SETTLEMENT AND SUBSISTENCE AT THE MIDDLE/LATE TRANSITION ON THE SOUTH SHORE OF SANTA CRUZ ISLAND

Robert R. Peterson, Jr.

Environmental Management, Cultural Resources Section
30 CES/CEVPC, 806 13th St. Suite 116, Vandenberg AFB CA 93437-5242
(805) 606-7453, FAX (805) 606-1339, E-mail: petersor@vafbla.vafb.af.mil

ABSTRACT

The 39 archaeological sites in Coches Prietos Drainage, on the south side of Santa Cruz Island, share a number of spatial and physical characteristics, which suggest that most of them functioned as habitations. Some of these appear to have been contemporaneous with the large village at the beach, identified as the historic village of *Liyam*. This village was the home base for several large ocean-going canoes, or *tomols*. The use of such watercraft offered significant advantages to those fishermen who could afford them. When the faunal evidence from the drainage is considered in terms of relative protein contributions of fish, sea mammal, and shellfish, and size of fish, there are significant differences between *Liyam* and the more inland sites. These differences suggest that fish and sea mammals were a far larger part of the subsistence at that village than the other sites. These findings suggest that the people in the small, inland habitations did not have equal access to some resources as those at the coastal village. This may have important implications in terms of the patterns of settlement and/or social hierarchy in the drainage and elsewhere in the channel region.

Keywords: Santa Cruz Island, Coches Prietos, *Liyam, tomol,* fishing, Transition Period.

INTRODUCTION

Coches Prietos Drainage, on the south side of Santa Cruz Island forms the study area. It contains 39 known prehistoric sites; one of which is a large village that was occupied nearly continuously from the Middle Period onward. Most of the rest of the sites are arrayed along the drainage and appear to have been occupied by small groups for varying lengths of time. The nature of these small living groups is of some interest in examining the socioeconomic patterns that developed in the Late Period on Santa Cruz and the other Channel Islands.

I here argue that it was the ability of certain individuals to obtain surplus meat, as a result of the development of efficient watercraft, which may have served as a catalyst for the initial development of economic and sociopolitical complexity in the channel region; and that this happened during times of relative abundance in the latter half of the Middle Period between about 500 and 1100 AD. The evidence from Coches Prietos indicates a significant increase in the recovery of fish and sea mammals consistent with what would be expected from the use of seaworthy boats. The bounty from this effort was not, however, distributed equally among the population. There are significant differences in subsistence data between the main coastal villages and the rest of the drainage. I will explore possible implications of these differences.

The *Tomol*

Hudson, et al. (1978) place the development of the plank canoe, or *tomol*, at about 500 AD; based on the initial appearance of canoe plugs, caulking, drills, and elaborate maritime technology in the channel area. They consider it a local invention, probably resulting from incremental elaboration of the dugout canoe (Hudson et al. 1978:22-23). Arnold (1992:75) reports identifying two probable canoe-making localities on Santa Cruz Island containing concentrations of macrodrills, redwood, cakes of asphaltum, and other construction materials. She notes that such canoe-making materials seem to appear with increasing frequency after about 1100 AD, indicating increasing importance of the *tomol* in the Late Period.

A plank canoe was extremely difficult and time consuming to build. It required specialized materials and tools, and its construction could be performed only by skilled boat builders. The wood had to be carefully selected and seasoned for several years and construction might take from forty days up to six months (Hudson et al. 1978:41); during which time the builders had to be supported and supplied with materials. The person who contracted for the construction of a canoe had to have some wealth built up to start with. Fernando Librado reported that "Only a rich man owned such a canoe, and sometimes he might own several." (Hudson et al. 1978:39). Arnold (1995:734) argues that the *tomol* was one of the stimuli for development of new levels of sociopolitical complexity at the end of the Middle Period. She argues that high capacity watercraft offered the new entrepreneurs the ability to become cultural brokers, manipulate transportation, facilitate logistics of daily activity, such as moving goods or acquiring new resources. Arnold (1996:66) appears to emphasize the role of the plank canoe

in trade and transportation and as symbols of social status and prestige, although she certainly acknowledges their ability to increase subsistence yields (Arnold 1995).

