

MORTARS, PESTLES, AND DIVISION OF LABOR IN PREHISTORIC CALIFORNIA: A VIEW FROM BIG SUR

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The mortar and pestle, technologically linked to intensive acorn economies, appeared initially in low frequencies over a large portion of California ca. 4000–3500 B.C. Three sites on the Big Sur coast of central California illuminate the circumstances surrounding the advent of this new technology, which initially supplemented hand stones and milling slabs. Excavation results suggest that ca. 3500 B.C. production of hunting-related flaked-stone tools increased relative to ground stone, and hunted resources became more important, as part of a transition from a highly mobile, selective use of the coastal resources, heavily focused on gathering, to a less mobile, more intensified lifeway. Obsidian hydration profiles indicate that interregional exchange increased at the same time. Evaluation of alternative mussel collection techniques further indicates that shellfish-harvesting strategies became less efficient at this juncture, promoting the emergence of a processing specialization, concomitant with increased hunting intensity. These transitions apparently mark the appearance of lineal descent organization and the system of gender-specific task appropriation observed at European contact.

El mortero y la mano, vinculados técnicamente a las economías intensivas de bellota, apareció originalmente disperso en una gran área de California ca. 4000–3500 a.C. Tres sitios en la costa de Big Sur en California central revelan el contexto de la llegada de esta nueva tecnología, que sirvió al principio como un suplemento a las manos y metates. Los resultados de las excavaciones indican que la producción de utensilios de la caza hechos de piedra tallada subió, comparados con los de piedra pulida, cerca de 3500 a.C. La caza llegó a ser más importante, como parte de la transición de el uso selectivo y transitorio de la zona costera, con su énfasis en la recolección, a un modo de vida más sedentario e intensivo. Una evaluación experimental de las alternativas técnicas la recolección de mejillones indica que las estrategias de la cosecha de mariscos perdieron progresivamente su eficiencia en este periodo, lo cual promovió el desarrollo de una especialización en el procesamiento, concomitantemente con una elevada intensidad en la caza. Estas transiciones marcan la aparición de descendencia lineal y división sexual del trabajo, las que fueron observadas en el momento de la conquista.

As implements associated with processing acorns, the most important dietary staple in aboriginal California, the mortar and pestle have been correlated with high population density, storage, sedentism, and complex sociopolitical organization (Basgall 1987; Baumhoff 1963). Repeatedly, this acorn economy has been described as the foraging equivalent of early horticulture (Baumhoff 1978; Bean and Lawton 1976; Meighan 1959), and prehistoric economies in California can be classified into those predating and those postdating acorn utilization. Substantial effort has been devoted to identifying the temporal and spatial distribution of the mortar and pestle as a potential index of acorn use. The ethnographic record, however, indicates that mortars and pestles were not exclusively associated with the acorn, but were used to process a number

of other dietary and nondietary commodities (Masters 1983:203; Schulz 1981:65–66). While not necessarily connoting acorn processing, the mortar and pestle are clear markers of intensified subsistence (Basgall 1987:30).

Throughout California, local archaeological sequences indicate that during the early Holocene, the vegetal component of the diet was dominated by small seeds, processed exclusively with the milling slab and hand stone (see Erlandson 1991; Meighan 1978; Wallace 1978, among others). The mortar and pestle first appear at mid-Holocene. Among the older examples are those reported from CA-SBA-53, in the Santa Barbara Channel (Harrison and Harrison 1966) dated ca. 3500 B.C., and a grave-associated pestle from CA-LAK-380/381, dated ca. 4300 B.C. (Fredrickson and White 1988:79; White and King 1993:134–135).

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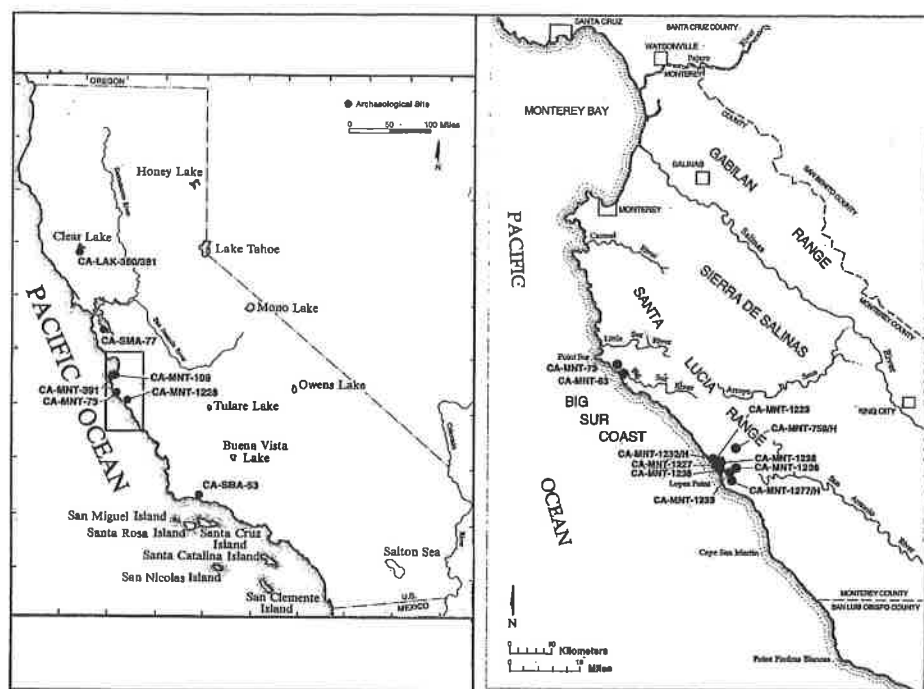


Figure 1. Early California mortar sites (left) and Big Sur sites (right) discussed in text.

Finds from the University Village (CA-SMA-77; Gerow and Force 1968), Saunders (CA-MNT-391; Cartier 1993), Fisherman's Wharf (CA-MNT-108; Breschini and Haversat 1989), and Redwood Terrace (CA-MNT-1228; Jones and Haney 1992) sites corroborate the presence of a mortar and pestle technology along the central California coast between 3700 and 1000 B.C. (Figure 1). Elsewhere in California a few examples of early mortars are known, but the Middle period (ca. 800 B.C.–A.D. 1000) is perceived as the era during which the mortar and pestle became the dominant milling technology, presumably reflecting the growth of acorn economies. Basgall (1987) and Bouey (1987) have described a multitude of subsistence, health, and technological transitions that accompanied the onset of the Middle period when the mortar and pestle dominated the vegetal processing technology.

Hypotheses developed to explain the mid-Holocene appearance of the mortar and pestle technology generally focus on the Santa Barbara Channel, where early researchers (e.g., Rogers 1929) attributed this innovation to an in-migration of a hunting culture, marked by side-notched and

stemmed projectile points and bowl mortars. Warren (1968) suggested this was a coastward migration by hunters from interior deserts. More recently, an ecological hypothesis has been proposed by Glassow et al. (1988), who, like Bouey (1987) and Basgall (1987), recognize mortars and pestles as markers of intensified subsistence, and attribute their appearance to a decreased expanse of seed-bearing plant communities as a consequence of early-Holocene sea level rise. Further, they describe the adoption of the new technology as one of several settlement and subsistence changes related to an amelioration of climate following the end of the early- to mid-Holocene warm period, alternatively known as the Altithermal or Hypsithermal. An apparent decline in sea water temperatures ca. 3400 B.C. is thought to have increased marine productivity in the channel, providing an enhanced resource base for growing human populations, previously stressed by low productivity (Glassow et al. 1994). This proposal is consistent with many which correlate mid-Holocene cultural change in western North America with the end of early-to-mid-Holocene warming (e.g., Antevs 1952; Baumhoff and

Heizer 1965; Moratto 1984:546; Moratto et al. 1978).

