❁ CHAPTER 8

Climatic Consequences or Population Pragmatism?

A Middle Holocene Prehistory of the Central California Coast

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WITH THE INCREASING APPLICATION of optimal foraging and intensification concepts to interpretations of prehistoric hunter-gatherer behavior in California (for example, Basgall 1987; Broughton 1994a; Erlandson 1991a), archaeologists face an emerging challenge to evaluate economic behavior relative to environmental context and to distinguish environmental causality from population-induced subsistence change. Alternative perspectives on this issue have been demonstrated recently in coastal and interior environmental settings. Basgall (1987), Basgall and Hall (1992), and Hildebrandt and Mikkelsen (1993) develop models in which economic intensification is seen as largely unrelated to environmental change. Others (for example, Cleland and Spaulding 1992; Glassow, Wilcoxon, and Erlandson 1988) argue for causal relationships between diachronic environmental variability and transitions in subsistence and mobility. Intimately related to these efforts are ongoing attempts to evaluate the relative subsistence utility of coastal versus terrestrial resources and habitats. Marine environments provide a unique setting with which to evaluate alternative perspectives on environment because of the dramatic effects of sea-level rise during the Early and Middle Holocene. Consideration of the Middle Holocene prehistory of the central coast raises issues that speak directly to alternative perspectives on environmental causality and the relative value of marine versus terrestrial resources.

The Middle Holocene in western North America is generally perceived as a period of warm, dry climate (Antevs 1948; Byrne, Busby, and Heizer 1979). As a consequence, many regional prehistories portray the era as one of cultural adjustment to severe conditions (see Antevs 1952; Baumhoff and Heizer 1965). Owing to an absence of regional data, events transpiring on the Central California coast have often been considered largely in conjectural terms: the coast was envisioned as a potential refuge from the severe interior conditions (Moratto, King, and Wolfenden 1978:158) or as an area directly affected by drought and decreased environmental productivity (Heusser 1978). Data accumulated in the last fifteen years finally allow the central coast to speak for itself. The portrait that emerges is one of distinctive local complexity as environmental flux through the Middle Holocene appears to have varied markedly throughout the region. Against this complex and varied backdrop, the Middle Holocene, particularly the period from 4000 to 3500 BC, marks a major cornerstone of cultural change. The trajectory and character of this change is considered here for the purposes of evaluating possible causal relationships between the paleoenvironmental record and human economic behavior and examining the direction of subsistence change vis-à-vis marine versus terrestrial emphases. Toward these goals, we examine the particular environmental settings along the central coast and the context and consequences of those settings as they relate to Middle Holocene human activity as reflected in artifact assemblages, dietary practices, settlement pattern, exchange, and human osteology. We conclude that environmental influence is readily apparent in unstable settings (for example, estuaries) at certain points in time but that broad-scale/low-intensity environmental change did not have uniform influence over the entire region and was less significant than localized variability. Broad-scale uniformity of Middle Holocene cultural changes, however, implicates population dynamics as a major causal variable. Marine resources were used throughout the Middle Holocene, but significant differences are apparent between open coasts and estuaries and in the relative intensity of use of different marine foods, particularly fish and shellfish.

Classificatory terms that identify variation in this regional and local cultural history pose a major problem in coastal

California. Middle Holocene transitions are variously referred to as the Lower/Middle Archaic transition in northern California (Fredrickson 1974, 1984), the Ex/Ey transition in the Santa Barbara Channel (C. King 1990), and Initial Early/Terminal Early in the Vandenberg area (Glassow 1992b). Throughout most of California, tool assemblages marking the early Middle Holocene are dominated by milling slabs, handstones, cobble and other core tools, and flake tools, with a low incidence of projectile points. First identified in Southern California, this milling-stone–dominated technology served as the hallmark for the Milling-Stone horizon (Wallace 1955). The assemblage has since been recognized in Central and Northern California (Cartier 1993a; Fitzgerald 1993; Hildebrandt 1983; McGuire 1994; Meyer, Rosenthal, and White 1994; True, Baumhoff, and Hellen 1979) in early Middle Holocene contexts. In most regions, the base tool inventory of the Milling-Stone horizon was augmented by an increased diversity of projectile point types and the mortar and pestle around 3500 BC[1]. In some areas, the assemblage transition was accretionary; in others, a wholesale replacement is evident; and in still others (for example, San Diego County) little or no change occurred. Because this technology was not restricted to the Early Holocene and persisted until historic contact in some locations, the Milling-Stone horizon has always been considered a problematic cultural historical unit. To recognize what we believe is meaningful regional patterning in Middle Holocene assemblages, and as a compromise among competing cultural historical schemes, nomenclature developed for the central coast portrays a large-scale transition circa 3500 BC between the Milling-Stone and Early periods (T. Jones 1993; Jones and Waugh 1995). The Milling-Stone period is roughly equivalent to Fredrickson's Lower Archaic and C. King's Phase Ex; the Early period equates with Fredrickson's Middle Archaic and King's Phases Ey and Ez.

ENVIRONMENTAL CONTEXT

Shoreline along Santa Cruz, Monterey, and San Luis Obispo counties can be classified as one of two types: open-coast beaches (that is, unprotected surf-swept shore)or rocky headlands and lagoon or estuaries. The latter, products of the drowning of river valleys during late Pleistocene/Early Holocene rise in sea level, provide significant shelter from the open ocean. The central coast is dominated by exposed shoreline with a mixture of rocky and sandy substrates that have shifted in expanse throughout the course of the Holocene. Major estuaries/lagoons are presently found at Elkhorn Slough (fig. 8.1) and Morro Bay (fig. 8.2). Preliminary excavation findings from the Pismo Beach area (Gibson 1981) suggest that a similar system was present in that locality prehistorically (Dills 1981). Perlman (1980) and T. Jones (1991) suggest that estuaries rank above exposed coasts in human resource potential because of dense packing of potential food commodities.

The terrestrial environment of the central coast is diverse, owing to its hydrographic and climatic variability. Vast tracts of land support grassland and oak woodland, while within reach of the summer fog belt, redwood forest occurs at moderate elevations in the coastal mountains. In precontact times, marshland, associated with the edges of estuaries and small inland lakes, made up a significant proportion of the central coast landscape. Lacustrine habitats of potential importance to prehistoric humans have been identified in the southern Santa Clara Valley (Lake San Felipe [Jenkins 1973] and Laguna Seca) and possibly at Scotts Valley in Santa Cruz County (Cartier 1993a). Freshwater shellfish remains (*Anodonta* sp., *Margaritifera margaritifera*, and *Gonidea angulata*) have been recovered from the former shoreline of Lake San Felipe (Hildebrandt and Mikkelsen 1993). T. Jones (1991) and T. Jones and D. Jones (1992) suggest that these lakes were as attractive to early human colonists as were the estuaries. Based on findings from test excavations in the Gilroy area, however, Hildebrandt and Mikkelsen (1993) portray San Felipe Lake as a relatively low-ranked habitat, which became a focus of Late Holocene lacustrine intensification.

The central coast vegetation mosaic harbors a variety of large-and medium-sized terrestrial mammals, including black-tailed deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), cottontail rabbit (*Sylvilagus audubonii*), and jackrabbit (*Lepus californicus*). Archaeofaunal data and historic accounts (Gordon 1974:85) indicate that tule elk (*Cervus elaphus*) and pronghorn (*Antilocapra americana*) were once common here as well.

Open rocky shorelines offer a distinctive suite of potential resources. Common shellfish taxa include California mussel (*Mytilus californianus*), barnacle (*Balanus* sp.), limpet (*Collisella* sp.), chiton (*Nuttalina californica*), black abalone (*Haliotis cracherodii*), and black turban snail (*Tegula funebralis*). The red abalone (*Haliotis rufescens*) occurs as well, but only in the low intertidal zone (Ferguson 1984:58). Dense kelp forests, also common along open rocky shores, provide habitat for a diverse array of rock fish including cabezon (*Scorpaenichthys marmoratus*), surf perch (Embiotocidae), rockfish (*Sebastes* sp.), and lingcod (*Ophiodon elongatus*). The exposed shoreline provides an abundance of offshore rocks and secluded nearshore settings used as haulouts and rookeries for large marine mammals. Seasonal migrants include

1 All calendar ages in this chapter are based on radiocarbon dates calibrated and corrected with Stuiver and Reimer's (1986) CALIB program. All marine shell dates were corrected for isotope fractionation (+410 years) and marine upwelling with a Delta R value of -325 + 35 years.

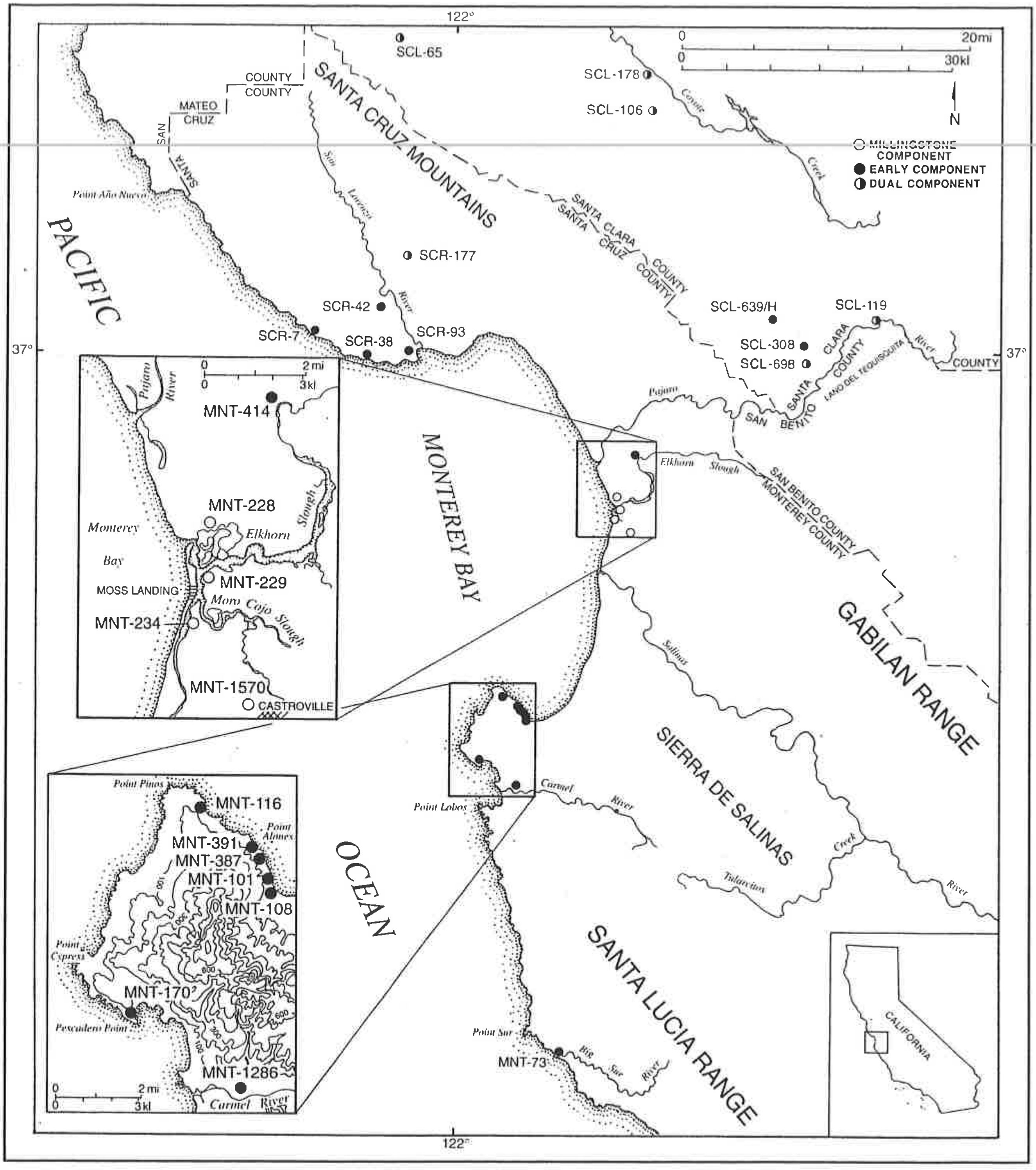

FIGURE 8.1 Middle Holocene archaeological sites in the Monterey Bay and northern Big Sur districts.

