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Changing Shellfish Exploitation in San Luis Obispo County, California

JAMES L. RUDOLPH

Analysis of shellfish remains from two sites in the Lodge Hill subdivision near Cambria, California (Fig. 1), suggests that a major change in mollusc exploitation may have occurred there prior to the Middle Period (1400 B.C. to A.D. 1150 [King 1981]). Specifically, by the end of the Early Period (7200 - 1400 B.C. [King 1981]) there was a pronounced shift from the intensive exploitation of *Mytilus californianus* to the exploitation of a more diverse molluscan assemblage consisting primarily of *Tegula funebralis*, limpets, and chitons. This change might have been a result of overexploitation of the *Mytilus* sp. population, but it also may

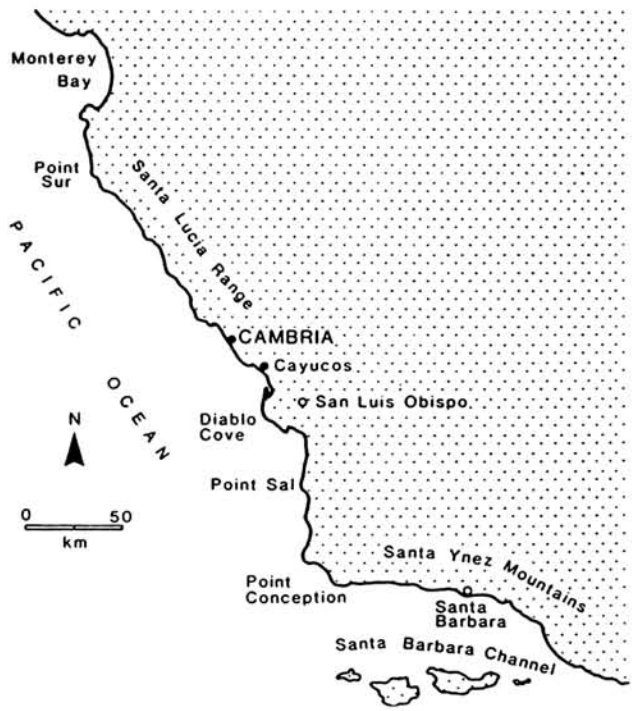

Fig. 1. Location of project area on the California coast.

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indicate a change in local environmental conditions due to rising sea level and shore cliff erosion.

ENVIRONMENTAL SETTING

Sites CA-SLO-177 and CA-SLO-178 both lie on a marine terrace about 600 m. from the Pacific Ocean (Fig. 2). Site CA-SLO-177 is approximately 75 m. above sea level and CA-SLO-178 is about 50 m. above sea level. Although a few sandy beaches can be found in the Cambria area, the shoreline near Lodge Hill is quite rocky and is exposed to strong wind and surf. Both sites overlook the valley of a very small intermittent stream that is the closest source of potable water. The nearest major stream is Santa Rosa Creek, 2 km. to the north.

Cambria is noted for its setting within a nearly pure stand of Monterey pine (*Pinus radiata*). True coniferous forests are rare in San Luis Obispo County and this particular stand is one of the southernmost occurrences of this species (Hoover 1970).

CA-SLO-177

Site CA-SLO-177 first was recorded in 1962 and later was visited by Robert Hoover (1974). At his instigation, a Stanford University field school was conducted there during March, 1976 (Pierce 1979). In 1983, residential construction was planned for a portion of the eastern edge of the site. At that time Teresa Rudolph of University of California, Santa Barbara (UCSB), excavated a single one-by-one-meter test pit and five auger tests on the house lot.