Resource Acquisition and the *Tomol*

Arnold (1995:735) notes that rich coasts offer access to multiple habitat types which are often much more productive than other nearby areas. She points out that advances in the technology of ocean going boats allow access to a wider range of potential habitats and resources. Ethnographic records of trip times and experiments with a *tomol* replica, the *Helek,* indicated that speeds of up to eight knots were possible. The *Helek* also appears to have a total carrying capacity between 3,000 and 4,000 pounds (Hudson et al. 1978:122). The use of the plank canoe thus provided the aboriginal fisherman with the ability to cover a wide territory and haul a large quantity of fish. If we assume a maximum two hour traveling radius and a six knot speed, the boatman could fish areas as far as 22.2 km (13.8 miles) from his home port. For a fisherman from *Liyam* this would allow access to most of the south shore of Santa Cruz Island, as well as about 225 square miles of ocean. While much of this area is relatively unproductive open sea there are a large number of very productive fishing areas located within it. It should also be noted that the Chumash were highly skilled, professional fishermen, who knew the waters around the islands intimately.

It is difficult to quantify the advantages offered by efficient watercraft, but data compiled by the California Department of Fish and Game and the National Marine Fisheries Service may provide some clues. One factor that can be examined is the catch rate differential between modern anglers on shore and those fishing from boats. According to data collected between 1987 and 1989, southern California shore fishermen averaged from 1.8 to 7.4 fish per trip while those fishing from boats averaged from 5.9 to 7.1 fish per trip (Witzig et al. 1992: 15). When the average number of hours fished is taken into account the catch rates per hour for all three years average out to 0.74 fish/hr for shore fishing and 1.42 fish/hr for boat fishing.

Figure 1 illustrates how this catch advantage might have been enhanced as a result of the species of fish captured. The figure shows the general size range of fish commonly caught by modern southern California fishermen. It is taken from California Fish and Game records. The fish are arranged in ascending order in terms of the percentage of the total catch of that species caught from shore. It is obvious that there is a general trend towards larger fish being caught from boats. Sebastian Vizcaíno, who visited the Southern Channel Islands in November of 1602, described Caneliño fishing techniques. He reported that " The smaller fish were taken in their canoes, the larger dragged to shore." (Vizcaíno 1967:10). It would have to be a pretty large fish that it could not be taken into a *tomol,* but CA-SCRI-1 contains swordfish vertebrae weighing over 40 grams apiece, suggesting that such fish were, indeed, taken. Additional advantages accrue when considering sea mammal hunting. Given that seals and sea lions are generally available for capture only at specific widely scattered locations on the coast, the use of plank canoes would greatly facilitate such hunting. The speed and carrying capacity of the *tomol* would provide the crew with the ability to travel to distant haul-out areas and to transport large packages of meat with relative ease.

The enormous cost of a canoe limited the number of people who could posses them to those who had already

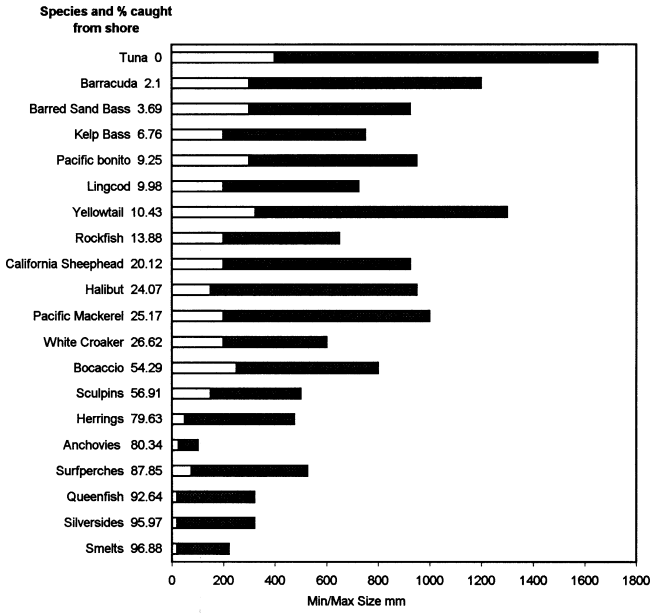

Figure 1. Sizes of fish and percentage caught from shore and boats.

begun to accrue some influence and wealth. They were in a position to take risks that others in the society could not. The increased ability to procure surplus protein, in the form of fish and sea mammals, allowed canoe owners to garner additional influence, since any surplus brought in could be distributed by the owner. Anyone who wished to share in the surplus needed to be allied in some way to that individual through kinship, political, or economic relationships. Kinship alliances were probably the most common. Fernando Librado told Harrington that those who assisted with the construction of the canoe got a share, as well as people chosen by the canoe-makers. The owner's relatives also received shares (Hudson et al. 1978:130). These alliances then allowed the elites to exert various levels of control over craft specialization, political organization, and economic institutions in ways that would further enhance their influence.