the California sea lion (*Zalophus californianus*), Stellar sea lion (*Eumetopias jubata*), northern fur seal (*Callorhinus ursinus*), and southern fur seal (*Arctocephalus townsendi*). Northern elephant seals (*Mirounga angustirostris*) presently breed at Point Año Nuevo in southern San Mateo County. Permanent residents include the sea otter (*Enhydra lutris*) and harbor seal (*Phoca vitulina*).

Central coast estuaries alternately support salt marsh and mud-flat communities, which provide habitat for a distinctive set of calm water-adapted intertidal clams and cockles, including bent-nose clam (*Macoma nasuta*), Pacific gaper (*Tresus nuttalli*), littleneck clam (*Protothaca staminea*), Washington clam (*Saxidomus nuttalli*), and Nuttall's cockle (*Clinocardium nuttalli*). Bay mussels (*Mytilus trossulus*) are also common as are oysters (*Ostrea lurida*) in locations with firm substrates and nearby freshwater outflows. The open

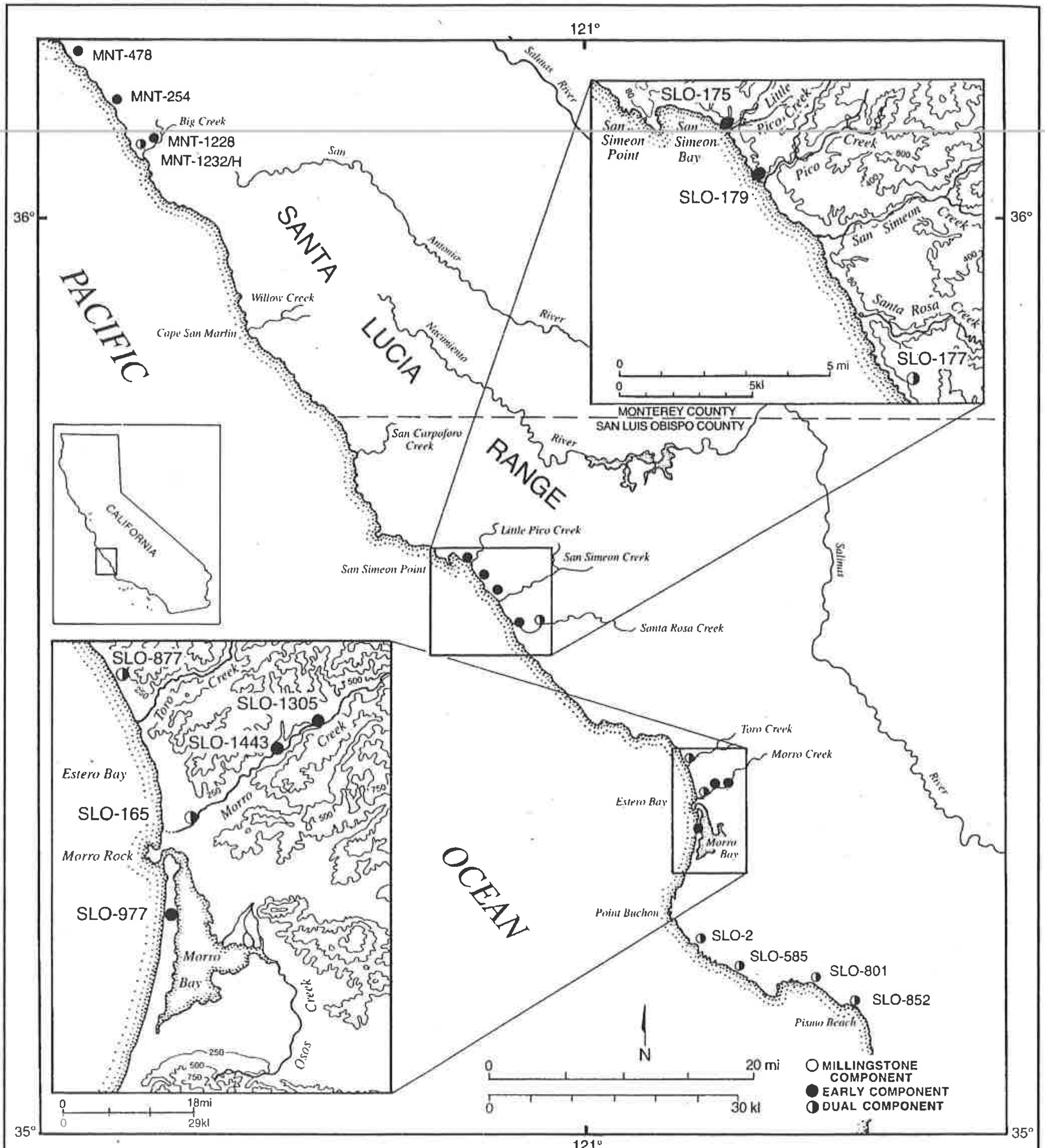

FIGURE 8.2 Middle Holocene archaeological sites in the southern Big Sur and San Luis Obispo districts.

beach Pismo clam (*Tivela stultorum*) occurs in significant frequencies along open beaches only as far north as Estero Bay, with an occasional specimen encountered in Monterey Bay.

Central coast estuarine marshes provide extensive habitat for marine and terrestrial waterfowl. Marine mammals are also found within these embayments, although permanent residents—harbor seals and sea otters—are more common than migratory breeders. Perhaps the most significant resource of the lagoonal habitats is their fisheries. Most thoroughly researched is Elkhorn Slough, where Yoklavich et al. (1991) inventoried a seasonal nursery for a vast number of fish taxa, many of which are not found nearshore on the outer coast. These include bat ray (*Myliobatus californica*), plainfin midshipman (*Porichthys notatus*), skates, sharks, and sculpins (Gobalet and Jones 1995). Some taxa, notably surfperches and the Pacific staghorn sculpin (*Leptocottus* *armatus*), are found within the slough year round. Preliminary studies of the contemporary Morro Bay fishery (Horn and Allen 1976) and archaeological findings (Salls, Huddleston, and Bleitz-Sandburg 1989; T. Jones et al. 1994) indicate that this habitat was equally rich in ichthyofauna.

SITE VISIBILITY

No discussion of Early and Middle Holocene environmental variability is complete without considering the effects of natural processes on archaeological site visibility and the potential for drawing false or misleading cultural inferences from patterns that are natural in origin. Archaeological research has been pursued on the Central California coast for nearly a century, and the latter half of this work was completed during the radiocarbon era. Thousands of acres have been surveyed, and hundreds of subsurface investigations have been completed, but despite this extensive field effort, few early Middle Holocene components are known. None whatsoever were identified before 1972 and, as recently as 1985, only four had been reported. Three natural processes contribute substantially to the low visibility of early sites in Central California: rise in sea level, coastal erosion, and rapid alluvial deposition. Problems with coastal site visibility are dealt with at length by Bickel (1978). For the most part, these problems increase along a north-south axis, with the greatest amount of land lost to rise in sea level in the north and the least in the south. The amount of coastal terrace lost along the central coast is moderate, but it must still be assumed that many early Middle Holocene deposits have been destroyed.

Problems with alluvial deposition in the interior are equally serious, albeit less frequently acknowledged, and limit our ability to firmly evaluate the relative importance of marine versus terrestrial habitats during the early Middle Holocene. Several key projects demonstrated that Middle Holocene components dating approximately 3000 to 2000 BC commonly occur at prohibitive depths in the interior valleys adjacent to the central coast. These include CCO-308, where a component dating to 2500 BC was found at a depth of 5 m (Fredrickson 1966); the BART skeleton from San Francisco dating to 3710 BC at a depth of 22.9 m (Henn, Jackson, and Schloeker 1972); and CA-SCR-239 in Scotts Valley dating to 3700 BC, beneath 3 m of natural, sterile alluvium (Cartier 1992). With components dating only to late Middle Holocene at such prohibitive depths, it is reasonable to conclude that many early Middle Holocene sites lie buried at depths unreachable by normal archaeological investigation. With higher annual rainfall in the north, these problems become exacerbated on a north-south axis. Any arguments for the relative use of inland versus coastal settings incorporating negative data or those positing relative utility on a north-south axis are likely to underestimate problems of site visibility.

PALEOENVIRONMENT

Terrestrial Component

Vegetation histories for the central coast continue to be largely dependent on research completed to the north at San Francisco Bay and to the south in the Santa Barbara Channel. The Middle Holocene has long been portrayed as a time of warmer and drier climatic conditions (Antevs 1948), classified alternatively as the Altithermal, Xerothermic, or Hypsithermal (Porter and Denton 1967). As more fine-grained regional studies have been completed, it has become clear that such conditions were neither constant through the entire Middle Holocene nor as severe as those evident during Pleistocene times.