More recently, in exploring the gender implications of aboriginal California subsistence, Jackson (1991) has directed attention toward bedrock mortars as markers of the role of women in production. He suggests that a shift to an acorn-based subsistence resulted in a substantial reduction in foraging mobility. Indeed, it is important to consider mortar use as an index of a shift in diet breadth among that portion of prehistoric California groups who engaged in gathering, and to further consider the implications of varied divisions of labor relative to foraging efficiency and overall group fitness (Claassen 1991; Foley 1988; Jochim 1988; Jones 1991:435; Sassaman 1992). Certain generalities about the division of labor according to gender have long been recognized among hunter-gatherers: men are mobile and more commonly associated with hunting, while women, owing to the constraints imposed by pregnancy and child-rearing, are tethered more closely to residential bases (Jochim 1988; Lee and Devore 1968:7; Zihlman 1981:110) and frequently associated with gathering and processing. There are strong differences of opinion as to the chronology of the development of gender-based division of labor (see McGrew 1981; Zihlman 1981), but there is some consensus that because this division was so pervasive among hunter-gatherers, it must have emerged as part of the biological evolution of modern humans. Certainly, it was well established before colonization of the New World. Not surprisingly, California groups conformed with this division at the time of contact (Kroeber and Barrett 1960:95; E. Wallace 1978:683; Willoughby 1963): men hunted, fished, and manufactured fishing paraphernalia, while women gathered, processed, and manufactured carrying and storage implements. Men, however, are perfectly capable of gathering, and California ethnography describes their collection of a number of vegetable commodities (McGuire and Hildebrandt 1994). Women are capable of hunting, and there are ethnographic accounts of heavy participation by women in hunting elsewhere (Estioko-Griffin and Griffin 1981), but in native California, hunting and fishing were male-dominated activities (E. Wallace 1978:683).

Recent archaeological investigations along the Big Sur coast of central California provide important data that can be employed to illuminate cultural changes associated with the appearance of the mortar and pestle. As in the Santa Barbara Channel, subsistence and other cultural changes associated with the appearance of these implements are distinctive: mortars, and side-notched and stemmed projectile points first appear ca. 3500 B.C., supplanting an earlier milling stone-dominated tool assemblage. Sites CA-MNT-73, CA-MNT-1228, and CA-MNT-1232/H span the transition between pre-mortar and mortar-using cultures, demonstrated by a Milling Stone component, dating ca. 4400–3300 B.C., that is superseded by mortar-bearing deposits, dating to 3700–2900 B.C. and from 2300–1700 B.C. Combined with comparative data from Middle and Late period components (CA-MNT-63, -1227, -1233, and -1277/H), and a historic feature (CA-MNT-63), these sites illuminate changes in diet, mobility, and exchange coeval with the advent of the new milling technology. Excavation results indicate that items of exchange (e.g., obsidian, otter pelts, and locally made stone pendants) became considerably more abundant, diet breadth decreased, fish increased in dietary significance, and mussel collection strategies became progressively more intensive, causing diminution in mussel populations. The increased importance of fish and the adoption of more labor-intensive shellfish exploitation strategies are consistent with the emergence of a processing specialization among women concurrent with increasing intensity in fishing and hunting by males. This appropriation of tasks approximates the division of labor observed at contact in native California, which apparently emerged from an earlier culture in which men participated more actively in gathering. Neither environmental change nor cultural migration appears to underlie these subsistence shifts. Rather, codevelopment of less efficient, semisedentary, intensified subsistence marked by the appearance of mortars and pestles and interregional exchange can be attributed on the Big Sur coast to population circumscription and the emergence of lineal descent organization from an earlier system associated with more mobile lifeways, lower population densities, and perhaps bilateral kin reckoning.

An Alternative Perspective on the Advent of the Mortar and Pestle

In a review of hunter-gatherer ethnography, Hayden et al. (1986) have identified associations between certain ecological and technological variables and the status of women. Low status appears to be associated with resource stress, participation in warfare, and the importance of hunting in overall subsistence. These associations have significant implications for alternative models of mobility and diet, particularly those emphasizing population growth and intensification. Intensive subsistence is contingent upon the availability of processing labor, which affects foraging decisions and influence a group's ability to behave in an optimal fashion (Bettinger 1991:101). Kelly (1991, 1992:58) has outlined the possible impacts on gender relations of intensification and reduced mobility, suggesting that reliance on narrower foraging radii encourages the development of social alliances through interlineage marriage. In such circumstances women may participate through intergroup marital exchange in the establishment of alliances. As interlineage alliances grow, exchange increases, the need for processing labor increases, and the status of women paradoxically decreases as they are exploited by men (Kelly 1991:146).

Native women in California, operating within systems of lineal descent, were associated with foodstuffs marking intensified subsistence (i.e., acorns and fish) (McCarthy 1993; E. Wallace 1978; Willoughby 1963). Assuming that circumstances differed earlier in time when population density was lower and mobility was greater, women's roles and the division of labor may have been different as well. Hill et al. (1987) have demonstrated that among contemporary foraging populations, men, by participating in hunting, provide far fewer calories to a group than they could by gathering, as gathering produces per capita caloric yields twice as high as those associated with hunting. Hill et al. suggest that one reason for male hunting is the occasional acquisition of a major bonanza which might be socially rewarded, but the relative importance of hunting versus gathering and the participation of members by gender may be related to diachronic variation

in the availability of prey and the relative importance of labor-intensive resources through time.

On theoretical grounds, the milling slab-hard seed economy of early Holocene California apparently represented a culture in which division of labor along gender lines was different from that recorded ethnographically among native groups in California, as this earlier economy appears to have been largely reliant on gathered foods (Meighan 1978:236; W. Wallace 1978:36). On the coast, this economy focused primarily on shellfish and hard seeds (Erlandson 1991; Glassow et al. 1988:67; Warren 1967:235). Shellfish were collected by both native men and women in California (Greengo 1948:20), but were more commonly gathered by females (Willoughby 1963:21). The occurrence of a subsistence strategy based largely on gathering at an early time period would support the contention by Hill et al. (1987) that participation of men in gathering can provide significant caloric rewards. Understanding when, how, and why the ethnographic pattern of gender-specific task appropriation came into existence is one goal of this paper. Findings from Big Sur suggest that a cultural transition ca. 3500 B.C., marked by the appearance of mortars and pestles, indicates a significant increase in the division of labor by gender. Evaluating this transition in the archaeological record requires careful consideration of environmental conditions, past and present, and control of potential recovery biases in the reconstruction of subsistence strategies.

Environmental Context

The coastline between Point Sur and San Carpoforo Creek—the area generally known as the Big Sur—is the most rugged stretch of shoreline in California, and one of the most environmentally diverse. Marked by a near absence of coastal terraces, the Santa Lucia Mountains rise directly and precipitously from the Pacific Ocean. Peaks of more than 1,500 m occur less than 5 km from the shoreline, creating one of the steepest coastal gradients in the continental United States (Henson and Usner 1993:12). Because of this steep gradient, the continental shelf is unusually narrow, and the strip of land lost to sea level rise during the most recent transgression is no more than a few hundred meters in width. This steep

coastal flank encompasses a varied topography associated with a wide array of microhabitats. Seven distinct plant communities have been identified in Big Sur, each with a variety of subtypes (Henson and Usner 1993:85–230). These range from cool, moist redwood forest, commonly found in drainages influenced by coastal fog, to steep, dry, rocky slopes supporting various types of chaparral. Terrestrial mammals that frequent these habitats include black-tailed deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), cottontail rabbit (*Sylvilagus auduboni*), and mountain lion (*Felis concolor*).

Also contributing to the lack of homogeneity in the Big Sur landscape is latitude. Big Sur is located midway between northern mesic environs, and more xeric southern environments. Both flora (Bickford and Rich 1984:7) and intertidal fauna (Ferguson 1984:5) reflect this mid-latitude position; topographic and microhabitat diversity result in the co-occurrence of both northern species and southern species found nowhere else. Big Sur also retains a number of endemic taxa, so that the composite environment, a mix of northern, southern, and endemic species, exhibits astounding taxonomic diversity that has attracted the attention of botanists since the nineteenth century (Henson and Usner 1993:85).

The coastal flank of the Santa Lucia Range is bisected by a series of small, steep creeks and rivers that drain directly into the Pacific Ocean. Among the largest of these are the Big Sur River and Big Creek, along which the archaeological sites investigated for this study are situated (Figure 1). The coastal zone typifies exposed, high-energy outer coasts of California. Much of the shoreline is marked by steep cliffs flanked by isolated narrow beaches. Potential resources occurring in the littoral zone and offshore waters include shellfish, fish, sea mammals, and marine algae (kelp). Shellfish in the mid- to high littoral zone include mussel (*Mytilus californianus*), barnacle (*Balanus* spp.), limpet (*Collisella* spp.), and one species of chiton (*Nuttalina californica*). Taxa most commonly encountered in the mid- to low intertidal zone include three other species of chiton (*Ischnochiton regularis*, *Mopalia* spp., and *Cryptochiton stelleri*), black abalone (*Haliotis*

cracherodii), and black turban snail (*Tegula funebris*). The red abalone (*Haliotis rufescens*) has been found exclusively in the low intertidal zone (Ferguson 1984:58).