The Stanford field school found evidence of both Early and Late period (A.D. 1150 - 1800 [King 1981]) occupations at CA-SLO-177. The Early Period occupation was indicated by large projectile points and by an age of 8,430 ±200 radiocarbon years: 6480 B.C. (UCR-789) (Pierce 1979). The dated sample consisted of 111.4 g. of *Mytilus* sp. and

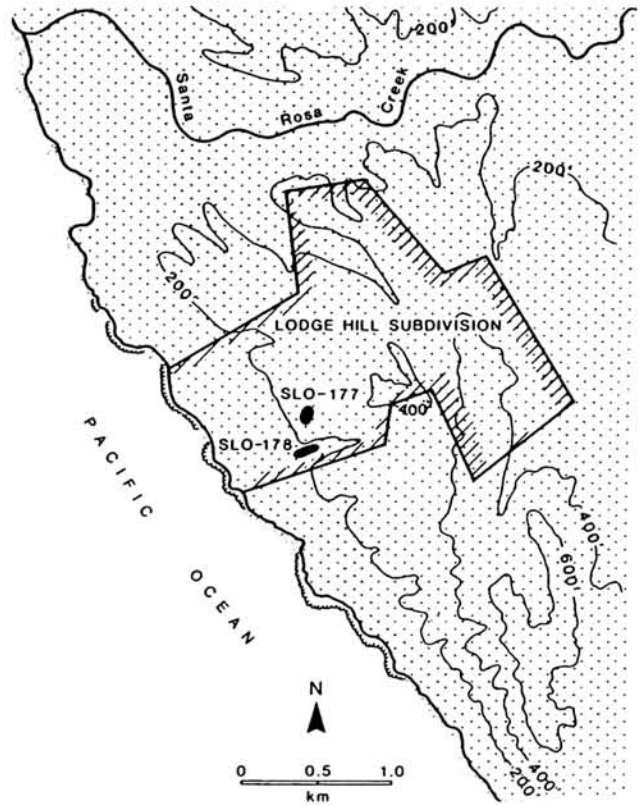

Fig. 2. Geographical setting of sites CA-SLO-177 and CA-SLO-178.

Haliotis sp. shell from the deepest stratum, 122 to 145 cm. below the surface. This date subsequently was supported by another obtained by UCSB of 8,290 ±100 radiocarbon years: 6340 B.C. (BETA-7035) (T. Rudolph 1983). That sample consisted of 83.0 g. of *Mytilus californianus* shell taken from 60 to 80 cm. below the surface. A Late Period occupation at CA-SLO-177 was reflected in the Stanford excavations by the presence of projectile points typical of the ethnographic Chumash and Salinan peoples (Pierce 1979). However, T. Rudolph's (1983) work produced no evidence of a Late Period occupation along the eastern edge of this site. The discussion below concerns only shellfish recovered by UCSB from the eastern edge of CA-SLO-177 and assumes that they represent a strictly Early Period occupation.

T. Rudolph (1983) analyzed 10% of all invertebrate remains larger than ¼ in. (0.65

cm.). Of the invertebrate species, 78% by weight are *Mytilus californianus*, 10% are *Balanus* sp., and 5% are *Tegula funebralis*. In contrast, Pierce (1979) reported that shells of *Haliotis* sp. were by far the most common remains at CA-SLO-177, followed by limpets, *Tegula funebralis, Mytilus californianus*, and barnacles. The discrepancy between the two collections is probably not due to different recovery techniques. Rather, Pierce (1979) did not segregate Early Period and Late Period shellfish assemblages in her report, and it appears that many of the *Haliotis* sp. shells may have been recovered from features and strata dating to the latest period of occupation.

CA-SLO-178

Site CA-SLO-178 first was recorded in 1962. Hoover (1974) later described the site, and Gibson (1979) conducted test excavations in that portion of CA-SLO-178 included within the Frosch property (see below). Another portion of the site, on the Conine property, was investigated by UCSB (J. Rudolph 1983).

The Conine Project

The Conine Project of UCSB entailed the excavation of 64 whole or partial one-by-one-meter units, totaling 32 cubic m. in volume. The midden from most units was screened through ¼-in. (0.65-cm.) mesh. Column samples, each with a volume of 3,785 cubic cm., were taken from 20-cm. levels in several units. These were processed through 1/16-in. (0.16-cm.) mesh.

Depth of the midden on the Conine property ranged from only 20 cm. at the northern end of the excavated area to over 100 cm. at the southern end. Downslope movement and rodent burrowing probably occurred in the past, but culturally significant differences in midden composition were detectable in the deeper deposits.