Compared to the Pleistocene, Holocene climatic changes were relatively minor, and many researchers emphasize the apparent complacency of Holocene pollen profiles (Byrne 1979), particularly on the central coast (Rypins et al. 1989:84; West 1987). There is a considerable difference of opinion on the dating of peak warm conditions and the severity of ambient conditions. In the San Francisco Bay area, Axelrod (1981:850) speculated that drier, warmer postglacial conditions, fostering an expansion of xeric vegetation, culminated sometime around the Middle Holocene. In the Santa Cruz Mountains, this transition is reflected by a decrease in pine and an increase in redwood (Adam, Byrne, and Luther 1981:269). Axelrod (1981:851) further argued that along the coast the effect of ocean waters probably ameliorated climate change. Adam, Byrne, and Luther (1981) have pointed out that the continued high frequency of redwood pollen in the Middle Holocene argues against persistent drought during this period on the coast. In any event, as cooler, moister climates returned following the Middle Holocene optimum, xeric taxa were apparently restricted to local sites in the interior and to the south coast ranges (Axelrod 1981:854).

To the south in the Santa Barbara Channel region, vegetation reconstructions developed from pollen data (Heusser 1978) suggest that the peak of the Middle Holocene warming occurred between 3500 and 2200 BC, reflected by high frequencies of oak and Compositae pollen grains. This dating conforms with Moratto's (1984:548) generalized dating of the Altithermal in California (circa 2600–900 BC). Marine water-surface temperatures were warmer than present between 6000 BC and 3400 BC and cooled noticeably between 3400 and 1800 BC. Pisias (1978:381) suggested that low water temperatures may have been responsible for peak atmospheric warming and drying, because a positive relationship is today evident between surface sea temperatures and rainfall along the California coast. As demonstrated by the El Niño Southern Oscillation of 1983, warm ocean temperatures are often associated with increased winter rainfall and decreased summer fog. The latter increases mean annual temperatures along the coast. Conversely, cool ocean waters are most commonly associated with periods of reduced

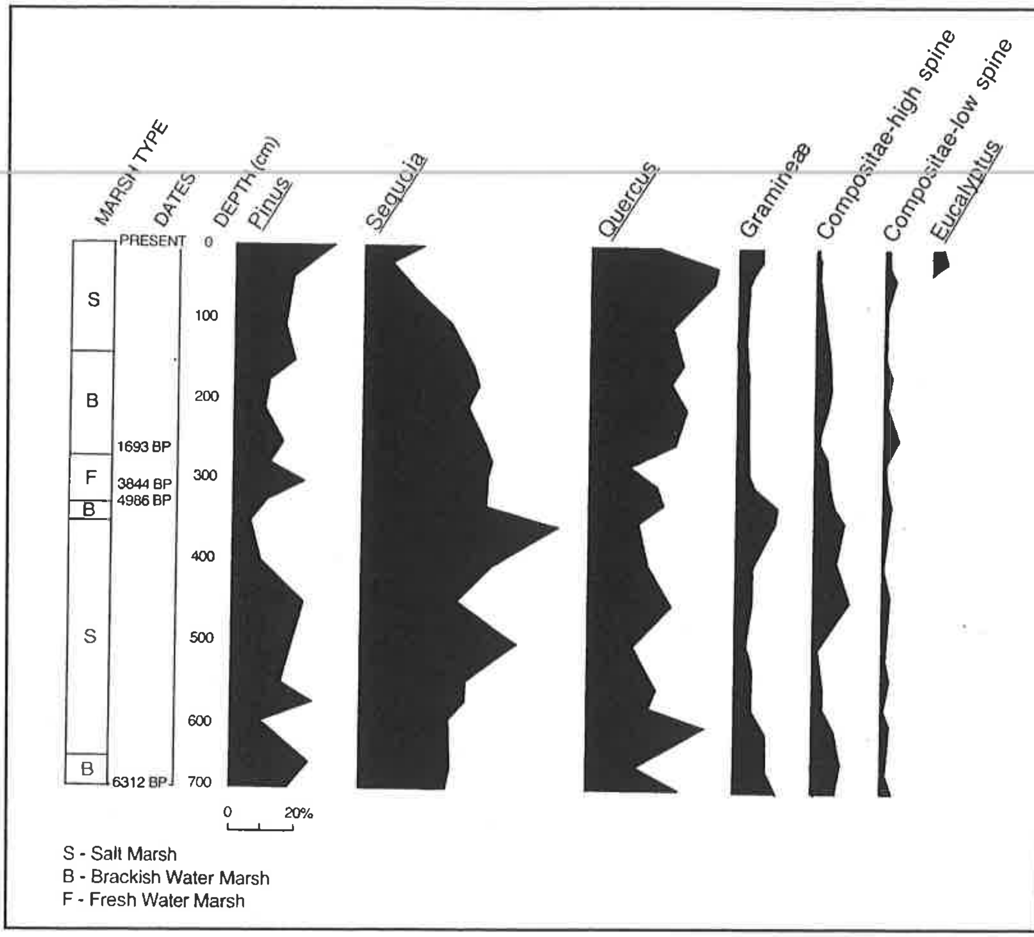

FIGURE 8.3 Terrestrial taxa from the Elkhorn Slough pollen core. *West 1988*

rainfall. Pisias' explanation for contemporaneity between a cold ocean and peak Middle Holocene warming fails to explain the correspondence between warm ocean temperatures and warm climate during the early Middle Holocene. Based on the dating of red abalone middens on the northern Channel Islands, Glassow et al. (1994) confirmed a decline in water temperature circa 3400 BC. Recent oxygen isotope studies from archaeological mussel shells from the channel further corroborate a decline in sea temperature circa 3400 BC. Van Geen et al. (1992) reported evidence from the San Francisco Bay area for a greater upwelling off the California coast circa 2000 BC than at present, which is consistent with lower water temperatures and greater summer insolation. Recent findings from the Sierra Nevada Range suggest that the interior experienced a warm and dry early Middle Holocene climate. Maximal warm dry conditions occurred during the Early Holocene (Davis and Moratto 1988; Smith and Anderson 1992), with a cooling regime beginning as early as 2500 BC (Smith and Anderson 1992:99). As rainfall correlates strongly with latitude in California, these findings suggest that the central coast was likewise drier than present during the early Middle Holocene.

A pollen profile reported by West (1988) from Elkhorn Slough provides the only direct index for central coast vegetation history through the Middle Holocene. Discussed elsewhere in varying detail (Dietz, Hildebrandt, and Jones 1988; T. Jones 1992:14; T. Jones and D. Jones 1992), dating of this sequence, originally tentative, has been refined based on two recently obtained radiocarbon dates. The combined pollen and radiocarbon data reveal an extremely complex sequence reflecting evolution of both the terrestrial and hydrographic landscapes as a result of large-scale Holocene climatic changes and localized stochastic events. Now dated by a total of four radiocarbon assays (table 8.1) the 6.9 m-deep column dates to a maximum of 4363 BC. Pine, redwood, oak, and grass pollen are all present in moderate frequencies in the lowermost levels, but a shift of some significance is evident between 400 and 356 cm, where pine reaches its lowest frequency and oak declines (fig. 8.3). Concomitantly, grasses, high-spine composites, and redwood all appear in increased proportions. Dating circa 3200 BC, this pattern conforms with the decrease in pine and increase in redwood associated with the Middle Holocene in the San Francisco Bay area (Adam, Byrne, and Luther 1981), and likewise seems to correlate with Heusser's (1978) dating of peak warming in the Santa Barbara Channel. As in San Francisco Bay, high frequencies of redwood pollen suggest this was not a period of extended drought.

In summary, Middle Holocene paleoenvironmental reconstructions from adjacent regions including both terres-

TABLE 8.1 Radiocarbon dates from Elkhorn Slough sediment cores

LAB NO.	UNCORRECTED DATE (YEARS BP)	DEPTH (CM)	CALIBRATED DATE[1]	1σ PROBABILITY	REFERENCE
N/A	1730±130	275	AD 260	AD 120–420	Schwartz 1983
			AD 300 AD 320		
WSU-3358*	3550±70	313[2]	1895 BC	2020–1780 BC	Dietz, Hildebrandt, and Jones 1988:37
Beta-63515**	4410±60	344[3]	3040 BC	3290–2920 BC	This chapter
Beta-63514**	5540±60	683[4]	4360 BC	4460–4350 BC	This chapter

*Charcoal; **Peat; processed using the AMS technique; corrected for ^{13}C; 1. Tree-ring calibration via the Stuiver and Reimer (1986) computer program; 2. Mean between 300 and 325 cm; 3. Mean between 337.5 and 350 cm; 4. Mean between 675 and 690 cm.

trial and marine perspectives are not wholly concordant for the central coast. Most suggest the presence of warmer seawater temperatures and warmer and drier climate during the early Middle Holocene (Milling-Stone period). The dating of peak Middle Holocene warming is subject to question, but multiple lines of evidence suggest a cooling of ocean waters circa 3500 to 3000 BC, at the onset of what we here refer to as the Early period. The persistence, indeed an increase, in redwood pollen across this transition suggests that climatic changes occurring across the Milling-Stone/Early period transition represented neither significant deterioration nor improvement in local climate, particularly with respect to the aboriginal resource base. Climatic change was more extreme inland, but could by no means have been severe enough in and of itself to promote major cultural change on the coast.

Rise in Sea Level and Habitat Change

The Middle Holocene on the Central California coast is characterized by a marked shift in the rate of rise in sea level, as the Flandrian transgression came to a near halt. According to Atwater, Helley, and Hedel (1977), sea level along the California coast was between 40 and 60 m below the present level circa 8000 BC; by circa 3000 to 4000 BC it had risen to within 10 to 12 m of its present level. Bickel (1978:11) suggests that after 4000 BC, sea-level rise proceeded at a pace of only 1 to 2 m per millennium. Prior to 6000 BC, the rate approximated 20 m per millennium.

The effect of this marked slowing of sea-level rise varies between open coasts and estuaries. On the outer coast, some localities show evidence for wide expansion of sandy beaches as sands accumulated over formerly rocky shores. This process is represented in the shellfish remains from SLO-877 on the open coast of San Luis Obispo County (fig. 8.2), where strata dating between 6000 and 3500 BC show high frequencies of rocky coast taxa: California mussel, turban snail, and barnacle. Beginning at 3500 BC, Pismo clam (an open sandy beach taxon) accounts for nearly 75 percent of the identified species (Breschini and Haversat 1991a; Gibson 1992:8). A different version of this process was identified at SLO-177 and SLO-178 in Cambria on the northern San Luis Obispo coast, where a change from mussel to turban snail is evident circa1000 BC. Rudolph (1985:131) attributed this change to shift in landscape from a stable sea cliff to a boulder-strewn sandy beach as a consequence of slow rise in sea level and accelerated cliff erosion. Not all portions of the outer coast yield evidence for increased sedimentation during the Middle Holocene, however. Littoral sites in Big Sur show no significant taxonomic change in the rocky-coast shellfish assemblage between 4400 BC and AD 1830 (T. Jones and Haney 1992; T. Jones 1995). Indeed, the California mussel was the dominant mollusc exploited throughout the Middle Holocene (table 8.2), reflecting a general diachronic homogeneity in available resources.