Marine fish include those common to the open rocky coast of central California, particularly rockfish that frequent near-shore kelp forests. Most abundant are cabezon (*Scorpaenichthys marmoratus*), surf perch (Embiotocid), rockfish (*Sebastes* spp.), and lingcod (*Ophiodon elongatus*). Smaller taxa include the northern anchovy (*Engraulis mordax*), herring, and sardines (Clupeidae).

Marine mammals include year-round residents, the sea otter (*Enhydra lutris*) and harbor seal (*Phoca vitulina*), and seasonal migrants including the California sea lion (*Zalophus californianus*), Stellar sea lion (*Eumetopias jubata*), northern fur seal (*Callorhinus ursinus*), and southern fur seal (*Arctocephalus townsendi*).

Unlike other stretches of California shoreline, the Big Sur coast shows no evidence of alteration in intertidal habitat through time. In other settings, stabilization of sea level rise at mid-Holocene resulted in increased sediment loads, reduction of estuaries, and expansion of sandy beaches (Gibson 1992:3, 4; Masters 1983:206; Rudolph 1985), all of which are commonly reflected in proportional changes in shell midden taxa. At Big Sur, midden constituents show virtually no significant taxonomic changes through time; deposits representing the last 6,400 years all show the California mussel constituting over 90 percent of the molluscan assemblage (Jones and Haney 1992).

Mid-Holocene paleoenvironmental reconstructions are not available for the immediate area of the Big Sur coast, and sequences developed in the Santa Barbara area to the south and the San Francisco and Monterey Bay areas to the north serve as proxies. A late Pleistocene/Holocene pollen core from the Santa Cruz Mountains reported by Adam et al. (1981) suggests that the climate of the central coast during the last full glacial interval was similar to that found today 260 km north in the vicinity of Fort Bragg: temperatures were 2–3°C cooler than at present; precipitation was about 20 percent greater; and vegetation was dominated by pine and fir (Adam et al. 1981:265–267). This environmental description

Table 1. Excavation Volumes and Dating of Big Sur Archaeological Sites.

Site	Total Excavation	Screened through			Dating ^a
	Volume (m ³)	6 mm (¼")-Mesh	3 mm (⅛")-Mesh	1.5 mm (⅙")-Mesh	
CA-MNT-63	4.6	1.4	3.2	.0040	A.D.1-1200, 1800-1816
CA-MNT-73	20.9	0.0	20.9	.0480	2300-1700 B.C.
CA-MNT-759/H	2.9	0.0	2.9	.0023	A.D.1450-1500
CA-MNT-1223	13.4	0.0	13.4	.0120	A.D.1250-1700
CA-MNT-1227	9.0	5.2	3.8	.0061	A.D.1300-1750
CA-MNT-1228	14.7	13.1	1.6	.0027	3700-2900 B.C.
CA-MNT-1232/H Stratum II	5.4	2.8	2.6	.0035	4400-3300 B.C.
CA-MNT-1233	10.0	6.6	3.4	.0187	A.D.1000-1300
CA-MNT-1235	2.4	0.0	2.4	.0000	A.D.1100-1500
CA-MNT-1236	2.0	0.0	2.0	.0000	A.D.1500-1750
CA-MNT-1277/H	8.5	3.5	5.0	.0067	A.D.800-1830 ^b
Total	93.8	32.6	61.2	.1040	

^a Based on radiocarbon, obsidian hydration, and temporally sensitive shell beads. All radiocarbon results corrected and calibrated with the Stuiver and Reimer (1993) program.

^b Multicomponent and partially mixed, but most occupation dates A.D. 1500-1830.

supports Johnson's (1977) view that the California coast experienced less severe glacial climate than did interior settings (Adam et al. 1981:267).

Of more relevance are climatic conditions and vegetation configurations present during the mid-Holocene, when conditions were warmer and drier than the present (Antevs 1948). Precise dating of this climatic optimum, sometimes known as the Altithermal (Porter and Denton 1967), varies locally, as do estimates of the severity of ambient conditions. In the San Francisco Bay area, drier, warmer postglacial conditions fostered an expansion of xeric vegetation, which culminated sometime around mid-Holocene (Axelrod 1981:850), with a decrease in pine and increase in redwood (Adam et al. 1981:269). Bay waters, however, probably ameliorated climate change (Axelrod 1981:851). Higher summer temperatures and decreased precipitation restricted oak woodland and mixed evergreen and redwood forest to favorable north slopes and sheltered valleys. Adam et al. (1981) have pointed out, however, that the continued high frequency of redwood pollen at mid-Holocene argues against persistent drought during this period on the coast. As cooler moister climates returned following the mid-Holocene optimum, xeric taxa were apparently restricted to local sites around San Francisco Bay, the interior, and the south coast ranges in the vicinity of Big Sur (Axelrod 1981:854).

In the Santa Barbara Channel, vegetation recon-

structions developed from pollen data (Heusser 1978) are in conflict with a marine paleotemperature sequence based on radiolarian fossils (Kahn et al. 1981; Pisias 1978), probably as a reflection of the complex relationship between marine and atmospheric temperature regimes. Marine water surface temperatures were warmer than present between 6000 B.C. and 3400 B.C., and cooled noticeably between 3400 and 1800 B.C. Glassow et al. (1988:74-75) have supplemented the radiolarian sequence with temperature-diagnostic molluscan findings from coastal middens (i.e., red abalone), and have constructed a terrestrial climatic sequence, which is largely congruent with the marine reconstruction. They date maximal warm dry conditions between 5800 and 3400 B.C., followed by cooling after 3400 B.C. A more recent study of oxygen and carbon isotope values obtained from archaeological mussel shells by Glassow et al. (1994) confirms ocean cooling ca. 3400 B.C., which apparently signals an increase in marine productivity. For the most part, the diversity of the Big Sur biome probably rendered it less susceptible to major fluctuations in resource potential as a consequence of large-scale, low intensity Holocene climatic changes. Vegetation patterns probably shifted as taxa migrated up and down, but key resources remained accessible to human populations. Resident floral and faunal taxa did not change enough in character or expanse to demand major cultural response, as rugged topography con-

Table 2. Vertebrate Remains from Big Sur Archaeological Sites.

Common Name	Taxon	CA-MNT-73 (2300–1700 B.C.)		CA-MNT-1228 (3700–2900 B.C.)		CA-MNT-1232/H Stratum II (4400–3300 B.C.)	
		NISP	MNI	NISP	MNI	NISP	MNI
Terrestrial Mammals							
Black-tailed deer	<i>Odocoileus hemionus</i>	28	16	76	42	27	13
Brush rabbit	<i>Sylvilagus audubonii</i>	8	8	0	0	0	0
Gray fox	<i>Urocyon cinereoargenteus</i>	0	0	1	1	3	1
Dog/coyote	<i>Canis sp.</i>	1	1	1	1	1	1
Weasel	<i>Mustela frenata</i>	1	1	0	0	0	0
Bobcat	<i>Lynx rufus</i>	0	0	1	1	0	0
Marine Mammals							
Harbor seal	<i>Phoca vitulina</i>	2	2	3	3	3	3
Sea otter	<i>Enhydra lutris</i>	2	2	0	0	0	0
California sea lion	<i>Zalophus californianus</i>	0	0	0	0	1	1
Northern fur seal	<i>Callorhinus ursinus</i>	1	1	1	1	0	0
Steller sea lion	<i>Eumetopias jubata</i>	1	1	1	1	0	0
Birds							
Duck	<i>Anas/Aythya/Melanitta</i>	2	2	0	0	0	0
White pelican	<i>Pelecanus sp.</i>	1	1	0	0	0	0
Hawk	<i>Buteo sp.</i>	0	0	1	1	0	0
Subtotal		47	35	85	51	35	19
Fish							
Shark	Carcharhinidae	0	0	0	0	4	3
Pacific hake	<i>Merluccius productus</i>	0	0	0	0	4	4
Surfperches	Embiotocidae	15	13	0	0	4	4
Prickleback	Stichaeidae	0	0	0	0	3	2
Monkeyface prickleback	<i>Cebibidichthys violaceus</i>	31	14	0	0	2	2
Rock prickleback	<i>Xiphister mucosus</i>	3,155	1,582	0	0	2	2
Pacific mackerel	<i>Scomber japonicus</i>	0	0	0	0	1	1
Rockfish	<i>Sebastes sp.</i>	570	1,604	2	2	17	14
Rock or kelp greenling	<i>Hexagrammos sp.</i>	27	18	1	1	1	1
Lingcod	<i>Ophiodon elongatus</i>	19	19	0	0	8	8
Cabezon	<i>Scorpaenichthys marmoratus</i>	102	57	7	7	33	28
Subtotal		3,919	3,307	10	10	88	69
Grand Total		3,966	3,342	95	61	118	88
Shannon Index of Diversity		.1840		.2104		.5213	

tinued to foster a diversity of microhabitats and accommodate a complex vegetative mosaic. As Moratto (1984:549) noted, the coastal zone was not unaffected by mid-Holocene warming, but it does not necessarily follow that those changes which did transpire had major cultural implications.