The Conine portion of CA-SLO-178 contained evidence of both Middle and Late period occupations. Most of the diagnostic artifacts, including beads and projectile points, indicate a Middle Period occupation (P. Snethkamp, personal communication 1984), but a few glass trade beads were found in the top 10 cm. of the midden (L. Michals, personal communication 1984). Therefore, shell from the upper 30 cm. of the Conine portion of the site is not included in Table 1. The author analyzed all shell larger than ¼ in. (0.65 cm.) that came from column samples collected at the southern end of the site where the midden was over 100 cm. thick. Shellfish from the Conine portion of the site are predominantly *Tegula funebralis*, chitons, limpets, and *Mytilus californianus*.

The Frosch Project

Excavations by the author on the Frosch property determined the extent of disturbance to CA-SLO-178 caused by the construction of garage and house foundations. The area is located only 30 m. east of the Conine property (J. Rudolph 1983).

This portion of CA-SLO-178 was first test excavated by Gibson (1979), who dug three one-by-one-meter test pits. He found strong evidence for a Late Period occupation of this locale in the form of an *Olivella* full-lipped bead and an age of 340 ±100 radiocarbon years: A.D. 1610 (UCR-790) (Gibson 1979; Pierce 1979). The sample came from 60 cm. beneath the surface.

The author excavated six test pits on the same lot. Midden, ranging from 2 cm. to 50 cm. in depth, depending upon the extent of damage, was dry screened through 1/8-in. (0.33-cm.) mesh. A total of 0.73 cubic m. of midden was processed. As in Gibson's study, a Late Period occupation of the Frosch property was indicated by several types of shell beads and by a single glass trade bead. The shell beads include two *Olivella* cupped beads,

two *Olivella* disc beads, and four *Mytilus* disc beads.

Disturbance and mixing of the midden was considerable: erosion, construction of house foundations, and grading all contributed to the damage. For this reason, all the midden from the six test pits was treated as a single stratigraphic unit in our analysis, although it had been excavated in 20-cm. levels.

Charles Dills performed the shellfish analysis for Gibson's (1979) excavations. Gibson reported that over 50% of the shellfish by count consisted of limpets, chitons, and *Tegula* spp. These percentages are comparable to the results of our own analysis of material larger than ¼ in. (0.65 cm.). *Tegula funebralis* comprised 64% by weight of the assemblage, chitons comprised 10%, and limpets comprised 10%. In fact, non-pelecypod species made up 92.8% by weight of all invertebrate remains larger than ¼ in. (0.65 cm.) recovered from the Frosch property in 1983.

DISCUSSION

Shellfish weights and percentages from the three excavated areas are presented in Table 1. It is evident that the most striking difference among the areas exists between CA-SLO-177 and both portions of CA-SLO-178. This is illustrated more clearly in Figure 3, in which the data are organized temporally. Shellfish from CA-SLO-177 date to the Early Period, those from the Conine property (CA-SLO-178) date to the Middle Period, and those from the Frosch property (CA-SLO-178) date to the Late Period. These data suggest that a major change occurred between the Early Period and the Middle Period in which *Tegula funebralis* and other species replaced *Mytilus californianus* as major constituents of the aboriginal diet. Other less dramatic patterns are present also. Limpets increase in importance gradually but steadily through time, and chitons are most abundant in the Middle Period strata. *Haliotis* spp. shells