The apparent relative constancy of the outer central coast resource base through the Middle Holocene is contrasted markedly by the dynamic environmental histories of Morro Bay and Elkhorn Slough. Archaeological investigations of these two systems have followed the seminal study of environmental change and human response in the San Francisco Bay estuary by Bickel (1978), who outlined a general sequence of Holocene sedimentation applicable to most California estuaries. During the Early Holocene, rise in sea level kept pace with sedimentary deposition within San Francisco Bay, constraining the expansion of mudflats. The Middle Holocene slowing of rise in sea level, however, encouraged the growth of mudflats and marshes, as sediment accumulation outpaced the slowly rising ocean waters.

The smaller central coast estuaries conform only partially with San Francisco Bay. A general trend toward infilling is evident through the Holocene, but the chronology of this progression varies between the smaller systems and San Francisco Bay. Indeed, because of its size, San Francisco Bay might best be considered an anomaly within the broader configu-

TABLE 8.2 Percentage summary of shellfish from exposed central coast sites

	Milling-Stone Period (6500–3500 BC)			*Early Period (3500–600 BC)*		*Middle Period (600 BC–AD 1000)*		
	MNT-1232/H	SCR-7	MNT-391	MNT-1228	SLO-175	MNT-63	MNT-185/H	SLO-175
Mussel	97.0	94.5	61.1	98.0	80.5	78.3	70.5	78.9
Abalone	0.3	0.0	9.4	0.1	0.1	1.7	0.8	0.0
Barnacle	1.8	4.9	6.8	0.5	9.3	0.4	9.4	6.7
Limpet	0.1	0.1	0.4	0.1	0.0	0.3	9.8	0.0
Urchin	0.5	0.1	1.2	0.1	0.3	1.7	0.3	0.6
Chiton	0.1	0.1	0.7	0.4	0.4	9.4	0.1	0.5
Littleneck	0.0	0.1	0.3	0.0	0.2	0.1	0.0	0.0
Cockle	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Turban	0.2	0.0	4.6	0.5	7.8	5.8	1.3	9.1
Other	0.1	0.2	15.3	0.3	1.4	2.3	7.8	4.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Cartier 1993b; T. Jones and Haney 1992; T. Jones 1995; T. Jones and Waugh 1995; Motz et al. 1989

TABLE 8.3 Percentage summary of shellfish from Elkhorn Slough and Morro Bay

	Milling-Stone Period (6500–3500 BC)			*Early Period (3500–600 BC)*	*Middle Period (600 BC–AD 1000)*		
	SLO-165	MNT-228	MNT-229	SLO-165	SLO-165	MNT-228	MNT-229
Protected habitat clams	81.4	65.6	74.9	23.8	27.2	16.8	53.4
Pismo clams	2.2	0.0	0.1	21.0	11.1	0.0	0.1
Oyster	1.7	3.0	1.7	2.7	3.1	0.0	1.1
Mussel	9.8	28.6	20.5	31.2	31.3	81.7	42.2
Barnacle	1.7	0.3	0.6	3.7	5.8	1.1	0.6
Moon snail	0.1	1.7	0.1	2.7	5.9	0.1	0.0
Turban snail	0.1	0.0	0.0	0.5	0.7	0.0	0.0
Other/non I.D.	2.9	0.8	2.1	14.3	14.9	0.3	2.6
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Dietz, Hildebrandt, and Jones 1988, T. Jones et al. 1994, 1996

ration of California estuarine prehistory. Radiocarbon-dated molluscan assemblages from Morro Bay, Elkhorn Slough, and, to a limited extent, Pismo Beach indicate that extensive protected clam habitat was well established in these locations by 6200 BC and that clams were the dominant taxon by a considerable margin (table 8.3). Through time, protected-habitat clams decreased, mussels increased, and oysters showed no significant change at either Elkhorn Slough or Morro Bay (table 8.3). Pismo clams appear in significant proportions at Morro Bay during the Early period, but latitude is responsible for the absence of this southern taxon at Elkhorn Slough. This sequence is nearly the reverse of what is reported from San Francisco Bay, where oysters occur in high frequencies early, give way to mussels in the Middle period, and later to clams (Bennyhoff 1978:39). The high incidence of oysters in early San Francisco Bay sites has long been attributed to a greater availability of rocky substrates prior to Late Holocene sedimentation, but oyster-dominated middens may be more indicative of the salinity tolerances of the taxon rather than substrate requirements. In the smaller lagoons of Elkhorn Slough and Morro Bay, taxonomic changes through time do not suggest a decrease in oysters or concomitant increase in clam habitat.

Findings from SLO-165 illuminate the Middle Holocene sedimentological history of a portion of Morro Bay. Situated near the mouth of what today is Morro Creek, this site yielded dated faunal assemblages that indicate the presence of a substantial estuary formerly connected to Morro Bay. Of interest in regard to the Middle Holocene are conclusions on the presence of fish and shellfish. Fish and protected-habitat molluscs were collected in respectable quantities circa 6200 BC, but the fishery was by far richer and of greater abundance between 3500 and 600 BC (T. Jones et al.1994; Salls, Huddleston, and Bleitz-Sandburg 1989). A protected shellfish habitat continued to provide substantial yields throughout the Middle period, but fish returns declined. By the Late period, both shellfish and fish yields had declined considerably. The richness of the Early period fishery probably is an outgrowth of sea-level dynamics, as the Morro Bay lagoon encompassed its greatest expanse of open

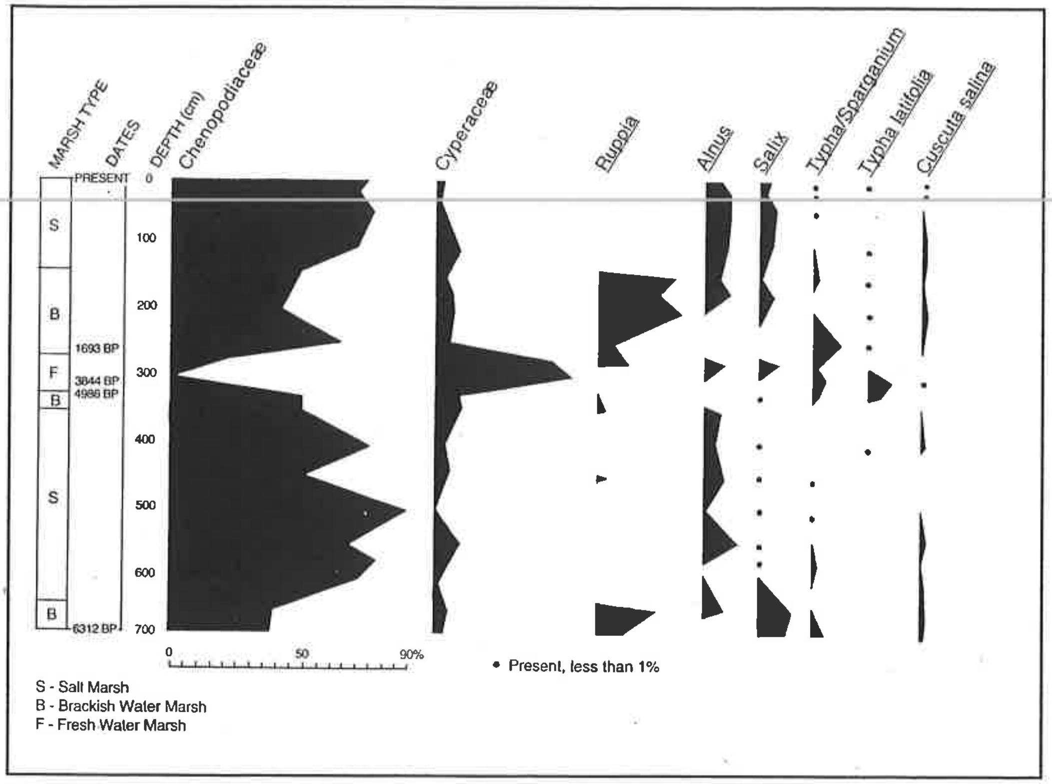

FIGURE 8.4 Hydrophytic taxa from the Elkhorn Slough pollen core. *West 1988*

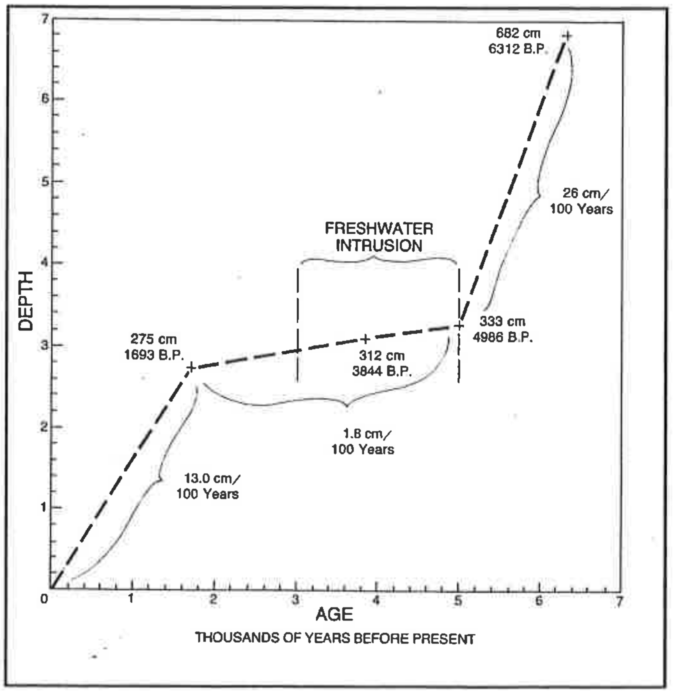

FIGURE 8.5 Elkhorn Slough sedimentation rates inferred from radiocarbon dating results.

water immediately following the diminishing rise of sea levels at Middle Holocene. Accumulating sediments continued to provide rich shellfish habitat at the expense of fish habitat, which decreased as the lagoon filled.

The Elkhorn Slough pollen sequence reveals a decidedly different Middle Holocene environmental sequence, highlighted by a dramatic reversal in salinity represented by fluctuations in aquatic taxa: Chenopodiaceae, Cyperaceae, *Typha* sp., and *Ruppia* sp. (fig. 8.4). Most significant is an apparent infusion of fresh water, marked by the disappearance of saline taxa (that is, *Salicornia* of the Chenopodiaceae family) and a sharp rise in less salt-tolerant members of the Cyperaceae family and *Typha* sp. West (1988:29–31) brackets this event between 280 and 333 cm below the present surface, and a newly obtained radiocarbon assay from a depth of 344 cm dates its inception at circa 3040 BC. The peak of freshwater conditions is dated 1900 BC by an assay from 313 cm. While the pollen core could reflect a localized event within Elkhorn Slough, archaeological site data, discussed in more detail below, suggest otherwise. The combined chronometric data further indicate that the freshwater reversal was associated with a drastic reduction in sedimentation rates within the slough (fig. 8.5). Radiocarbon dates from Elkhorn Slough shell middens indicate that saline or brackish conditions returned by 1000 BC.