Brian Hayden (1996) provides compelling arguments suggesting that these events likely began during times of relative plenty, rather than times of stress. He notes that it would be easier for those in positions of wealth to increase their influence during times of stress if these prerogatives were already a well established facet of the society (Hayden 1996:55). Plentiful resources allow time and surplus energy to be devoted to possibly risky changes in procurement strategy, which are less likely to be attempted in stressful

periods. He also points out that communities are more likely to recognize claims to special privileges or private ownership of resources when there is plenty to go around and the privileges would not affect other's livelihood. If these privileges were perceived, as limiting other's ability to procure food or materials, during times of stress for example, they were liable to be revoked by the community (Hayden 1996:52-53). The use of the plank canoes did not, however, affect other people's ability to fish and a canoe-owner who was perceived to be generous with the surplus, could actually increase his influence and prestige during hard times. Thus the initial steps toward social complexity and differentiation in Chumash society probably occurred during the more environmentally friendly Middle Period, but may have been accelerated by drought conditions identified with the Middle/Late Transition (Raab and Larson 1997). Kennett, in his recent dissertation (1998:359), has demonstrated that this period was probably characterized by relatively high marine productivity but low terrestrial productivity. He also indicates that changes in subsistence and settlement were occurring gradually on the Northern Channel Islands over the period between about 3,000 and 800 BP (Kennett 1998: 357-361).

The Coches Prietos archaeological sites span the Middle/Late Transition and provide some evidence bearing on subsistence patterns over this critical period. The evidence is based on nearly 500 samples from all levels of 22 different sites in the drainage. There are interesting patterns in the data which suggest that the above may have been taking place but other explanations are also possible. Below we will examine the subsistence data as it applies to this crucial period.

PROJECT AREA

Coches Prietos canyon is near the center of the south side of Santa Cruz 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 three kilometers. In general, the terrain is quite rugged, with projecting ridges separated by steep-sided canyons. 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. The grassland community is dominated by nonnative annual grasses but also includes an overstory of scattered woody shrubs, chiefly lemonade berry (*Rus Integrifolia*) and scrub oak (*Quercus dumosa*). Along the main channel the riparian vegetation consists mainly of mulefat (*Baccharis glutinosa*) with scattered patches of willow (*Salix sp.*). The chaparral is dominated by scrub oaks (*Quercus sp.*), toyon (*Heteromeles arbutifolia*), and manzanita (*Arctostaphylos sp.*). Nearly all of the plant communities present on the island are represented in the drainage but most are found in relatively small patches in specific topographic situations. Because of this tie to the drainage topography, plant resource availability probably has not changed drastically since prehistoric times.

Fresh water is found year round all along the lower portions of the main stream channel and on two of the major tributaries. Even during the late summer during a major drought, water was noted flowing in these drainages. It was not, however, flowing along the entire length of the stream, but only at a few specific points where bedrock was close to the surface. 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 in the bottom of the canyon.

METHODS

The data come from limited auger probing and excavation at 22 sites in Coches Prietos drainage as part of my dissertation research; and from a column sample recovered by Dr. Michael Glassow in 1974 (Glassow 1993:79). The 22 sites I tested ranged from large dense middens to very small scatters of lithics and shell and were found from the mouth of the drainage to the top of the divide ridge 3 km from the beach.

The auger probing was done with a 10 cm diameter soil bucket auger, recovered in 20 cm increments. One-half by one meter excavation units were also dug in five of the sites. Nearly all recovered material from the augers and large samples from the excavation units were bagged and returned to the lab at the field station, where they were run through a 55 gallon flotation system. The intent was to recover charred seeds and macrobotanical remains from as many samples as possible. While this was not as productive as had been hoped, it did produce very clean samples of shell, bone, and lithics, which made sorting easier. Prior to flotation the soil volume was measured for each sample so that comparable density measures could be calculated. The non-floating, or heavy fraction, material was size-sorted into three categories using standard screens; 1/4-, 1/8-, and 1/16-inch All the 1/4 inch material and at least 100 ml of 1/8 inch material was sorted from each sample. Using the total volume of material and the 1/8 inch volume actually sorted, estimated total amounts of each category for the 1/8 inch size fraction were calculated and used in subsequent analyses. The 1/16 inch material was only examined for column samples, and is not discussed here.

Glassow's column sample came from the major village site of *Liyam*, at the mouth of the drainage (CA-SCRI-1). The column sample was 30 x 30 cm in size and went to a depth of over 130 cm. The data used here comes from two strata (7 to 23 cm BS and 123 to131 cm BS); radiocarbon dated to the Late and Middle Periods respectively. I used the original data from the columns to recalculate both Late and Middle Period values using meat weight and protein conversion factors that I used for the rest of the drainage. I

was also able to reexamine the bone from the Late Period levels. Material is reported in grams/1,000 cubic cm (g/1,000 cm^3) of excavated volume.