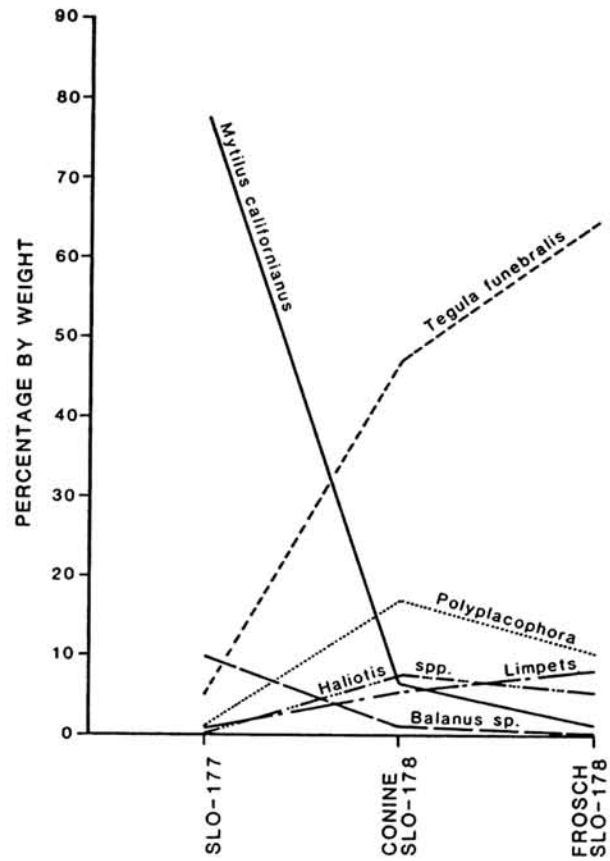

Fig. 3. Comparison of shellfish percentages from sites CA-SLO-177 and CA-SLO-178.

increase in frequency through the Middle Period, but decline slightly during the Late Period. Pierce (1979) reported a high proportion of *Haliotis* spp. shell in the probable Late Period component at CA-SLO-177. The reasons for the discrepancy in *Haliotis* spp. frequencies between the late component at CA-SLO-177 and the late component at CA-SLO-178 are not known. There are no *Haliotis* sp. shell features at CA-SLO-178 like those found by Pierce (1979) at CA-SLO-177. The proportion of *Balanus* spp. decreases over time, probably as a reflection of the corresponding decrease in *Mytilus californianus.* Barnacles are often attached to *Mytilus* valves and could have been collected simultaneously.

The central California coast has not received as much attention from archaeologists as have coastal areas to the north and south.

Table 1

SHELLFISH (>0.6 CM) FROM CA-SLO-177 AND CA-SLO-178

	SLO-177 (all)		CONINE SLO-178 (30-80 cm.)		FROSCH SLO-178 (all)	
	wt. (g.)	%	wt. (g.)	%	wt. (g.)	%
PELECYPODA						
Mytilus californianus	1129.2	77.8	83.6	6.4	66.6	1.3
Mytilus edulis			12.0	0.9	20.4	0.4
Mytilus sp.			0.2	<0.1	0.4	<0.1
Petricola carditoides					1.0	<0.1
Pholadidae					2.8	<0.1
Protothaca staminea	6.9	0.5	1.2	0.1	3.9	<0.1
Saxidomus nuttalli					3.0	<0.1
Septifer bifurcatus					2.9	<0.1
Tivela stultorum					11.3	0.2
GASTROPODA						
Acanthina punctulata					5.6	0.1
Astraea undosa	23.8	1.6	2.4	0.2		
Crepidula adunca	0.4	<0.1	6.7	0.5	7.4	0.2
Crepidula coei	1.7	0.1				
Haliotis cracherodi			1.8	0.1	40.0	0.8
Haliotis rufescens			36.5	2.8	213.4	4.3
Haliotis sp.	1.7	0.1	54.0	4.2	32.1	0.6
Limpets, undiff.	10.1	0.7	72.1	5.5	413.3	8.2
Naticidae					1.2	<0.1
Ocenebra circumtexta			3.7	0.3		
Ocenebra minor					2.0	<0.1
Ocenebra sp.			0.4	0.1		
Olivella biplicata	2.5	0.2			0.4	<0.1
Tegula brunnea					49.6	1.0
Tegula funebralis	73.6	5.1	614.3	47.2	3190.5	63.6
Thais lima	0.4	0.1				
Gastropoda, undiff.			38.8	3.0	46.2	0.9
AMPHINEURA						
Cryptochiton stelleri	32.9	2.3	15.8	1.2	155.5	3.1
Polyplacophora, undiff.	17.6	1.2	219.3	16.9	513.4	10.2
MOLLUSCA, UNDIFF.	6.0	0.4	115.4	8.9	187.5	3.7
OTHER INVERTEBRATES						
Balanus sp.	143.4	9.9	0.8	1.0	4.8	0.1
Decapod, undiff.	1.0	0.1	13.0	1.0	44.0	0.9
Pollicipes polymerus	0.4	0.1				
Strongylocentrotus sp.					1.2	<0.1
Invertebrate, undiff.					0.4	<0.1
TOTALS	1451.6		1301.1		5020.8	