Alternative explanations, developed to explain similar oscillations in other California estuaries, can potentially be applied to Elkhorn Slough. Decreased productivity at Batiquitos and other lagoons in San Diego County has been attributed to the silting-in of the mouths of the embayments (Gallegos 1987, 1992; Masters 1988; Warren and Pavesic 1963). At Newport Bay on the south coast, Davis (1992) correlates similar changes with broad scale (that is, global) climatic change. The Elkhorn Slough salinity reversal could have resulted from climate change, tectonic activity, a shift in river courses, or outflow from inland lakes in southern

Santa Clara County. In conflict with any correlate to broad-scale climatic change, however, is the simple fact that the other central coast estuary, Morro Bay, shows no evidence of contemporaneous events. The hydrographic landscape in the vicinity of Elkhorn Slough clearly reflects shifting river courses, and it is most likely that the temporary deterioration of Elkhorn Slough reflects an interval during which neither the Pajaro nor Salinas River emptied into the Slough, and it had no marine outlet.

For the central coast of California, paleoenvironmental reconstructions thus suggest that while climate was warmer during portions of the Middle Holocene, elevated temperatures did not prevail continuously. More importantly, in concert with the effect of the slowing rise in sea level and the concomitant habitat change, many coastal settings exhibit unique histories of environmental change that appear to have been influenced less by broad-scale climatic shifts than by local stochastic events.

Evidence for human response to the variety and intensity of the environmental flux and events along the central coast falls into these categories: sites and assemblages, settlement and subsistence, trade and exchange, and human osteology. The pattern that this evidence provides demonstrates a provocative, albeit sometimes scant, picture of human activity.

SITES AND ASSEMBLAGES

Between 6500 and 3500 BC archaeological evidence for assemblage variability is simply not supported by a robust set of data on the central coast. In the southern part of the region near San Luis Obispo, assemblage definition in large part still depends on recovery from sites at Diablo Canyon (Greenwood 1972). Of the two radiocarbon-dated sites there, SLO-2 and SLO-585, the latter with an apparent differentiation of dated components that directly pertain to the Middle Holocene is the most informative in terms of temporal assemblage patterning. Here, in the deposit dated from circa 6500 to 3000 BC, the handstone/milling-stone dyad is more common, exceeding that from the post-3000 BC deposit by a ratio of 8.8:1. Conversely, pestles were restricted to the more recent component. And while bowl mortars were recovered from both components, they were fully represented after 3000 BC by a ratio of 3.5:1. Another key artifact type was the large side-notched projectile point with both wide and narrow stem, the most common point type in the upper component, which was followed in frequency by leaf-shaped points and by large triangular specimens with straight bases. Variants of the latter, with convex bases and narrow stems were recovered at SLO-2 in all levels. Contracting stem points were not retrieved from the lower component at SLO-585; indeed, only one specimen that could be so classed was recovered from the upper component. Variations of the contracting stem specimens, however, were recovered from SLO-2 in fairly substantial numbers. Consistent with contemporaneous sites in Southern California, projectile points are a very minor constituent of Milling-Stone period components on the central coast, and it difficult to isolate temporally diagnostic types for the early Middle Holocene.

Elsewhere in mid-coastal contexts, the dearth of sites with clearly definable components that date between 6500 and 3500 BC, together with the vagaries of differential preservation and bioturbation, have hindered investigations that might serve to tie the Middle Holocene together in an integrative manner in this region. Dated sites are reported from this time span, and key artifacts are recovered, but too often the mixing of components and the limited sample have provided frustrating results. A case in point is SLO-177, one among a complex of sites at Lodge Hill near Cambria (Gibson 1979; Pierce 1979), where ^{14}C dates from Early Holocene times (circa 6500 BC) and a substantial complement of milling tools were recorded. The clear mixing of key artifact types from early to late periods, however, obviates the ability to sort out discrete assemblages, much less to derive specific patterns of subsistence. This, of course, is not a new story for coastal sites in the region and has been elegantly summarized elsewhere (Bouey and Basgall 1991; Erlandson and Yesner 1992).

Several additional sites that have supplied dates ranging from approximately 6000 to 3500 BC include SLO-877 near Cayucos (Breschini and Haversat 1991a) and SLO-801 and SLO-832. The latter two sites are located adjacent to what apparently was a large marsh and estuarine environment near present-day Pismo Beach (Dills 1981). Unfortunately only ^{14}C dates are available, but no substantive artifact collection was recovered; so, once again little knowledge has been forthcoming in terms of assemblage definition or subsistence data. At SLO-165 at Morro Bay, however, some evidence of assemblage constituents is present in the form of flake and cobble tools, a milling slab, and a net weight (T. Jones et al. 1994).

Along the shore and in the cismontane valleys of the northern central coast, several sites bring data to bear on the period between circa 6500 BC and 3500 BC. Located adjacent to the wide flood plain of the Santa Clara Valley and the large shallow seasonal lake, Laguna Seca, is SCL-178. During the early Middle Holocene occupation at this site, the assemblage was dominated by ground stone, cobble tools, and several notched stones, the last identified as net weights (Hildebrandt 1983)—strongly resembling that artifact class for a similar time frame at SLO-165. Flaked stone, as represented by debitage, was construed as evidence of hunting practices.

Ten kilometers from the Santa Cruz coastline in Scotts Valley, SCR-177 is situated on a small alluvial fan, adjacent

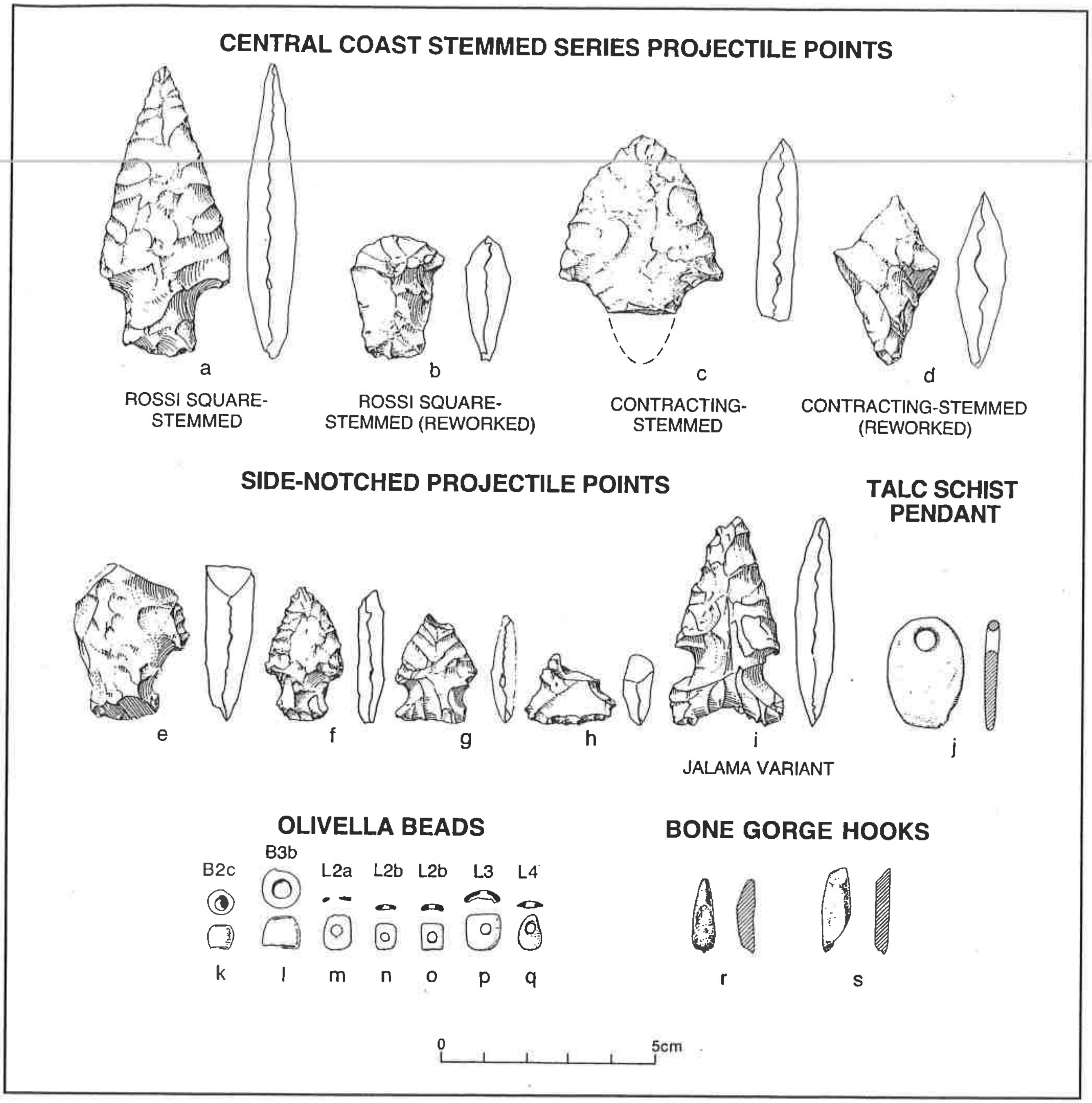

FIGURE 8.6 Early period projectile points, beads, bone tools, and stone pendant: *a*, 42-3-19, (MNT-1228); *b*, 42-10-17 (MNT-1228); *c*, 42-10-26 (MNT-1228); *d*, 42-6-33 (MNT-1228); *e*, P942-1-100 (MNT-73); *f*, 170-238 (MNT-170); *g*, 170-627 (MNT-170); *h*, 170-709 (MNT-170); *i*, 484-280 (SLO- 175); *j*, 42-4-17 (MNT-1228); *k*, 170-707 (MNT-170); *l*, 42-1-23 (MNT-1228); *m*, 42-9-07 (MNT-1228); *n*, 170-110 (MNT-170); *o*, 170-455 (MNT-170); *p*, 170-619 (MNT-170); *q*, 47-4-70 (MNT-1228); *r*, 42-1-20 (MNT-1228); *s*, 42-1-42 (MNT-1228).

to a small freshwater marsh (Cartier 1993a). For the period bracketed by dates of 5500 to 3200 BC, a substantial sample of ground stone, particularly milling equipment, was the dominant artifact class and was supplemented by a wide variety of cobble tools whose material did not conform to local lithic resources. Some leaf-shaped projectile points and bifaces were also recovered.