In nearly all the middens, shell is the most obvious component, and at all sites the vast majority of the shell, over 90% in most cases, is California mussel (*Mytilus californianus*). In terms of edible meat and protein, however, this is very misleading because the ratio of shell weight to edible meat is very high. For example in *Mytilus* the weight of edible meat is approximately 1/3 of the weight of the shell while for fish 1 gram of bone equates to approximately 28 g of edible meat. It is therefore necessary to convert shell and bone weights to some comparable value. Because protein is the primary nutritional value of meat this is often utilized as a comparison value (Erlandson 1988); therefore all bone or shell weights were converted to protein. These conversions are generally based on experiments and take into account the loss of meat due to processing. Table 1 shows the conversion figures that have been used in the following analyses.

Table 1. Meat and protein conversion factors.

Meat Source	Meat Weight Multiplier	Protein Weight Multiplier
Shell (*Mytillus*)	0.322[a]	1.144[b]
Fish - general	27.7[a]	0.193[b]
Sea Mammal	24.2[c]	0.283[d]
Land Mammal (deer)	10.0[e]	0.215[d]

[a] Tartaglia 1976; [b] Watt and Merrill 1963; [c] Glassow and Wilcoxon 1988; [d] Erlandson 1988; [e] Erlandson 1991.

SITE CHRONOLOGY AND DISTRIBUTION

There is abundant evidence of profound change in Coches Prietos at the end of the Middle Period. Settlement appears to have changed in both intensity and pattern. All sites with Middle Period components also show evidence of occupation in the Late Period but the number of sites with datable material increases significantly (Figure 2). Every one of the 17 sites for which there are dates had at least some evidence suggesting Late Period utilization. Eight appear to have been initially occupied at the end of the Middle Period or later. Rockshelters appear to have been popular with Late Period home seekers, as five of the eight newly occupied habitations had overhangs associated with them. A couple of the sites appear to have been located in particularly favorable places and may have been occupied nearly continuously. As *Liyam* also appears to have been occupied almost continuously through the Late and Historic Periods, it is evident that at various times there were small groups of people living up-canyon contemporaneous with the main village.

With the exception of a few sites on the ridge tops nearly all the inland sites are located on the relatively shallow slopes in the bottom of the drainage, near the creek. All of the middens at the inland sites appear to represent fully maritime orientations. A few bones of island foxes and some bird bones made up the total of non-marine fauna and the few seeds found did not suggest that any of these sites were primarily focused on plant processing. None of the sites was more than about a 1 hr walk from the coast and all contained shell, fish bone, and sea mammal bone in varying percentages. It has been suggested that they might be temporary or seasonal camps but the short distance separating them from the coast and the dispersed pattern of terrestrial resources on the island would seem to argue against this interpretation. It would make little sense to set up a temporary plant gathering camp less than 1 hr's walk from the base and then carry in substantial amounts of food from the coast to support it. The evidence all suggests that these sites represent small group habitations. People were at these locations long enough to build up substantial middens in some cases, and to bury their dead on site. They also produced beads at a "cottage industry" scale and so may have been involved in the inter-island trade. It is possible, however that they represent special use habitations, such as fishing camps for people from the villages in the Central Valley of the island. Unfortunately, I do not have sufficient data to determine seasonality at any of them. Kennett (1998:361) identifies a pattern of satellite villages developing on the islands after about 1,300 BP. He suggests that these may represent territorial outposts to monitor activities of other groups. In Coches Prietos however, most of the small interior settlements are not in locations suitable for monitoring anything outside the immediate area. They are, however, in locations that would provide a measure of control over the most valuable terrestrial resource on the island; fresh water.

SUBSISTENCE DYNAMICS IN THE MIDDLE AND LATE PERIODS

Non-artifactual cultural material from the sites in Coches Prietos drainage consisted almost entirely of shell, fish bone, and sea mammal bone. Very small quantities of bird and terrestrial mammal bone were also recovered but these made up a non-significant portion of the faunal material. Charred seeds, probably representing utilized plants, were also recovered from a few samples but the numbers were low enough as to be difficult to decipher. Metate fragments and stones with grinding surfaces on them indicate that seeds were being utilized at some sites but, again, the identified material is rare. The role of plant foods in the islander's diet is still largely unknown. For this analysis only faunal material will be examined.