Archaeological Investigation

Excavation data from 11 Big Sur shell middens (Table 1) are included here to monitor the emer-

gence of mortar and pestle technology. The sites were investigated between 1986 and 1990, and are reported by Jones (1988, 1995) and Jones and Haney (1992).

Field and Analytical Methods. Attempts to infer diet from midden deposits require serious consideration of methods, since different field strategies produce vastly different results and lead to variable interpretations. Studies have demonstrated that very small mesh is needed to effec-

Table 3. Bone:Shell Ratios from Big Sur Components.

Component	Shell:Mammal Bone	Shell:Fish Bone	Fish Bone:Mammal Bone
Milling Stone period			
CA-MNT-1232/H Stratum II	60.7:1	15.8:1	3.8:1
Early period			
CA-MNT-1228	16:1	134:1	.2:1
CA-MNT-73	1.6:1	.02:1	93.3:1

Note: Shell in kilograms (Kg) and fish bone in NISP.

Table 4. Dietary Reconstructions from Big Sur Archaeological Sites.

Component	Percentage of Edible Flesh				
	Marine Mammals	Terrestrial Mammals	Fish	Shellfish	Birds
Milling Stone period					
CA-MNT-1232/H Stratum II	30.5	32.6	10.6	26.3	.0
Early period					
CA-MNT-1228	24.4	58.5	.2	16.8	.1
CA-MNT-73	12.7	12.2	74.4	.6	.1

tively evaluate midden constituents (Erlandson 1994; Gibson 1988:107; Gordon 1993), particularly ichthyofaunal remains (Fitch 1972). Site data discussed here were acquired from a mixed excavation strategy in which different mesh sizes were used to evaluate different constituents: mammal bones were collected from 1-x-2-m units, dry-screened with 6-mm and 3-mm mesh; fish and shellfish were evaluated by column samples, water-screened through nested 6-, 3-, and 1.5-mm mesh. The 1.5-mm mesh was used to tabulate fish bone, since some small taxa and individuals are seriously underrepresented in larger mesh. Column sample findings have been volumetrically extrapolated to compare with findings from the larger units. Total recovery volumes and mesh sizes used at the investigated sites are summarized in Table 1.

Converting faunal remains into dietary indexes is fraught with difficulties, especially when different classes (i.e., mammals, fish, and shellfish) are involved. Different techniques are employed, none without problems (Lyman 1979). Researchers from the University of California, Santa Barbara (e.g., Erlandson 1994; Glassow 1992; Glassow and Wilcoxon 1988), advocate a weight method for converting faunal remains into meat estimates: weights of recovered shell and bone are converted into meat values using bone or

shell:flesh ratios. This method tends to underestimate the value of large mammals in the diet, because many bones are not preserved in identifiable form due to field butchering and postdepositional destruction. An alternative is to employ minimum number of individuals (MNI). Although not without problems (Brewer 1992), MNI compensates for postdepositional loss of identifiable elements. NISPs (numbers of identified specimens) and MNIs from the study sites are summarized in Table 2.

For this study, faunal data were manipulated two ways. First, ratios of NISP and shell weights are presented as empirical representations of the relative importance of faunal classes (Table 3). Second, diets have been reconstructed using shell:meat ratios for shellfish, and MNIs (calculated for each excavation level) and mean meat values for mammals and fish (Table 4). In both cases, emphasis has been placed on constancy of method, and identification of relative change in faunal assemblage over time. Dietary diversity was also calculated using the Shannon Index of Diversity.

Since faunal remains provide only a proximal estimate of diet, analyses of bone and shell were supplemented with isotope readings from isolated human bone fragments obtained from some of the middens. Readings of ^{13}C and ^{15}N are available

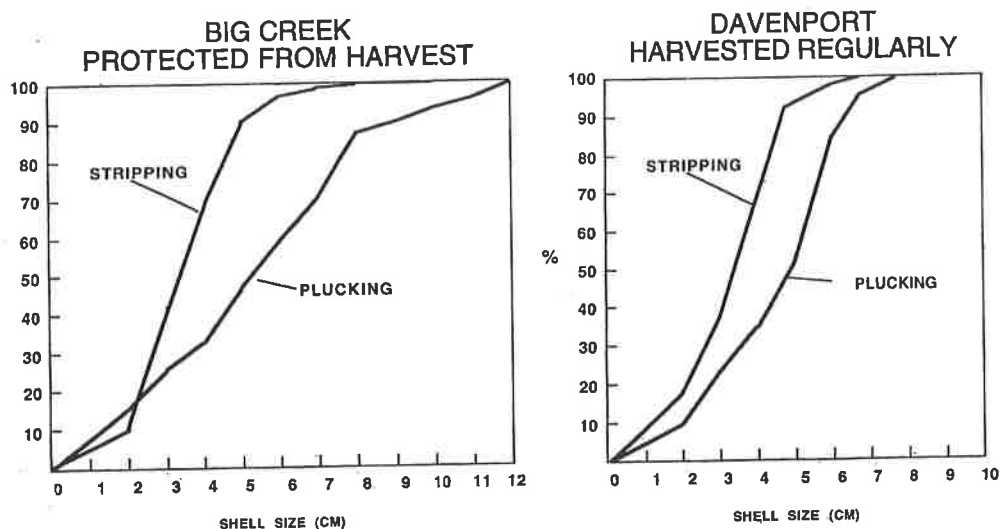


Figure 2. Experimentally derived cumulative proportion curves for stripping and plucking *Mytilus californianus* in protected and regularly harvested settings (specimens 0–1 cm not included) (from Jones and Richman 1995).

from six individuals from five sites (Table 5). Small as the sample is, it represents one of the few assemblages from the California coast where faunal and human bone isotope data are available from the same locations.

Special effort was also made to evaluate shellfish collection strategies. Column samples showed that all of the excavated deposits were dominated by the California sea mussel *Mytilus californianus*. To determine the mean size of the exploited populations, all whole and nearly whole (30 percent or more) mussel shells were collected from excavation units and measured. A template was used to approximate the complete measurement of fragmentary specimens. Shell measurements were used to construct cumulative proportion curves, similar to those used by biologists (e.g., Suchanek 1981) to assess living populations. This technique was first applied to archaeological specimens by White (1989) who identified two alternative techniques for the collection of mussels, each associated with a distinctive cumulative proportion curve. The first, a selective harvesting technique (plucking), emphasizes large individuals. The alternative, a nonselective strategy (stripping of entire mussel colonies), produces an archaeological assemblage with a smaller mean shell size, reflecting the general mussel population. White

used only hypothetical cumulative proportion curves to portray the size frequencies associated with these different collection strategies, but these hypothetical curves were subsequently questioned (Bouey and Basgall 1991).

To establish the cumulative frequency curves associated with different strategies empirically, and to evaluate the relative efficiency of different collection methods, two replicative mussel collection experiments were undertaken in different locations, employing identical procedures. The first was in a setting (Landels-Hill Big Creek Reserve in Big Sur), where mussel beds have not been subject to human predation for at least 15 years. The second was completed at Davenport in Santa Cruz County, where mussel beds are regularly harvested by the public. At each location,

Table 5. Stable Isotope Ratios from Human Bone from Big Sur Archaeological Sites.