The Saratoga site, SCL-65, located at the eastern base of the Santa Cruz Mountains, suffered from salvage operation that did not supply clear provenience for a large portion of the assemblage. Part of that assemblage, however, was associated with a component that featured burials whose bone collagen was dated to 4500 to 4000 BC (Fitzgerald 1993). Ground-stone tools consisted of milling slabs and handstones, while mortars and pestles were absent from the earlier component. The latter pairing was noted at an incipient date of circa 2000 BC.

On the rocky exposed shore of Big Sur, stratum II at CA-

Table 8.4 Summary of Middle Holocene archaeological component site locations on Central California coast

	0–2 km from shore				Inland							
	Open coast		Protected coast		2–10 km		10–35 km		Lacustrine		Totals	
	N	%	N	%	N	%	N	%	N	%	N	%
3500-1350 BC	27	60.0	4	8.9	4	8.9	4	8.9	6	13.3	45	100.0
6500-3500 BC	4	19.0	8	38.0	4	19.0	1	4.7	4	19.0	21	100.0
Totals	31	12	8	5	10	66						

Table 8.5 Shell: bone and mammal bone: fish bone ratios from Middle Holocene central coast site components

	Shell (kg): mammal bone (NISP)	Shell (kg): fish bone (NISP)	Fish bone (NISP): mammal bone (NISP)
MILLING-STONE PERIOD (6500–3500 BC)			
Estuarine sites			
SLO-165	27:1	0.2:1	132:1
MNT-228	192.9:1	5.4:1	41.6:1
Open-coast sites			
MNT-1232/H stratum II	60.7:1	15.8:1	3.8:1
EARLY PERIOD (3500–600 BC)			
Estuarine sites			
SLO-165	75:1	0.04:1	1589:1
Open-coast sites			
MNT-1228	16:1	134:1	0.2:1
MNT-73	2:1	0.4:1	3.1:1
SLO-175	32:1	0.1:1	355:1
MNT-108	-	-	11.6:1
SLO-179	4.7:1	0.04:1	102:1

Sources: Breschini and Haversat 1989; T. Jones and Haney 1992; T. Jones et al. 1994; T. Jones 1995; T. Jones and Waugh 1995; Waugh 1992

MNT-1232/H (the Interpretive Trail site), yielded artifacts and fauna dating 4400-3000 BC (T. Jones and Haney 1992; T. Jones 1995). The assemblage is not large, as the deposit consists primarily of a dense accumulation of shell remains. It is dominated by handstones, milling slabs, and a single lanceolate projectile point. Mortars and pestles are absent.

The period after 3500 BC is more fully represented on the central coast and is marked by an extensive series of shoreline midden deposits. From north to south these include SCR-7, MNT-108, MNT-387, MNT-391, MNT-116, MNT-170, MNT-73, MNT-1228, SLO-175, SLO-179, SLO-383, SLO-165, and SLO-977 (figs. 8.1, 8.2). Assemblages available from these locations exhibit marked uniformity. Two phases, Saunders in the Monterey Bay area and Little Pico Creek I in San Luis Obispo County, represent local variants of a generalized artifact pattern, which is best represented at MNT-391 (Cartier 1993b). Significant artifactual and chronometric data are also available from MNT-108 (Breschini and Haversat 1989, 1992), MNT-1228 (T. Jones and Haney 1992), MNT-73 (T. Jones 1994), SCR-7 (D. Jones and Hildebrandt 1990), SLO-175 (T. Jones and Waugh 1995), and SLO-165 (T. Jones et al. 1994).

All of these assemblages include Central Coast Stemmed Series and side-notched projectile points, co-occurring with the mortar/pestle and milling slabs/handstones, Class B and L *Olivella* beads, bipointed bone gorge hooks, and simple talc-schist pendants (fig. 8.6). Crude cobble/core tools (fig. 8.7) also occur in variable frequencies at some locations (for instance, MNT-170, MNT-391, SCR-7). A robust side-notched variant with bifurcated base, referred to by Lathrap and Troike (1984:107) as a Jalama Side-notched, is known only from the southern districts. Abalone square beads, found in abundance at MNT-391, have not yet been found in Big Sur or in the San Luis Obispo region.

SETTLEMENT AND SUBSISTENCE

Varied environmental histories of the central coast shorelines have affected different progressions of settlement and subsistence through the Middle Holocene. Milling-Stone components have been identified in a variety of settings, including open and protected coasts, inland valleys, and lacustrine or other freshwater marsh settings. Although potentially a correlate of visibility and/or site survivorship, a slight emphasis on estuarine locations is apparent among central coast archaeological components (table 8.4). An equal settlement focus on lakes has been suggested (T. Jones 1991, 1992) but has been challenged elsewhere (Fenenga 1993:251; Hildebrandt and Mikkelsen 1993).

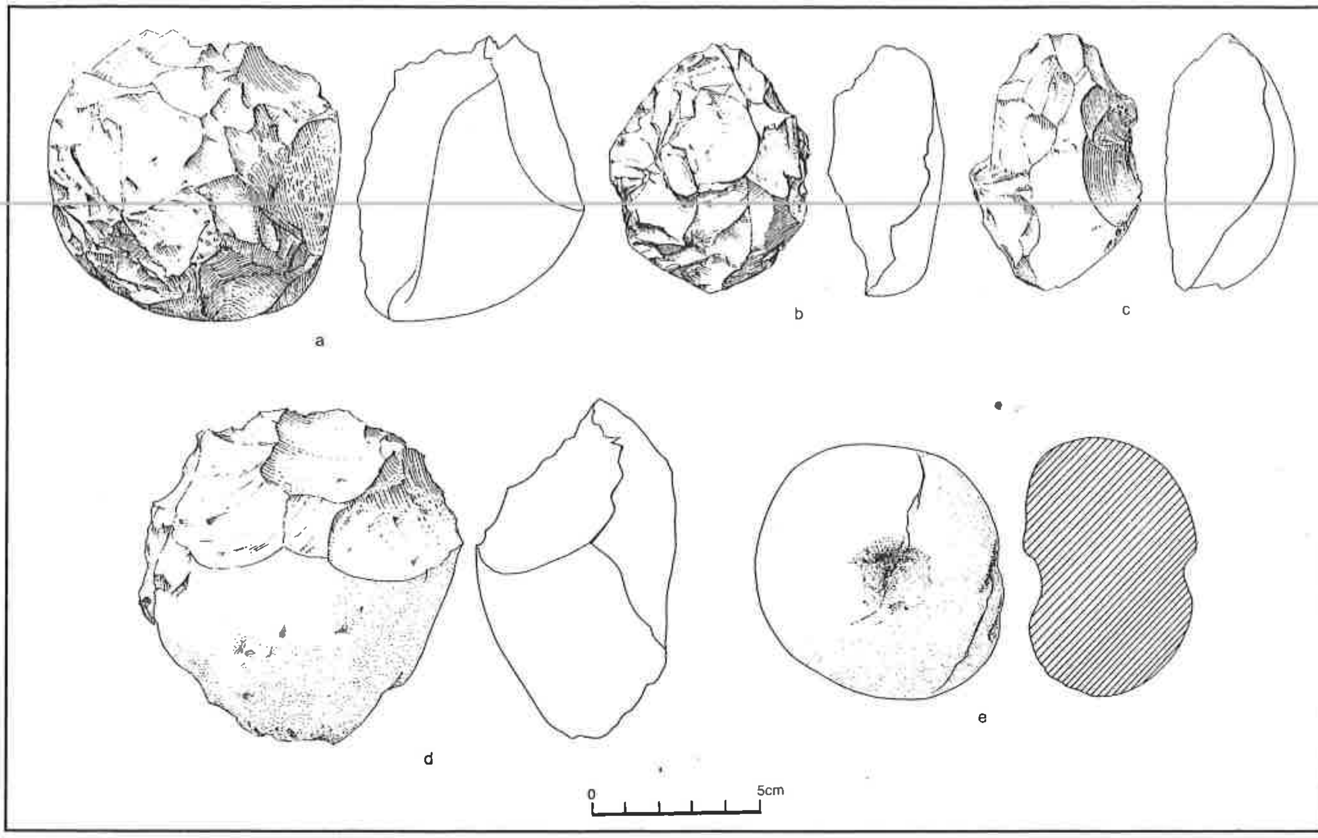

FIGURE 8.7 Early period cobble/core tools and pitted stone from MNT-170: *a*, 170-51; *b*, 170-408; *c*, 170-808; *d*, 170-604; *e*, 170-490.

Owing to vagaries of faunal preservation, subsistence remains are available from an incomplete range of Milling-Stone period locations. Nonetheless, a hard seed/shellfish/fish diet, comparable to that ascribed to Early Holocene coastal groups in Southern California (Erlandson 1991a, 1994), can generally be inferred. Mollusc remains occur in high densities in both estuarine and outer-coast settings (table 8.5), but fish remains are abundant only at Elkhorn Slough and Morro Bay. Fish are represented among the Milling-Stone components at MNT-1232/H on the Big Sur coast and SLO-2 at Diablo Canyon, but frequencies are considerably lower. Based on species counts at Diablo Canyon (Greenwood 1972:91), Fitch (1972:115) suggests that fish were most commonly taken either by hand or by intertidal traps. An asphaltum-smeared sinker recovered from SLO-165 testifies to the use of nets at this time as well, as does the recovery of notched sinkers from the inland lacustrine setting of SCL-178.

The period beginning about 3500 BC is marked by a substantial increase in occupation of the open coast (table 8.4), concomitant with shifts in assemblage composition and an intensification in the deposition of vertebrate remains. While there is considerable variability between sites, reflecting localized specialization, fish and mammal remains generally show striking increases relative to shellfish (table 8.5). This trend, first recognized by Greenwood (1972:91) at Diablo Canyon, has since been documented at open-coast sites MNT-1228 and MNT-1232/H, which show high frequencies of mammalian remains. SLO-165 at Morro Bay and MNT-108 on the Monterey Peninsula have yielded dense accumulations of fishbone. Fishing and particularly hunting, apparently emerged as distinct specializations about 3500 BC. Variation is evident among mammal assemblages, which on the Monterey Peninsula show high frequencies of marine mammals but at Big Sur are dominated by terrestrial taxa (table 8.6). Marine mammals apparently had a greater onshore presence on the Monterey Peninsula prehistorically than at Big Sur, a presence that probably included mainland rookeries (Hildebrandt and Jones 1992). The appearance of the mortar and pestle during the Early period is further equated with a shift to a more intensified economy. While this technological dyad did not become the dominant vegetal-processing implements until the Middle period, their use suggests at least some experimentation with nut crops and storage. In concert with the emergence of a hunting specialization, it can further be inferred that the ethnographic pattern of gender-specific task appropriation emerged at this time.