When the Middle and Late Period protein densities for shellfish, fish, and sea mammals for sites in the drainage are graphed three major patterns emerge. First, there are many more sites with identified Late Period components. Second, CA-SCRI-1 and CA-SCRI-3 demonstrate patterns of faunal utilization decidedly different from the rest of the drainage. These two sites are separated only by the stream channel and are likely parts of the same large village. Third, there are significant differences in the sizes of fish found at *Liyam*

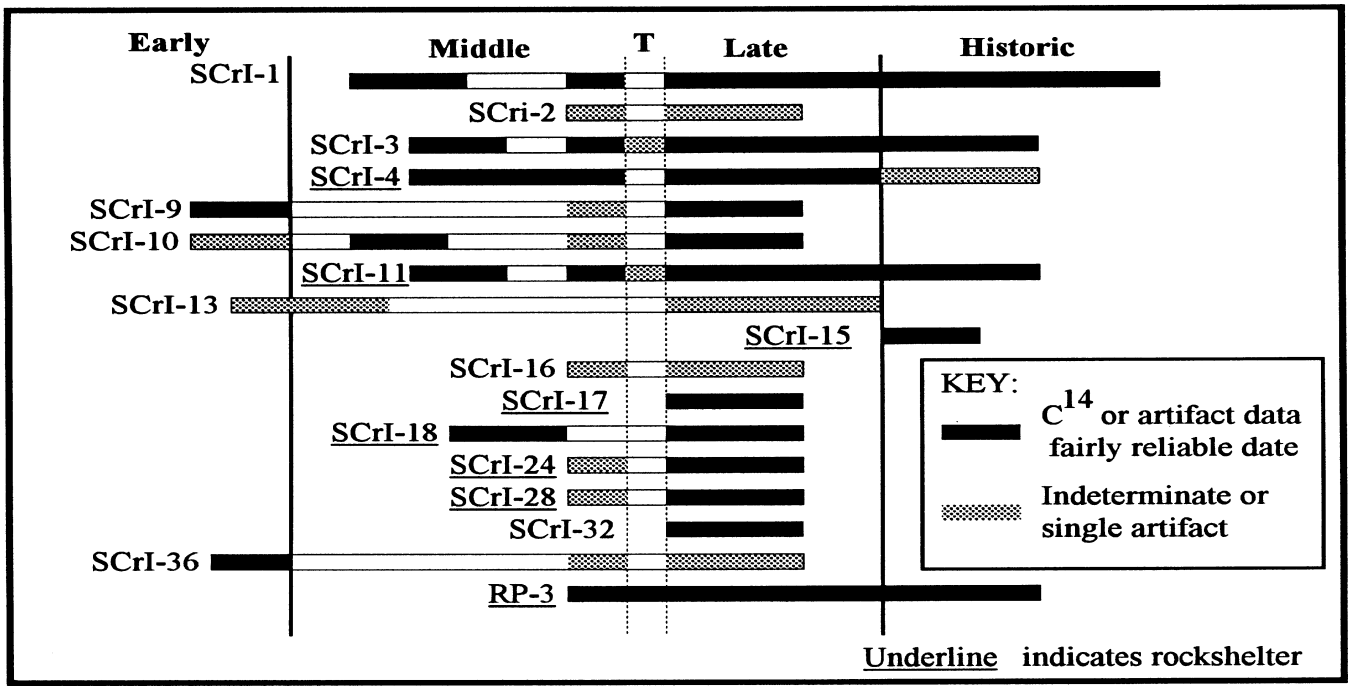

Figure 2. Coches Prietos site chronology.

and the inland sites. In the following graphs the Middle and Late Period sites with fairly reliably datable levels are arranged from left to right by increasing distance from the beach. Levels with Transitional, Late, and Historic markers are all identified as Late due to the difficulty of separating them in many sites. The data for CA-SCRI-1 includes three very large swordfish vertebrae that, by themselves, weighed some 95 g.

In both the Middle and Late Periods, CA-SCRI-1 and CA-SCRI-3 are markedly different from the other sites in terms of the percentage of protein contributed by fish and sea mammals (Figure 3). In the Middle Period components, shellfish overwhelmingly dominates the protein regime in all the inland sites, but it is ranked below both fish and shellfish at CA-SCRI-1, and CA-SCRI-3. In the Late Period we see that shellfish is still the largest percentage in most sites; although the percentage of both fish and sea mammals has increased significantly. There also appears to be a trend towards greater shellfish contribution in the sites further from the beach. CA-SCRI-1 and CA-SCRI-3 have, however, markedly different patterns. In both of these sites protein from fish and sea mammals is far more significant than that of shellfish.

When midden density is considered (Figure 4) the village of *Liyam* is hard to miss. Shellfish density doubles between the Middle and Late Periods but it is overwhelmed by the increase in fish and sea mammal. Fish density in the late period is over six times what it was in the Middle Period levels and sea mammal increases 15 times. While some of the difference might be attributed to differential preservation, there was little evidence of poor preservation, and the magnitude of the change clearly suggests that it does, in fact, represent a change in resource utilization. The other middens in the drainage that had Middle Period components, including CA-SCRI-3, show little change in overall density between the Middle and Late Periods. The fact that CA-SCRI-3 does not show this dramatic change suggests spatial differentiation within the village.