Site	Gelatin	
	^{13}C	^{15}N
CA-MNT-1227 Individual A	- 15.6	+ 10.2
CA-MNT-1227 Individual B	- 17.4	+ 8.7
CA-MNT-1228	- 17.7	+ 8.1
CA-MNT-1232/H Stratum II	- 18.0	+ 6.3
CA-MNT-1233	- 15.3	+ 11.8
CA-MNT-1277/H	- 17.2	+ 9.3

Table 6. Experimental Mussel Collection Specifications and Results.

	Collection	Weight		No. of Mussels	% ≥ 4.0 cm	Processing	Weight	
	Time	Total Load	Meat			Time	Meat/Hour	Kcal/Hour
Landels-Hill Big Creek Reserve								
Plucking	20	5,954.3	470.7	424	66.5	40	470.7	543.2
Stripping	20	5,506	343.5	1,298	30.1	90.87	185.6	214.2
Davenport Landing								
Plucking	20	4,863	564	746	64.6	48	497.6	574.2
Stripping	20	10,227.2	750.2	1,478	32.2	116.57	386.4	445.9

Notes: Collection and processing time in minutes; weight in grams (g); kcal based on energy values by Gilliland (1985:62). Source: Jones and Richman (1995).

Table 7. Artifact Assemblages from Big Sur Archaeological Site Components.

Artifact	CA-MNT-1232/H		
	Stratum II	CA-MNT-1228	CA-MNT-73
Barrel <i>Olivella</i> beads (Class B)	2	1	0
Thick rectangle <i>Olivella</i> beads (Class L)	0	1	1
Talc schist pendants/pendant blanks	0	3	0
Lanceolate projectile points	1	0	0
Long-stemmed projectile points	0	0	0
Square-stemmed projectile points	0	2	2
Contracting-stemmed projectile points	0	8	5
Side-notched projectile points	0	1	3
Indeterminant projectile points	1	2	1
Flake tools	0	8	9
Bifaces	1	23	25
Hammerstones/battered cobbles	2	2	5
Mortars	0	1	1
Pestles	0	1	5
Anvil	0	0	1
Milling slabs	2	4	6
Hand stones	5	2	8
Pitted stones	0	0	12
Notched net weights	0	0	1
Bone fish gorges	0	2	0
Bone awls	0	1	1
Antler tines	2	1	0
Total	16	63	86

mussels were collected by a single individual for 20 minutes employing either a stripping or plucking strategy. The collected mussels were then transported to base camp where they were boiled; the meats were removed, and meats and shells were weighed and measured (Table 6). The resulting cumulative proportion curves clearly distinguish plucking versus stripping strategies (Figure 2). In terms of net efficiency, a selective strategy is always superior to stripping; in both settings plucking produced over 500 kilocalories/hour (Table 6). This finding is supported by the practices employed by commercial harvesters of

California mussel who, under pressure from contemporary markets, suggest that a selective gathering of large individuals is the only way to sustain large yields (Yamada and Peters 1988). As White (1989) noted, this optimal strategy could only be maintained by groups who were not exploiting the same mussel beds too frequently (i.e., mobile groups), since it takes at least two years for a mussel to reach a length of 12 cm (Coe and Fox 1942:2). A stripping strategy produces the greatest number of total kilocalories, but only with the input of greater processing labor. In a regularly exploited setting, the absence of large individuals

renders less extreme the difference between stripping and plucking, both with regard to cumulative proportion curves and net efficiency.

Also influenced by excavation strategy are data on obsidian among flaked stone. Obsidian was imported to the Big Sur coast in the form of bifaces from several sources 200–300 km distant. It occurs in middens as either biface fragments or pressure flakes, resulting from biface retouch. Without the use of 3-mm ($\frac{1}{8}$ ") mesh, pressure flakes are underrepresented in collections lacking this control. With the use of 3-mm mesh, the relative frequency of obsidian, an indicator of inter-regional exchange, can be monitored through time for the Big Sur coast.

Site Findings. Sites were excavated by a University of California, Davis, field class in 1990. Three deposits span the Milling Stone/Early transition.¹ The Milling Stone period is represented by CA-MNT-1232/H, a relatively small shell midden (87 m long x 55 m wide) located at an elevation of 246 m, 1 km inland from the shoreline (Figure 1). Multicomponent and stratified, the site was occupied intermittently from 4400 B.C. through the Late period. The upper portion of the deposit (Stratum I; 0–130 cm) was extensively mixed, but the lower portion, between 130 and 270 cm below surface, contained a physically and culturally discrete layer, Stratum II. Four radiocarbon assays date Stratum II to 4400–3300 B.C. (Table 1). The associated artifact assemblage, highlighted by a lanceolate projectile point and *Olivella* barrel beads (type B3, Bennyhoff and Hughes 1987:122) (Table 7), is typologically consistent with contemporaneous assemblages of the southern coast. Milling tools were limited to hand stones and slabs (Jones 1995; Jones and Haney 1992). The faunal assemblage was dominated by mussels, black-tailed deer, and marine mammals (Tables 2 and 3). Stratum II presently constitutes the only known evidence from Big Sur for occupation predating 3500 B.C.

CA-MNT-1228, the Redwood Terrace Site, is situated 250 m inland from CA-MNT-1232/H. A total of 14.7 m³ was excavated from the small (548 m²) and shallow (10–70 cm) shell midden, which, based on three radiocarbon assays, was occupied between 3700 and 2900 B.C. The site

yielded *Olivella* shell beads (types A1 [2], B3b [1] L2 [1]), stemmed and side-notched projectile points, talc schist ornaments, and bone fish gorges (Table 7; Jones 1995; Jones and Haney 1992). Vegetal resource processing equipment was dominated by milling-slab fragments and hand stones, but a bowl mortar fragment and a pestle fragment were also recovered. This assemblage is nearly identical to that recovered from CA-SBA-53 (Harrison and Harrison 1966) and CA-MNT-391 (Cartier 1993). The faunal inventory was dominated by black-tailed deer and marine mammals (Table 2).

CA-MNT-73, located near the mouth of the Big Sur River in Andrew Molera State Park (Figure 1), is a more expansive (10,350 m²) shell midden. Seven radiocarbon dates indicate a relatively brief occupation between 2300 and 1700 B.C. (Jones 1995). Radiocarbon dating was corroborated by an unusually large suite of obsidian hydration readings, obtained from a sample of 138 pieces, a significantly larger representation of this constituent than that from CA-MNT-1232/H or CA-MNT-1228. A total of 20.9 m³ of deposit was excavated, and the resulting assemblage, including mortars and pestles (Table 7), was similar to that obtained from CA-MNT-1228.

Eight other shell middens, CA-MNT-63, 759/H, -1223, -1227, -1233, -1235, -1236, -1277/H, post-date the Milling Stone/Early transition (Table 1) and provide important comparative data on mean shell sizes and obsidian frequencies. Particularly significant was a discrete historical feature uncovered at CA-MNT-63, dating A.D. 1800–1816, from which a large sample of mussel shells was recovered.

Assemblage Variability Across the Milling Stone/Early Transition. Important changes are evident in Big Sur tool assemblages ca. 3500 B.C., paralleling those marking the end of the Milling Stone period elsewhere in California. The ratio of ground stone to flaked stone reverses, as projectile points and bifaces, rare in Milling Stone assemblages (see Meighan 1978:236), became more abundant (Table 7). This pattern, originally identified by Rogers (1929) in the Santa Barbara Channel, has long been an indicator of increased hunting at the end of the Milling Stone period.