A useful index of change and intensification is provided by mussel and limpet size profiles from MNT-1232/H on the Big Sur coast. Extending across the Milling-Stone/Early period transition, these mollusc shells show a distinct trend toward diminution over time (fig. 8.8), suggesting longer occupation of coastal residential bases and more frequent col-

TABLE 8.6 Early period mammal remains from Central California coast

		BIG SUR DISTRICT			MONTEREY BAY DISTRICT				
COMMON NAME	TAXON	MNT-1232/H	MNT-1228	MNT-73	MNT-391	MNT-108*	MNT-170*	SCR-7*	TOTALS
Terrestrial taxa									
Black-tailed deer	*Odocoileus hemionus*	14	75	31	25	33	4	12	194
Prong-horn	*Antilocapra americana*	0	0	0	0	0	0	1	1
Gray fox	*Urocyon cinereoargenteus*	1	1	0	0	0	0	0	2
Dog/coyote	*Canis latrans*	1	1	1	4	8	0	0	15
Rabbit	*Sylvilagus bachmani*	3	0	8	5	18**	2	7	43
Jackrabbit	*Lepus californicus*	0	0	0	0	1	0	0	1
Bobcat	*Lynx rufus*	0	1	0	0	0	0	0	1
Skunk	*Mephitus mephitus*	0	0	1	0	2	0	0	3
Weasel	*Mustela frenata*	0	0	1	0	0	0	0	1
Badger	*Taxidea taxus*	0	0	0	0	6	0	0	6
SUBTOTAL		19	78	42	34	68	6	20	267
Marine taxa									
Northern fur seal	*Callorhinus ursinus*	5	0	0	13	16	0	0	34
Southern fur seal	*Arctocephalus townsendi*	0	0	0	12	0	0	0	12
Fur seal		0	0	0	35	0	6	0	41
California sea lion	*Zalophus californianus*	0	0	0	6	0	0	2	8
Steller sea lion	*Eumetopias jubatus*	0	1	1	1	0	0	1	4
Sea lion		0	0	0	17	0	9	0	26
Sea otter	*Enhydra lutris*	1	0	2	54	4	8	6	75
Harbor seal	*Phoca vitulina*	3	3	2	2	2	3	1	16
SUBTOTAL		9	4	5	140	22	26	10	216
TOTAL		28	82	47	177	92	35	30	491

*Partially mixed component. **168 elements of *Sylvilagus* sp. not included.
Sources: Breschini and Haversat 1989:100-101; Cartier 1993b:219; Dietz 1991:144; T. Jones 1994; T. Jones and Haney 1992; D. Jones and Hildebrandt 1990; T. Jones 1995

lection. Extended site use is corroborated by seasonality analyses of fish otoliths from SLO-165, which suggest nearly year-round habitation (fig. 8.9).

Settlement history at Elkhorn Slough is more complex. Radiocarbon dates indicate that the Slough witnessed a major population hiatus during the Early period coincident with the intrusion of freshwater (fig. 8.10). This contrasts markedly with Morro Bay, where human occupation seems to have been most intensive during the Early period, with a depopulation occurring much later during the latter half of the Middle period (fig. 8.10). The temporary deterioration of Elkhorn Slough may have contributed to increased human presence on the exposed shoreline of the Monterey Bay area.

In general, changes in settlement and subsistence along the central coast suggest a transition from selective exploitation strategy to a more intensive strategy involving extended, but not permanent, occupation of residential bases. This transition was noted by Greenwood (1972:91), who found among the shellfish remains at SLO-2 evidence for wide-ranging subsistence forays, including trips by inhabitants of Diablo Canyon to Morro Bay. Evidence for these collecting trips disappeared at the onset of the Hunting period (around 3500 BC) when increased attention to the pursuit of game apparently rendered such trips unnecessary. These changes, equating with what Beaton (1991) describes as a shift from extensification to intensification (see also Waugh 1986:17–19), can be attributed to population circumscription during the Middle Holocene. Dietary diversity decreased as the presence of groups in adjoining areas constrained mobility, decreasing the size of resource acquisition radii and forcing an inward focus in subsistence.

TRADE AND EXCHANGE

Hallmarks of trade and exchange networks for the archaeology of the central coast are obsidian and shell beads. Obsidian evidently arrived in finished bifacial forms, which subsequently were refurbished and reworked. Hydration study results from SCL-65 and SCR-177 indicate clearly that obsidian was reaching the central coast prior to 3500 BC, but the salvage nature of those two investigations makes it impossible to evaluate obsidian frequency quantitatively. For those Milling-Stone period components for which hydration values can be quantified relative to excavation volume and field-recovery strategies, it is apparent that obsidian was indeed a rare commodity. Of a combined excavation volume of over 30 m^3 (processed with 3-mm mesh) from MNT-229, MNT-228, and MNT-1232/H, only a single hydration reading marks the occupation (table 8.7). In contrast, several sites postdating 3500 BC have yielded obsidian in abundance. MNT-108 on the Monterey Peninsula produced 184 pieces from a mere 4.8 m^3 of deposit, although the exclusive use of water screening at that location undoubtedly contributed to this inordinately high figure. Recovery techniques employed at MNT-73, occupied from 2300 to 1700 BC on the

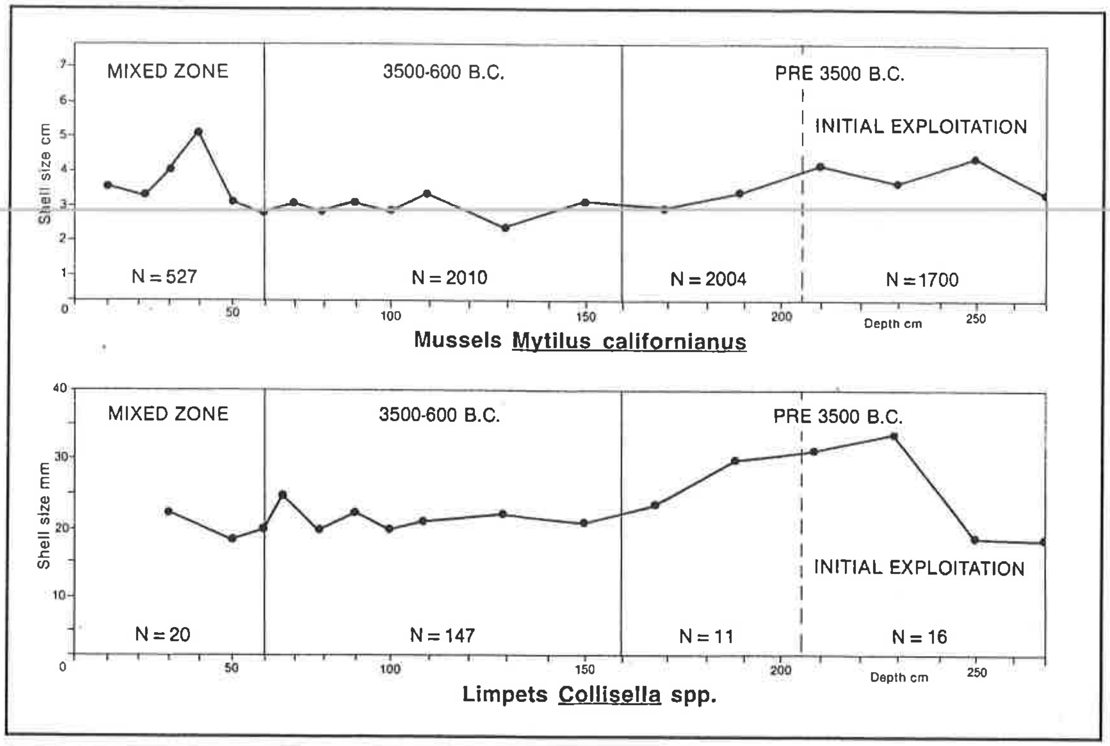

FIGURE 8.8 Middle Holocene mussel and limpet size profile from MNT-1232/H

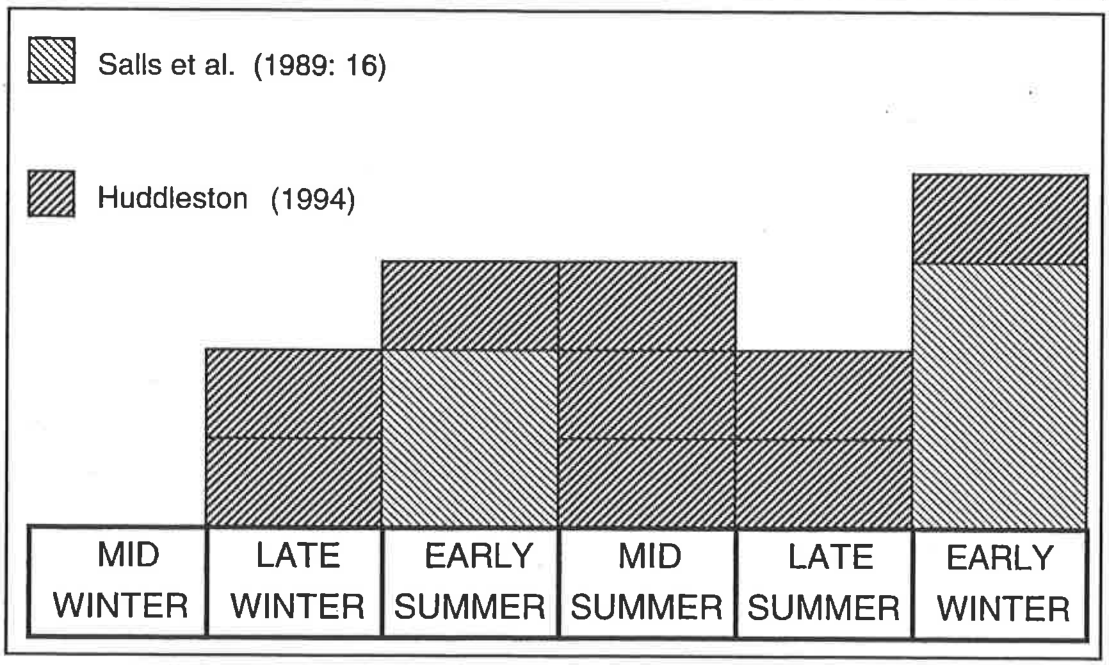

FIGURE 8.9 Seasonality of otoliths from SLO-165

Big Sur coast, however, were identical to those employed at the earlier sites, and obsidian was more than eighty times more abundant than at MNT-229 (table 8.7), with most pieces originating from sources 200 to 300 km distant at Napa, Coso, and Casa Diablo. The chronology of increased obsidian arrival is synchronous with the initial settlement of many sites along the central coast at the beginning of the Early period. Apparently the earliest use of settlements at MNT-73, MNT-108, MNT-254/266, MNT-391, MNT-1228, and SLO-179 was accomplished in concert with the development of exchange networks of at least an informal if not formal nature. This increase in obsidian exchange appears to be only one more facet of a major shift toward a more intensified lifeway resulting from population circumscription beginning at the Milling-Stone/Early period interface. With direct resource access restricted in some areas by the increased human population, exchange was apparently engaged in as a substitute for direct resource acquisition. The currently available regional obsidian-hydration profile further indicates that obsidian exchange continued along these lines with increased frequency through the Middle period.