One indication that the two coastal villages were obtaining large quantities of fish from boats can be seen in the size of the fish found in the middens. As noted above fish caught mainly from boats tend to be somewhat larger than those caught mainly from shore. When we look at the Late Period fish bone from CA-SCRI-1 we find that the two coastal middens have much higher percentages of bone from large fish. Fish bone which did not pass through the 1/4 inch mesh made up 64% of the total in CA-SCRI-1 and 42% in CA-SCRI-3, while the remainder of the sites ranged from 11 to 30%. In fact, 34% of the 1/4 inch bone at CA-SCRI-1was greater than 1/2 inch in size and there were three individual fish vertebrae whose weight totaled some 95 g. These three bones alone equate to over 500 g of protein. None of the inland sites contained bones of large fish and nearly all the identified specimens were of species that could be caught from the rocks along the shore. Some of the bone size difference might be the result of the auger breaking up large bones during the testing, but no large fish were found in excavation units either. Unfortunately, I was unable to examine the bone from the Middle Period levels at CA-SCRI-1 and could not determine if this pattern began prior to the Middle/Late Transition.

DISCUSSION

The increase in the importance of fish and sea mammal protein in the Late Period in Coches Prietos is consistent with general trends identified from both mainland and island sites (Colten 1993; Glassow 1993:78; Kennett 1998).

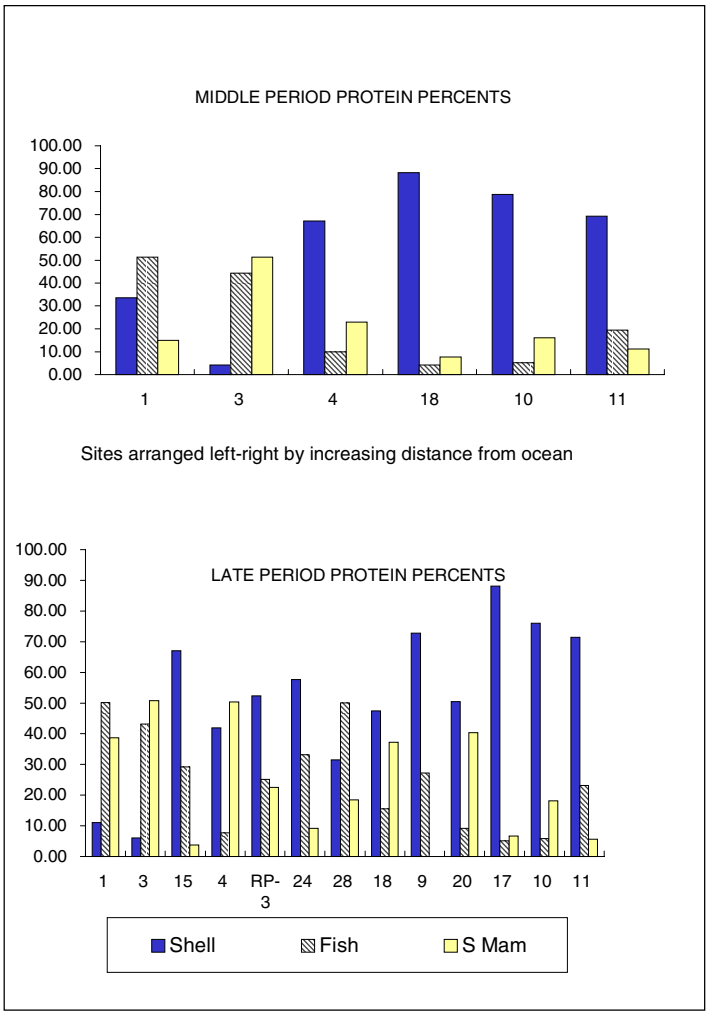

Figure 3. Percent of protein contributed by shellfish, fish, and sea mammal in Coches Prietos middens.