Comparative data are scarce, and one may be tempted to follow a normative approach and infer that the changes observed in the shellfish assemblages at Lodge Hill represent a major regional shift in subsistence activities attributable to climatic change or population pressure. However, published data from sites at Diablo Cove, 43 km. southeast of Cambria, do not indicate a change in subsistence analogous to that at Lodge Hill. At Diablo Cove, Greenwood (1972) found *Mytilus californianus* the most frequently exploited mollusc species throughout the prehistoric occupation. *Tegula funebralis* was usually the second most important species, but it was a distant second. Given the differences between the Lodge Hill shellfish remains and those at Diablo Cove, we cannot assume, without additional evidence, that the pattern observed at Lodge Hill was widespread. An explanation

of subsistence change at Lodge Hill must not require a concurrent and similar change at Diablo Cove.

Mytilus californianus and *Tegula funebralis* are both easily collected, high intertidal species. They differ, however, in that the former is a sessile species preferring hard, solid substrates while the latter is mobile, flourishing on less stable substrates such as boulder beaches. Seapy and Littler (1978) reported that near Cayucos, 20 km. from Cambria, the density of *Tegula funebralis* averaged 84.9 individuals per square meter on a boulder beach and averaged only 0.9 individuals per square meter on a sea stack, a stable rocky headland separated from the shoreline. In contrast, the mean cover of *Mytilus californianus* was 0% on the boulder beach and 5.6% on the sea stack. Therefore, the change in shellfish assemblages at CA-SLO-177 and CA-SLO-178 might be due to a shift from exploiting a stable rocky shore to exploiting a boulder beach or similar unstable area.

Two alternative hypotheses may explain the changes in shellfish assemblages at the Lodge Hill sites – overexploitation of certain species or environmental change. Overexploitation of the *Mytilus* population might have forced the inhabitants of Lodge Hill to shift their collecting activities from a preferred location, where mussels were common, to a less preferred habitat where other species, especially gastropods, could be obtained. Both habitats very easily could have been located near Lodge Hill.

The hypothesized environmental change may have involved two related processes – a rise in sea level and sea-cliff erosion. According to Inman (1983), sea level rose rapidly (about 100 cm. per 100 years) until about 6,000 B.P. Using a curve presented by Inman (1983), one can estimate that the sea level at 8,500 B.P., the approximate age of the shellfish assemblage from CA-SLO-177, would have been 19 m. lower than today, and the shoreline would have been about 900 m. farther west than it is today. At 6,000 B.P. the sea level was 6 m. lower and the shoreline 400 m. farther away than at present. After 6,000 B.P. and continuing to the present, the sea level rose at a slower rate of 10 cm. per 100 years. Both Bickel (1978) and Inman (1983) pointed out, however, that sea-level changes would have varied from one region to another, depending on local tectonic histories, so one can not assume that the exact curves developed elsewhere on the California coast are a precise model of sea-level changes in the Cambria area.

It is possible that a gradual sea-level rise might have inundated a stable bedrock surface, destroying both an established mussel population and its habitat. However, it is not clear from a bathymetric map of the Cambria area whether this form of environmental change could have occurred in the vicinity of Lodge Hill. On the other hand, a rise in sea level, especially if it is punctuated by still-stands, increases the rate of sea-cliff erosion (Inman 1983) and might have turned a stable sea cliff, where mussels thrived, into a less stable rocky beach occupied by mobile species. A gradual sea-level rise can produce greater sea-cliff erosion than a rapid sea-level rise, and Inman's (1983) curve indicates that the rate at which the sea level rose decreased significantly after the Early Period occupation at Lodge Hill. A combination of sea-level rise and erosion could have contributed, therefore, to the changes in shell midden constituents observed at the Lodge Hill sites.

More evidence from other shell middens in the Cambria area is needed before we can determine how widespread the replacement of *Mytilus californianus* by *Tegula funebralis* and other species in the aboriginal diet might have been. However, it is important that we consider whether patterns observed in a single shellfish assemblage or among different assem-

blages can be attributed to local environmental conditions before we infer prehistoric subsistence behavior for an entire region.

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