upwelling, marked by lower $\delta^{13}C$ values in the shells, occurred during cooler-water months marked by higher $\delta^{18}O$ values. The stable isotopic data in the archeological material indicate significant variability in the seasonality of inferred upwelling. Colder conditions and more variable climatic and oceanic conditions during this middle Holocene interval may have significantly influenced human maritime adaptations.

Keywords: Santa Cruz Island, California; Santa Barbara Channel; prehistory; archaeology; paleoenvironmental change; climatic change; sea-surface temperature change; oxygen isotopic analysis; carbon isotopic analysis.

Background and Objectives

Early and middle Holocene shell middens on the northern Channel Islands of California contain abundant red-abalone (*Haliotis rufescens*) shells. In island sites dating after ~4,500 CYBP (calendar years before present) red-abalone shells typically are much less abundant, and black abalone (*Haliotis cracherodii*) is the prevalent abalone species represented (Glassow 1993a). Based on earlier work by Hubbs (1958, 1967), Glassow (1993a) proposed that the prevalence of red-abalone shells in island sites during 2 main intervals of time (~8,100–7,300 CYBP and ~5,900–4,500 CYBP) resulted from cooler intertidal temperatures equivalent to latitudes of central and northern California today. Following ~4,500 CYBP, black abalone became the dominant abalone species in shell-midden deposits, reflecting warmer intertidal conditions. Black abalone is the dominant form in the intertidal zone today in southern California, while red abalone occurs subtidally. To the north of Monterey, California, red abalone is dominant and black abalone less frequent in the intertidal zone.

The selection of intertidal shellfish by prehistoric peoples depended on a number of factors, including abundance, availability, and ease of collection. Thus, some archaeologists have challenged the hypothesis that the prevalence of red-abalone shells in early to middle Holocene midden deposits resulted from changes in molluscan distribution related to cooling. Salls (1992) argued that overexploitation or factors other than temperature change accounted for red abalone abundance in prehistoric middens on the islands off southern California. However, a sea-surface paleotemperature record based on