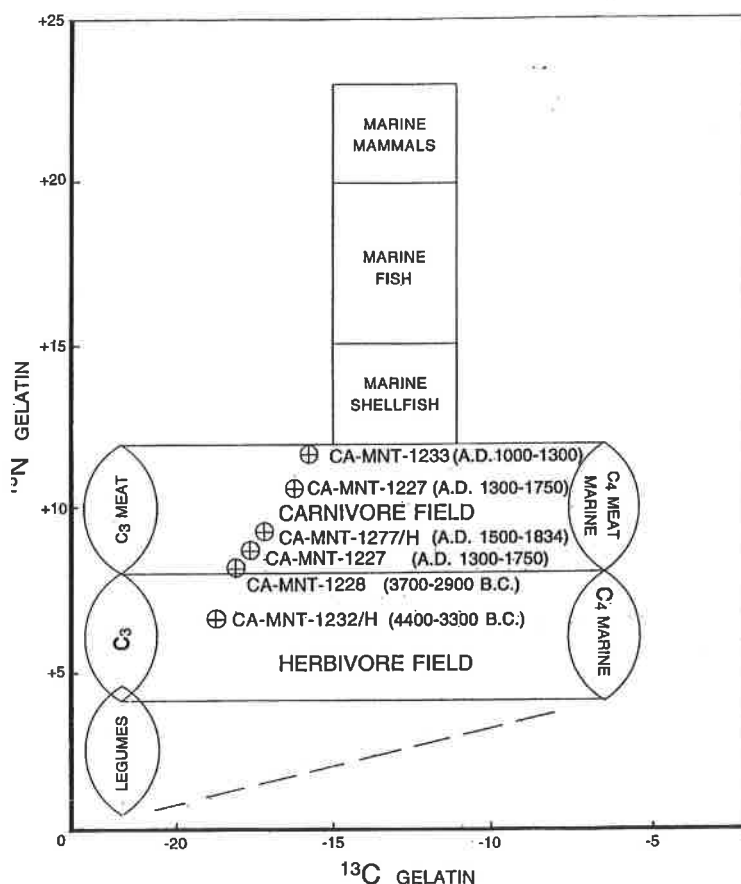


Figure 3. Stable isotope results from Big Sur archaeological sites plotted according to the composite geochemical model of diet reported by Ericson et al. (1989:91).

Diachronic patterns in the Big Sur faunal assemblages are consistent with both the stone tools and faunal trends identified elsewhere. The Milling Stone occupation at CA-MNT-1232/H is marked by high frequencies of shellfish remains reflected in shell:bone ratios and reconstructed diet (Tables 2 and 3). In combination with the representation of ground-stone implements, the combined faunal/artifact assemblages reflect the same hard seed and shellfish diet ascribed to the Milling Stone period in the Santa Barbara area (Erlandson 1991). This focus on gathered commodities is followed by an increased emphasis on mammals and fish at the inception of the Early period, as represented by decreased ratios of shellfish (primarily mussel) to mammal bone, and increased fish bone:shell and fish bone:mammal bone ratios (Table 2).

A human bone isotope reading from Stratum II at CA-MNT-1232/H confirms a terrestrial, herbivorous dietary focus during the Milling Stone period (Figure 3), but seems to conflict with the dense accumulations of mussel shells in this deposit. This same discrepancy is suggested in the Santa Barbara area, where Early period middens yield dense accumulations of shell (Erlandson 1994; Glassow 1991, 1992), but human bone studies show a diet focused on terrestrial vegetable foods (Walker and DeNiro 1986). The isotope findings for the channel, however, are not clearly contemporaneous with the dense shell deposits. Isotope values from Big Sur sites postdating the Milling Stone period suggest a more generalized diet, with increased emphasis on meat and marine foods (Figure 3). Studies from the Santa Barbara Channel show the same trend (Walker and DeNiro 1986).

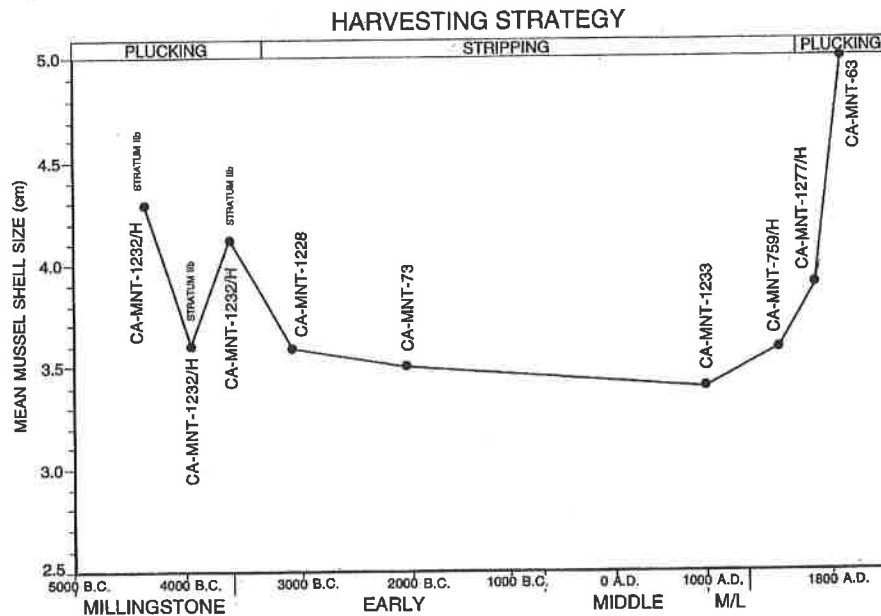


Figure 4. Mean sizes of *Mytilus californianus* shells and collection strategies through time on the Big Sur coast.

Mussel shells from three sites exhibit a marked diminution across the Milling Stone/Early transition (Figure 4). Following this sharp decline, mean shell sizes continued to decrease slightly for ca. 5,000 years. During the Protohistoric period mean shell size shows a rebound, which continued into the Historic period, as the feature at CA-MNT-63 exhibited the greatest mean shell size of any of the investigated sites. The Milling Stone/Early decrease transpired at a time when, in the Santa Barbara Channel, surface sea water temperatures declined. Since a decline in ocean temperatures would encourage increased growth rates in mussels (Seed and Suchanek 1992:90), this diachronic pattern is the opposite of what would be expected as a consequence of environmental change.

Comparison between the experimentally derived cumulative frequency curves and curves generated from the archaeological collections shows a change in exploitation strategy coincident with the decrease in mean shell size across the Milling Stone/Early transition (Figure 5). A decrease in selectivity is apparent because a "plucking"-like strategy, evident in the milling-stone assemblage, was superseded by stripping during the Early period. This technique continued

in use until the Protohistoric period (Figure 4). The historic feature at CA-MNT-63 showed a distinctive "plucking" curve (Figure 4). Clearly, mean size of the exploited mussel populations was controlled by the intensity of human harvest; a selective strategy used during the Milling Stone period was associated with a large mean shell size, while smaller means were associated with a nonselective, "stripping" strategy. With decreased human populations and collection pressure during the Protohistoric and early Historic periods, mussel populations apparently rebounded, when selective collection techniques were once again employed.

The final and most striking marker of the Milling Stone/Early transition is increased evidence for interregional exchange after ca. 3500 B.C. No obsidian was recovered from the Milling Stone assemblage at CA-MNT-1232/H. In contrast, CA-MNT-73 yielded 94 pieces of obsidian for a density of 4.49 pieces/m³ (Table 8), which is similar to the high volume reported by Breschini and Haversat (1989) from CA-MNT-108 on the Monterey Peninsula, 40 km north of Big Sur. It also is consistent with the cumulative hydration profile from all Big Sur sites, which shows virtually no readings predating the Early period and a