Beads and ornaments present a more complex, poorly understood argument for exchange. On the Big Sur coast, increased import of obsidian occurs concurrently with the

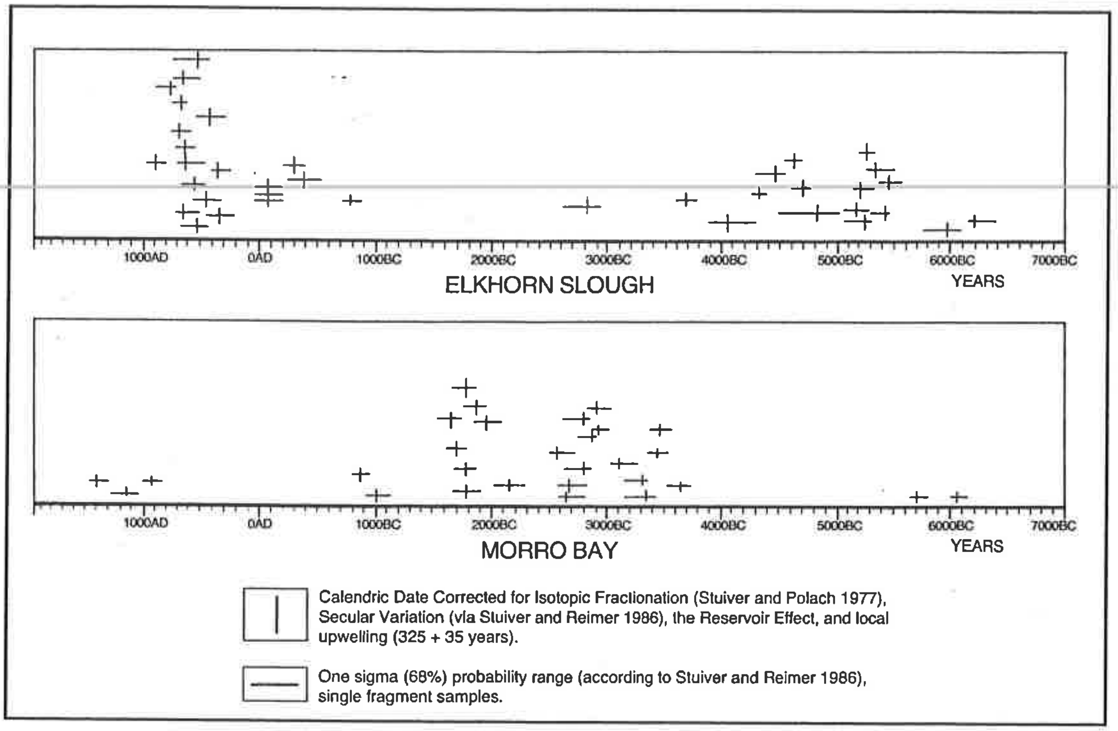

FIGURE 8.10 Summary of radiocarbon dating from Elkhorn Slough and Morro Bay. *Breschini, Haversat, and Erlandson 1992; Breschini and Haversat 1991b; Dallas 1992; Dietz, Hildebrandt, and Jones 1988; Gibson 1992d; T. Jones et al. 1994, 1996; Patch and Jones 1984.*

initial manufacture of talc-schist ornaments (fig. 8.6), produced at MNT-1228 and MNT-1232/H (T. Jones and Haney 1992). Dated between 3700 and 2900 BC at MNT-1228 (T. Jones and Haney 1992:267), similar pendants have been identified in comparable temporal contexts at MNT-391 (Cartier 1993b) and SBA-53 (Harrison and Harrison 1966). Early period manufacturing sites for *Olivella* rectangular beads have been documented at MNT-108 and MNT-391, and it is likely that additional manufacturing localities will be identified as more excavation is undertaken along the central coast. Beads and ornaments were probably produced in many locations as part of regularized but casual, unspecialized, nonmonetized exchange.

HUMAN OSTEOLOGY

Conclusions derived from osteological analyses can supply important information on population structure and health and, thus, address issues on the demography of prehistoric groups. Unfortunately, data that provide adequate mortality or morbidity profiles for Middle Holocene populations from the central coast are scanty at best. At SCL-65 only fragmented burials were recovered and no substantive analysis was possible (Fitzgerald 1993). At SLO-2 at Diablo Canyon (Greenwood 1972), only three of the sixty-six burials apparently dated to the Milling-Stone period, and analyses were not directed toward temporally specific burial groups. Data were supplied on anthropometrics and a brief summary of age-related degenerative disease. Mortality peaked at the 25 to 40 year age range, and 26 percent of the total population was over 40 years of age at death. Because the dating of the total burial population is not secure and detailed pathologies were not supplied, summary information is only partially useful.

At MNT-391, an Early period site (Pierce, Filippo, and Van Zandt 1993), however, the mortality profile and pathological analyses are more complete. The mortality profile shows peaks at 15 to 19 and 40 to 44 years of age. The median age for both sexes was 40 years, and survival into the fifth decade was not uncommon. Data indicate that there was no demonstrable evidence for dietary deficiency or parasitism and the general health of the group was good—conditions that very probably reflect the lifeways of a nonsedentary hunting-gathering group with access to a wide array of resources. Of some interest to paleodemographers is the conclusion that the morphology of the male skulls at MNT-391 reflects a craniofacial pattern similar to that observed in individuals in the lower Sacramento Valley (although see Gerow 1974), while females display a more generalized pattern such as found over a broad geographic area (Pierce, Filippo, and Van Zandt 1993:48).

SUMMARY AND DISCUSSION

Fifteen years ago consideration of the Middle Holocene on the Central California coast would have been brief and highly speculative. Our discussion here represents an attempt to summarize a significant and rapidly expanding data base that will no doubt continue to grow. The central coast shows greatly varied environmental histories through the Middle Holocene, which have had variable influence on resident human populations. Significant changes are evident at the two major estuaries, Elkhorn Slough and Morro Bay. Over

TABLE 8.7 Obsidian recovery from Middle Holocene central coast components

	Obsidian (n)	Obsidian/m³	Obsidian/m³ 3-mm mesh	Obsidian with early hydration measurement/m³ 3-mm mesh
Milling-Stone components				
MNT-228B	1	0.125	0.156	0.000
MNT-1232/H stratum II	2	0.435	0.869	0.000
MNT-229	32	1.440	1.440	0.021
Early components				
MNT-108*	34	7.083	7.083	2.500
MNT-170	55	0.937	1.667	0.000
MNT-73	138	6.602	6.602	3.971

*Total obsidian recovery = 184 specimens, but only 34 specimens were large enough for sourcing. A sample of 20 specimens was subjected to hydration analysis.
Sources: Breschini and Haversat 1989; Dietz, Hildebrandt, and Jones 1988; Dietz 1991; T. Jones and Haney 1992; T. Jones et al. 1992; T. Jones 1995; T. Jones and Waugh 1995

the course of the Holocene, these systems shared a common pattern of infilling reflected in archaeological shellfish assemblages, but they also demonstrate individual idiosyncrasies. Elkhorn Slough was apparently abandoned by human populations between 3000 and 1000 BC in response to a rapid reversal in the slough's salinity, which temporarily degraded its resource potential. Morro Bay, on the other hand, exhibits an intensive occupation during this same span. An occupational hiatus is evident later, at about AD 1 (fig. 8.10). In contrast to the estuaries, the open coast of San Luis Obispo County, Big Sur, and the Monterey Bay shows a constancy of occupation through the Middle Holocene, which impacted the quality of the resource base and demanded further cultural adjustments.

Clearly, environmental change affected significant cultural responses at both Elkhorn Slough and Morro Bay. Rapid habitat degradation simply forced people to pursue other settlement and subsistence options. Elsewhere, on the open coast, humans transcended low-intensity, broad-scale ambient change associated with the warm conditions of the early Middle Holocene. From these varied trajectories, it is relatively apparent that broad-scale Holocene climatic changes did not have a uniform influence over the region, and indeed should not be considered the primary agents underlying Middle Holocene cultural changes. In the absence of uniform environmental flux, Middle Holocene cultural changes can be more confidently attributed to population trajectories, as a successful, mobile, Early Holocene subsistence pattern fostered population growth and eventually, circumscription. As a consequence, a more settled, intensified lifeway began circa 4000 to 3500 BC; hunting, fishing, and processing specializations—marked by the mortar and pestle—came into use, and individual residential bases were occupied for more extended periods of time. Storage was probably employed on a limited basis, and inter-regional exchange was engaged in routinely as a substitute for direct resource access. Health was good and longevity high as the crowding-induced maladies of the Middle period had yet to take their toll (see Lambert 1993).

With respect to polarized alternative perspectives on environmental causality, the Central California coast suggests this issue cannot be resolved in absolute terms. High-intensity and rapidly transpiring environmental change indisputably provoked human responses, indicating that environmental variability cannot be entirely overlooked as a causal variable. Less-intense and long-duration climatic change did not affect major human response on the central coast, however, particularly in the coastal zone where environmental flux was muted by the tempering influence of coastal waters (D. L. Johnson 1977). It is possible, however, that coastal population increase during the Middle Holocene reflects the deterioration of more arid environments far in the interior and westward migration to the coast. In general, population pressure seems to explain significant aspects of Middle Holocene settlement and subsistence change, particularly when attributed to a threshold of population circumscription.

With respect to trajectories of marine versus terrestrial resource exploitation over time, a full spectrum of marine resources and habitats was exploited during the early Middle Holocene, but problems with site visibility and component integrity obfuscate possible patterns. Nonetheless, estuaries seem to have attracted more settlement than the open coast, and many interior early Middle Holocene sites occur near lakes (for example, SCL-178, SCR-177, SCL-119/SBN-24). On both estuaries and open coasts, shellfish were important during the Milling-Stone period but decreased in dietary significance through time. Rich estuarine fisheries, on the other hand, were important during the early Middle Holocene and became increasingly so with time. Open-coast fisheries, however, became significant only after the Middle Holocene. Fish are clearly a resource that can withstand intensification; with increasing labor inputs and more sophisticated technology, fisheries can provide increased caloric yields for growing human populations. Shellfish, particularly mussel beds along the rocky coast, are strictly limited in their caloric potential and do not respond well to overly intensive harvest (Jones and Richman 1995). The simultaneous decrease in shellfish harvesting and increase in fishing during the Middle Holocene are consistent with growing human populations. Furthermore, optimal subsistence solutions were unlikely to conform with a strict marine/terrestrial dichotomy over time but would have incorporated resources and habitats based on utility ranking and potential for intensification.

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