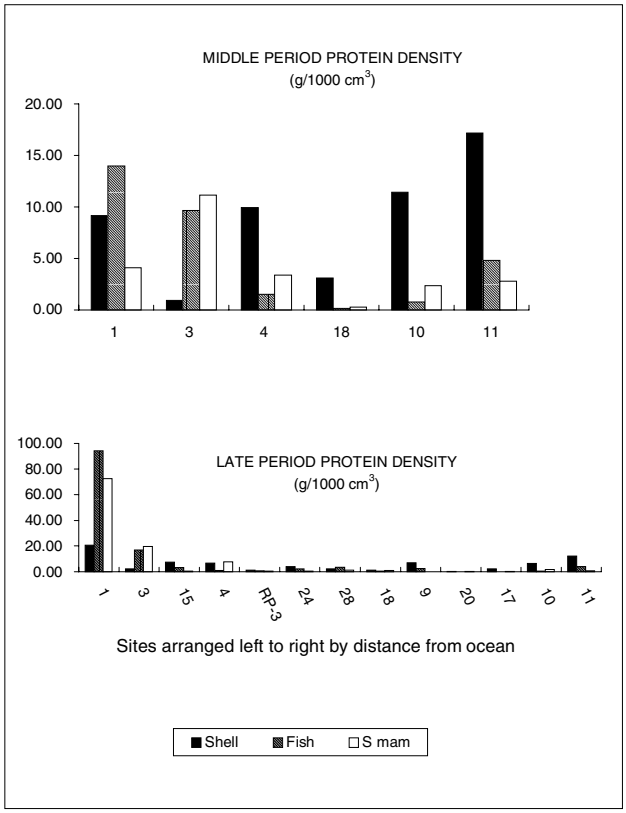

Figure 4. Faunal protein density by site and time period.

The increase in the number of occupied sites during this time could be an indication of increasing population, or the effects of drought, as people spread up the drainage to secure access to those locations where water remained relatively reliable. Raab and Larson (1994) have compiled data from a number of sources suggesting that such a drought coincided with the Transition Period in southern California. It could also indicate that both were occurring. Glassow (1993:81) has postulated that either or both of these conditions could require aboriginal peoples to shift to higher cost resources such as fish and sea mammals. The evidence from Coches Prietos suggests that such a shift was occurring.

Perhaps the most significant piece of data relates to the differences between the major village at the mouth of the canyon and the sites in the rest of the drainage; some of which were probably contemporaneous with it. The village has been identified as *Liyam*, the home of a major chief and a center of great importance (Johnson 1982, 1993), occupied at the time of Spanish contact. It would have supported a sizable population, and would probably have had several canoes based there. It is these canoes which probably account for much of the difference in resource pattern. In the Middle Period we see that fish and sea mammals have become extremely important resources in the two beachfront sites, while they are of limited importance in the rest of the sites. In the Late Period we see shellfish at these two sites drop to near insignificance as midden constituents, while the density of fish and sea mammal skyrockets. In addition, the large sized fish are found almost exclusively at *Liyam*. Inhabitants at the inland sites are still depending more on shellfish than fish or sea mammals. These factors suggest that these people do not have access to the bounty being brought in by the boat crews.

We do not have enough control over the chronology of sites in the drainage to determine if the main village was continuously occupied through this period. Nor can we tell with any certainty which of the inland sites might have been contemporaneous with it. Some of them, CA-SCRI-11 in particular, appear to have been occupied through the Late Period and into the Historic. This suggests that this site, at least, was contemporaneous with the coastal village part of the time. Arnold (1991:956-957) indicates that transitional period dating at CA-SCRI-1 is uncertain and that it might have been abandoned during the 1150 to 1300 AD time frame. Some of the inland sites do, however, appear to date over this period. One possible explanation is that they represent a dispersal of part of the population from the coastal village to locations with reliable water, as drought conditions worsened. Kennett's (1998) data, however, suggests that this same period was one of high marine productivity. If people who were moving up-drainage had relationships to

the boat owners, we might expect to see higher percentages of fish, and some of the larger fish, showing up in these middens.

The differences in protein percentages between the main village and all other sites suggests that subsistence at the small sites was significantly different than at *Liyam*. The large fish and spectacular increases in fish and sea mammal density in the Late Period at CA-SCRI-1 are consistent with increasing use of plank canoes, and the data suggest that this began in the Middle Period. This is not, however reflected in the rest of the drainage. Ethnographic information indicates that fish and meat recovered by boats was not distributed to everyone in the village but was reserved for those with relationships to the boat owners and boat builders. It would thus make sense that the people who were in some way related to the elites would be living as close to them as possible, probably in the main village. Were the inland sites occupied by people of lower status, not related to the elites? The near total lack of large fish remains in inland sites suggests that the people who lived there did not have such relationships and obtained their subsistence from the local shoreline instead. The presence of burials and bead making at some of them also suggest that they were more than simply task-oriented habitations. Perhaps the satellite villages noted by Kennett (1998:360-361) represent habitations of lower status individuals who do not have reason to reside in the larger central villages. The nature of these inland sites and their relationship to the large coastal village have a bearing on our understanding of the nature of social and economic complexity in the Late Period. Clarification awaits more detailed dating and seasonality data but the data so far developed are interesting nonetheless.