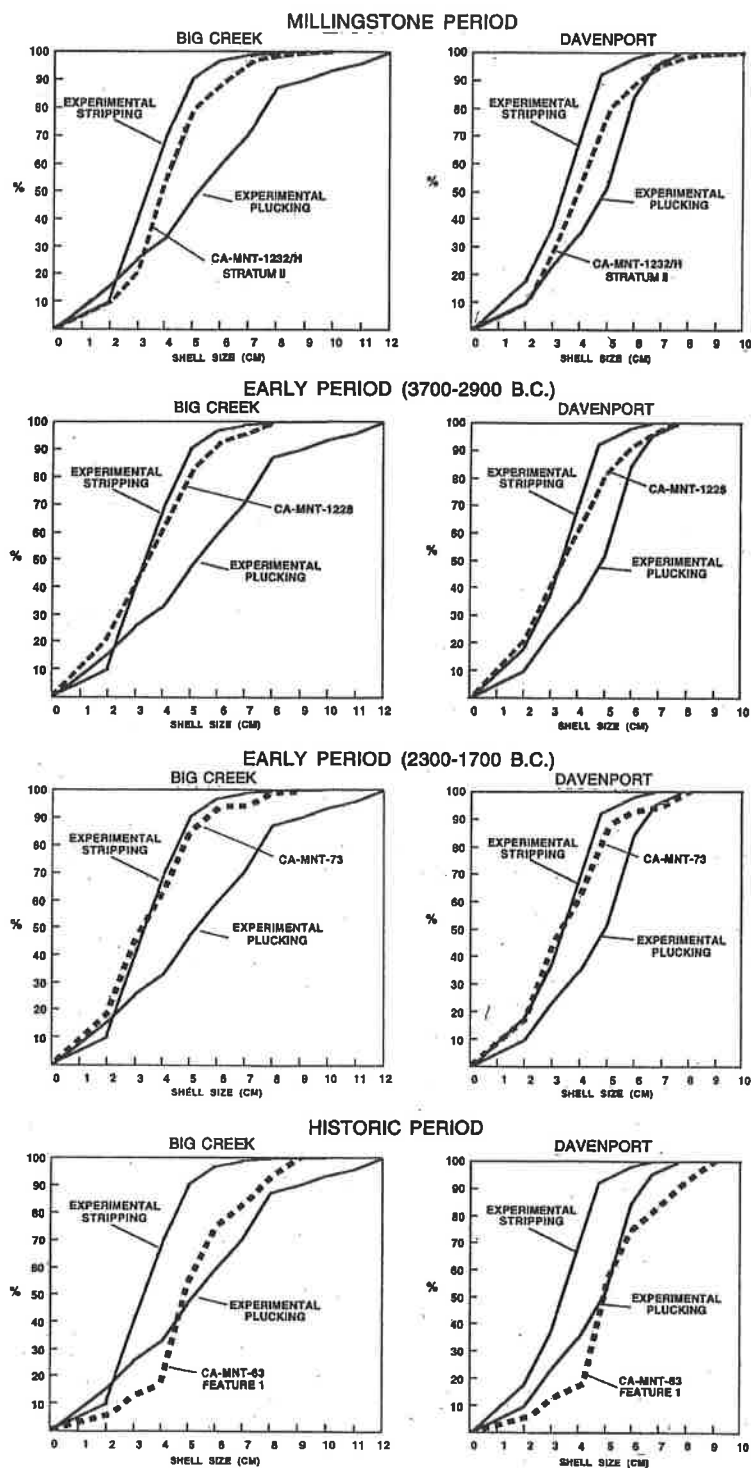


Figure 5. Comparison between experimentally derived cumulative proportion curves and archaeological specimens from CA-MNT-63, -73, -1228, and -1232/H (specimens 0-1 cm not included).

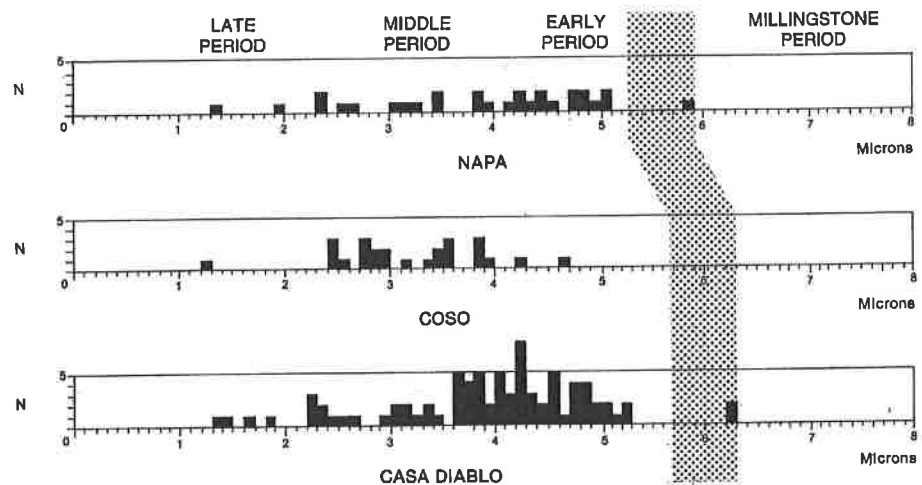


Figure 6. Cumulative obsidian hydration profile from the Big Sur coast for the Napa, Casa Diablo, and Coso sources.

significant number following that date (Figure 6). A small industry producing pendants from local talc-schist pebbles (Figure 7) also developed after the Milling Stone period, based on findings from CA-MNT-1228 and CA-MNT-1232/H Stratum I. The exchange network apparently also included sea otter pelts, as otter bone frequencies parallel obsidian frequencies through time (Figure 8), and otter bones do not appear in the record before the occupation of CA-MNT-73, where obsidian was prolific.

Summary and Discussion

Cultural transitions ca. 3500 B.C. on the Big Sur coast exhibit changes in artifact assemblages that conform with the appearance of what was formerly known as the Hunting Culture in the Santa Barbara Channel, which replaced Oak Grove, a local manifestation of the Milling Stone Horizon. Stemmed and side-notched projectile points appear for the first time along with the mortar and pestle, supplementing the earlier milling stone-dominated assemblage.

A marked decrease in mobility is suggested by several patterns in the record. First, the disparity between the faunal data and the bone isotope results from CA-MNT-1232/H suggests that the Milling Stone period was characterized by high mobility, as site inhabitants occupied a number of interior and coastal settings. Early period and later sites show a stronger correlation between

faunal residues and the isotopic results, suggesting a more constrained system of transhumance. Early period faunal reconstructions suggest a decrease in the importance of shellfish, and an increased reliance on fish and terrestrial mammals. Dietary diversity decreased across the 3500 B.C. threshold, suggesting that foraging radii were shrinking.

Comparison between the experimentally derived cumulative frequency curves for alternative mussel collection strategies and curves generated from CA-MNT-73, CA-MNT-1228, and CA-MNT-1232/H suggests a change in exploitation strategy coincident with a decrease in mean shell size. A selective strategy evident at CA-MNT-1232/H Stratum II was superseded by a stripping strategy, which continued in use until the Protohistoric period. Experimental data indicate that plucking is a more efficient strategy. The advantage of plucking over stripping is greatest in settings not subjected to human harvest, whereas in areas where human harvest has occurred frequently, the lowered availability of large individuals reduces the difference between the two techniques. Intensity of human collection, therefore, influences the value of the resource through time. Mussels collection that was either too frequent or too intensive will affect mussel populations and lower the value of subsequent collections. Any degree of exploitation could potentially reduce the population's recovery rate, although

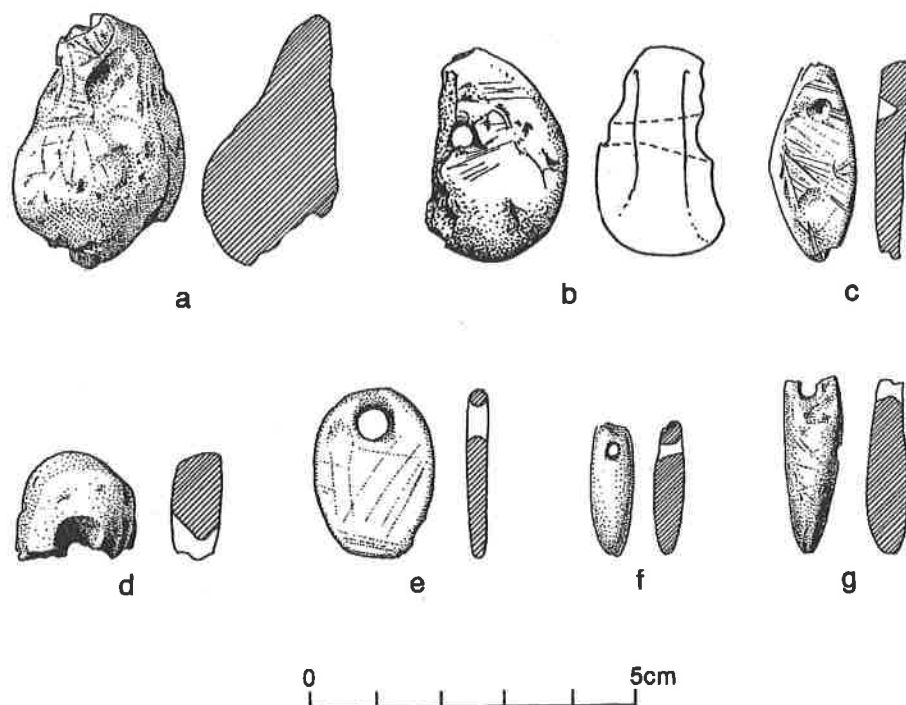


Figure 7. Talc-schist pendants and pendant-manufacturing detritus from the Big Sur coast: (a) split pebble, CA-MNT-1232/H Stratum I, 47-18; (b) drilled pebble, CA-MNT-1232/H Stratum I (surface), 47-6; (c) partially drilled pendant blank, CA-MNT-1232/H Stratum I, 47-4-36; (d) broken, drilled pendant, CA-MNT-1228, 42-3-08; (e) complete pendant, CA-MNT-1228, 42-4-17; (f) broken pendant, CA-MNT-1232/H Stratum I, 47-4-26; (g) broken pendant, CA-MNT-1232/H Stratum I, 47-1-7.