LITERATURE CITED

Ally, J. R. D. S. Ono, R. B. Read, and M. Wallace 1991. Status of major southern California sport fish species with management recommendations, based on analysis of catch and size composition data collected on board commercial passenger fishing vessels from 1985 through 1987. Marine Resources Division Administrative Report No. 90-2. State of California Department of Fish and Game.

Arnold, J. E. 1996. Organizational transformations: Power and labor among complex hunter-gatherers and other intermediate societies. Pages 59-73 *in* Arnold, J. E. (ed.), Emergent Complexity: the Evolution of Intermediate Societies. International Monographs in Prehistory, Series 9 Ann Arbor, MI.

Arnold, J. E. 1995. Transportation innovation and social complexity among marine hunter-gatherers societies. American Anthropologist 97(4):733-747.

Arnold, J. E. 1992. Complex hunter-gatherer-fishers of prehistoric California: Chiefs, Specialists, and Maritime Adaptations of the Channel Islands. American Antiquity 57(1):60-84.

Arnold, J. E. 1991. Transformation of a Regional economy: sociopolitical evolution and the production of valuables in southern California. Antiquity 65:953-962.

Colten, R. H. 1993. Prehistoric subsistence, specialization, and economy in a southern California chiefdom. Ph.D. Dissertation Department of Anthropology, University of California, Los Angeles.

Erlandson, J. M. 1988. The role of shellfish in prehistoric economies: A protein perspective. American Antiquity 53(1):102-109.

Erlandson, J. M. 1991. Shellfish and seeds as optimal resources: Early Holocene subsistence on the Santa Barbara Coast. Pages 89-100 *in* Erlandson, J. M., and R. H. Colten (eds), Hunter-Gatherers of Early Holocene Coastal California, Perspectives in California Archaeology, Vol. 1. Institute of Archaeology, University of California, Los Angeles.

Glassow, M. A. 1993. Changes in subsistence on marine resources through 7,000 years of prehistory on Santa Cruz Island. Pages 75-94 *in* Glassow, M. A. (ed.), Archaeology on the Northern Channel Islands of California: Studies of Subsistence, Economics and Social Organization. Coyote Press Archives of California Prehistory No. 34, Salinas, CA.

Glassow, M. A. and L. Wilcoxon. 1988. Coastal adaptations near Point Conception, California, with particular regard to shellfish exploitation. American Antiquity 53(1):36-51.

Hayden, B. 1996. Thresholds of power in emergent complex societies. Pages 50-58 *in* Arnold, J. E. (ed.) Emergent complexity: the Evolution of Intermediate Societies. International Monographs in Prehistory, Series 9, Ann Arbor, MI.

Hudson, T., J. Timbrook, and M. Rempe. 1978. *Tomol*: Chumash watercraft as described in the ethnographic notes of John P. Harrington: Ballena Press/Santa Barbara Museum of Natural History. Santa Barbara., CA.

Johnson, J. R. 1993. Cruzeno Chumash social geography. Pages 19-46 *in* Glassow, M.A. (ed.), Archaeology on the Northern Channel Islands of California: Studies of Subsistence, Economics and Social Organization. Coyote Press Archives of California Prehistory No. 34. Salinas, CA.

Johnson, J. R. 1982. An ethnohistoric study of the Island Chumash. M.A. Thesis, University of California, Santa Barbara, CA.

Miller, T. and R. N. Lea 1972. Guide to the coastal marine fishes of California. Fish Bulletin 157. Division of Agricultural Sciences, University of California Publication 4065, Berkeley, CA.

Raab, M. L. and D. O. Larson. 1997. Medieval Climatic anomaly and punctuated cultural evolution in coastal southern California. American Antiquity 62(2):319-336.

Tartaglia, L. J. 1976. Prehistoric maritime adaptations in southern California. Ph.D. dissertation University of California, Los Angeles. University Microfilms 76-15, 962.

Vizcaíno, S. 1967. The Vizcaíno expedition. Pages 52-110 *in* Bolton, H. E. (ed.), Exploration of the Southwest 1542-1706. Barns and Noble, New York, NY.

Watt, B. K. and A. L. Merrill. 1963. Composition of foods. Agriculture Handbook No. 8, United States Department of Agriculture, Washington D.C.

Witzig, H. F., M. C. Holliday, R. J. Essig, D. L. Sutherland. 1992. Marine Recreational fishery statistics survey, Pacific Coast 1987-1989. U.S. Department of Commerce National Oceanic and Atmospheric Administration and National Marine Fisheries Service, Silver Spring, MD.