Yamada and Peters (1988) have demonstrated that limited harvesting is beneficial to the growth curve of *Mytilus californianus*. The Milling Stone/Early transition, therefore, represents the adoption of a less efficient bivalve collection strategy, which could yield higher total calories but only with the expenditure of more processing time, particularly in locations where humans had previously collected. The high frequency of mussel shells in Stratum II at CA-MNT-1232/H is most likely a product of relatively mobile foraging groups. The subsequent adoption of a less efficient strategy was associated with extended occupation of coastal residential bases and concomitant human impact on intertidal fauna.

The other major change marking the Milling Stone/Early transition involves exchange commodities. Stratum II at CA-MNT-1232/H yielded virtually no signs of interregional exchange; no obsidian was found, nor was there evidence for local manufacture of trade goods. Otter bones,

associated with later trade in otter pelts, were absent as well. Obsidian is likewise absent from nearly all Milling Stone components on the central California coast (Jones and Waugh 1995). It appears for the first time in Big Sur at CA-MNT-1228, albeit in low quantities, at the same time as a small local industry in talc-schist pendants. By 2300 B.C., when CA-MNT-73 was occupied, obsidian exchange was apparently quite regularized, as this commodity was also abundant at CA-MNT-108, which is similarly dated (Breschini and Haversat 1989). Otter bones also appear for the first time at CA-MNT-73, and become proportionately more abundant through time.

The diachronic patterns in tool assemblages, dietary remains, mussel collection strategies, and exchange goods suggest that selective use of the coast was replaced by a less diverse, more intensive exploitation strategy involving extended, but not permanent, occupation of residential bases. These changes, equating with what Beaton (1991)

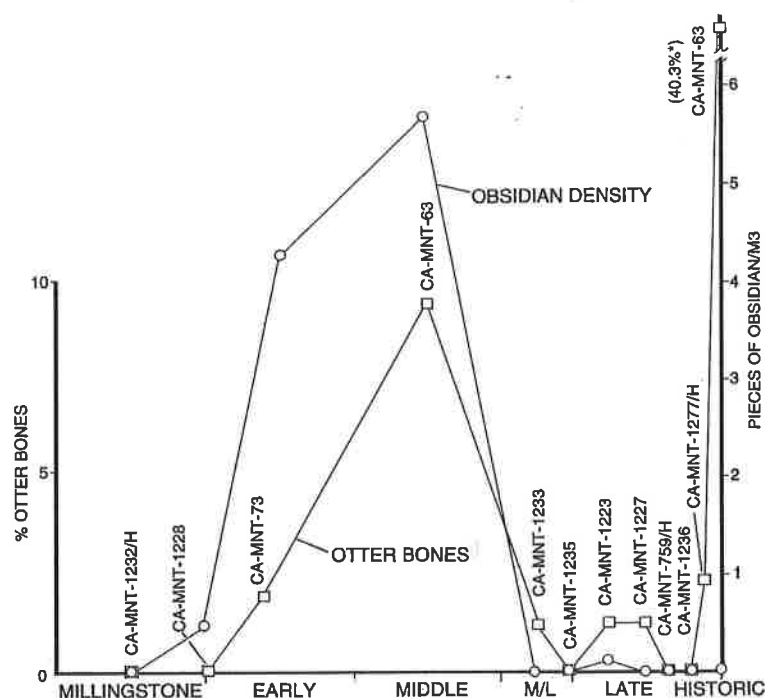


Figure 8. Relative proportion of otter remains and obsidian density through time on the Big Sur coast.

describes as a shift from extensification to intensification, can be attributed to population circumscription, reflecting the success of an earlier, mobile, and selective adaptive strategy. Diets became less diverse as foraging radii shrank in

response to the presence of groups in adjoining areas. Shellfish became less important in the diet as longer use of individual sites depleted the beds, requiring pursuit of alternative foods. More time was spent processing mussels, but less net dietary

Table 8. Obsidian Frequency from Big Sur Archaeological Sites.

Site	Total Excavation Volume (m ³)	Screened through 3-mm Mesh	Contemporaneous Obsidian	Obsidian Frequency (N/m ³)
Milling Stone period				
CA-MNT-1232/H	5.4	2.6	0	.00
Early period				
CA-MNT-1228	14.7	1.6	1	.40
CA-MNT-73	20.9	20.9	94	4.49
Middle period				
CA-MNT-63	4.6	3.2	19	5.93
Middle/Late Transition				
CA-MNT-1233	10.0	3.4	0	.00
Late and Protohistoric periods				
CA-MNT-759/H	2.9	2.9	0	.00
CA-MNT-1223	9.0	3.8	0	.07
CA-MNT-1227	9.0	3.8	0	.00
CA-MNT-1235	2.4	2.4	0	.00
CA-MNT-1236	2.0	2.0	0	.00
CA-MNT-1277/H	8.5	5.0	0	.00

Note: Based on obsidian hydration readings consistent with radiocarbon dating and excavation volume from 3-mm mesh screening.

value was obtained. The mortar and pestle, while minor additions to the equipment inventory, support conclusions from the mussel profiles suggesting that processing became increasingly important, concomitant with a reduction in mobility and decreased subsistence efficiency.

These dietary and exchange shifts also seem to signal a change in social organization and division of labor by gender. Based on faunal remains and human isotope findings both from this study and the Santa Barbara Channel, there are indications that gathered foods contributed a large portion of the diet during the Milling Stone period. Gathering was probably undertaken by all group members, and a less rigid division of gender-defined tasks may have existed. At the beginning of the Early period, economies became more intensive, with the onset of the historically recorded pattern of men hunting and fishing, while diverting less time to gathering.

As hunting became more important, a concurrent increase in processing is suggested by the mussel profiles, the appearance of the mortar and pestle (tools indicative of intensive processing), and an increased reliance on fish. Women's processing labor may have been critical to this newly intensified economy. A dramatic and concomitant increase in exchange goods (obsidian, pendants and otter pelts) accompanying the changes in subsistence may signal the rise of lineal descent organization, in response to the enhanced value of, indeed the need for, processing labor, particularly that of women participating in marital exchange. This may have been the beginning of the system of marriage-related exchange identified at contact by J. P. Harrington (1942:30). The concomitance of increased processing and interregional exchange conforms with expectations of Kelly (1991), who, on the topic of the possible gender implications of subsistence intensification, suggested that a reduced foraging radius would encourage the development of social alliances through interlineage marriage. At Big Sur, interregional exchange begins abruptly and seems to signal an increase in processing labor. Interlocality trade would also serve as a substitute for direct resource acquisition, as population circumscription resulted in decreased access to some resources.

In the Santa Barbara Channel the appearance of

the mortar and pestle has been linked with a decline in ocean temperatures ca. 3400 B.C. The Big Sur coast must have experienced this event, but a decrease in mean shell size associated with the Milling Stone/Early transition (Figure 4) is the opposite of what would be expected. Human behavior, in the form of more intensive collection, influenced the character of this resource more significantly than climate change both across this transition and through the rest of the known human occupation of Big Sur. Other cultural changes, including changing task appropriation by gender in response to changing social structures, are likewise consistent with population circumscription and subsistence intensification. Whether the mortar and pestle also represent initial use of the acorn is unclear, and may in fact be less significant than the increased focus on processing that these implements apparently represent.

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Note

1. Variation in regional and local cultural historical nomenclature is a major problem in California and the mid-Holocene transition evidenced at these sites is variously referred to as the Early/Middle Archaic transition in northern California (Fredrickson 1974, 1984), the Ex/Ey transition in the Santa Barbara Channel (King 1990), and Horizon II (Milling Stone)/Horizon III (Intermediate) elsewhere on the southern coast (Wallace 1955). Nomenclature for the central coast, largely a compromise between these competing schemes, portrays a large-scale transition ca. 3500 B.C. between the Milling Stone (ca. 6500-3500 B.C.) and Early (3500-600 B.C.) periods. The Milling Stone period is considered largely the equivalent of Fredrickson's Early Archaic and King's Phase Ex; the Early period equates with Fredrickson's Middle Archaic and King's (1990) Phases Ey and Ez.

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