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Catalysts to Complexity

Late Holocene Societies of the California Coast

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Preface

As many readers are undoubtedly aware, this is the third volume in a series dedicated to the archaeology and paleoecology of the California Coast published by the Institute of Archaeology at University of California, Los Angeles (UCLA). The first volume of 11 chapters (Erlandson and Colten 1991) covered the evidence for terminal Pleistocene and Early Holocene (ca. 10,000 to 6650 RYBP) occupations of the California Coast, with coverage limited by the lack of early archaeological sites located north of the Monterey Bay area. The second volume of 11 chapters (Erlandson and Glassow 1997) summarized the nature of coastal California's Middle Holocene environments and human adaptations, including single chapters on both the San Francisco Bay and North Coast areas. The current volume, which includes 17 chapters from 31 California archaeologists, grew out of a symposium held at the 1998 Society for California Archaeology Annual Meeting in San Diego, California. That symposium, "The Late Holocene along the California Coast: Archaeological and Environmental Records," included 16 papers. The purpose of this session was to provide a forum for archaeologists working along the California Coast to examine the environmental and archaeological records from various coastal regions, focusing on the development of cultural complexity over the past 3500 years, the relationships between environmental shifts and cultural changes, and other stimuli to the emergence of sociopolitical and economic complexity in Native California.

Among the symposium participants who chose not to prepare chapters for the published volume were Richard Carrico, John R. Johnson, and Jerry D. Moore. After the symposium was held, an additional paper was solicited from Brian Byrd and Seetha Reddy (Chapter 4) to supplement treatment of the San Diego Coast and incorporate a wealth of new archaeological and paleoenvironmental data emerging from the Camp Pendleton area on the northern San Diego Coast. The result is a volume of 17 chapters, including our own introductory and concluding comments. For the first time in the three volume series, there is more than one paper from the northern California Coast. Nonetheless, the relative dearth of archaeological research north of the San Francisco Bay area still limits the amount of data available for regional synthesis. Consequently, the 15 regional summaries are heavily weighted toward the southern and central California Coast, reflecting the more intensive nature of archaeological research in these areas, their better documented archaeological sequences, and the comparatively larger number of archaeologists working in them.

The authors who contributed to this volume approach data from individual areas in a variety of ways. To some extent, this variation reflects epistemological differences between researchers or "schools of thought." It is also related, however, to inherent variability among the Late Holocene cultures of the California Coast, where the organizational complexity of coastal peoples varied considerably through both space and time. Finally, the different approaches taken in individual chapters are also heavily influenced by differences in the quantity, quality, and resolution of the archaeological and paleoenvironmental records available in each area.

We should also note that the authors contributing to this volume have been asked to limit their analysis and discussions primarily to the period prior to European contact, which began in California with the voyage of Juan Rodriguez Cabrillo in AD 1542, but intensified with the Spanish colonization of Alta California in AD 1769 and the discovery of gold in northern California in AD 1849. This decision was not intended to minimize the devastating impact of European colonialism on Native Californians or to diminish

the importance of the archaeological study of Contact period processes. In fact, a fourth volume is currently being planned by Erlandson and Kent Lightfoot to deal explicitly with archaeological approaches to the study of the Protohistoric and Historic periods in Alta California and the dramatic sociopolitical, economic, and demographic changes that occurred as California was increasingly integrated into a global economy.

Clearly, the current volume could never have come together without a tremendous amount of work by a diverse array of people. First and foremost, we wish to thank all the authors who participated in the original symposium or contributed chapters to this volume. Their efforts in the field, in the lab, and at the computer—at data collection, processing, synthesis, writing, and revision—are all greatly appreciated. At UCLA, we thank Jeanne Arnold (Series Editor), Marilyn Beaudry-Corbett (former Director of Publications), Brenda Johnson-Grau (Managing Editor), Julia Sanchez (Acting Director of Publications), and the editorial staff at the Cotsen Institute of Archaeology at UCLA for their extensive efforts in nurturing this volume through review, production, and distribution. We are also indebted to anonymous reviewers who dedicated large amounts of their time to evaluating individual chapters and the volume as a whole, and made constructive suggestions on how the volume could be improved. Special thanks are also offered to Angela Barrios of the Social Sciences Department, California Polytechnic State University for her efforts in electronic editing near the final hour of production. Finally, we wish to extend our gratitude to the Cotsen Institute of Archaeology and their editorial board for sharing a commitment to continue the publication of fundamental research in California archaeology—a legacy at UCLA and other University of California campuses with a long and hallowed history.

— Jon M. Erlandson
Terry L. Jones

CHAPTER 1

Late Holocene Cultural Complexity on the California Coast

TERRY L. JONES

In two previous volumes on California coastal prehistory—dealing sequentially with the Early and Middle Holocene (Erlandson and Colten 1991a; Erlandson and Glassow 1997)—researchers described evidence for the initial human colonization of California shorelines, placed that evidence in the context of rapidly and dramatically changing coastal environments caused by post-glacial sea level rise, and described some of the first changes in adaptation brought about by the settling in and growth of initial populations. The Early Holocene coastal archaeological record generally speaks to very basic issues of subsistence, environment, and technology, dated in 1991 to about 8000 BC, but more recently pushed back to at least 9750 BC (Erlandson et al. 1996). While littoral foragers were exploiting shellfish and employing watercraft by this early date, we know very little of their social and political organization, rituals, intergroup relationships, or cultural identities (see Erlandson 1994). Some authors have argued for reliance on storage and semisedentism as early as 6500 BC (for example, Glassow 1991; Koerper, Langenwalter, and Schroth 1991), but these possible signs of cultural complexity are lost among a myriad of unresolved questions about the basic adaptation of California's earliest coastal inhabitants. The archaeological record is more substantial for the Middle Holocene, and many primary adaptive traits are reasonably well defined. Signs of incipient complexity (for example, regularized interregional exchange) are slightly more abundant, but most of the Middle Holocene record has been interpreted largely with reference to technology, subsistence, and habitat.

Relative to these earlier periods, several aspects of the Late Holocene archaeological record for the California Coast are unique. The record of occupation is much more complete, with abundant evidence of human occupation along the entire coast, sea level was more stable, preservation is more favorable, and chronological resolution is higher. More importantly, the Late Holocene archaeological record ends with historically documented Native societies that showed significant, albeit varied, signs of cultural complexity, including sedentism, permanent social inequality, and hierarchical political organization. California's maritime societies probably acquired most of this cultural sophistication some time during the last 3500 years. As a consequence, many of the chapters in this volume deal extensively with issues of cultural complexity—viewed alternately as fully emergent during the Late Holocene or as the culmination of trends that began earlier.

The Northwest Coast of North America has long been linked with culturally complex foragers. Permanent social inequality, sedentism, and elaborate maritime adaptations (Ames 1994:209) were documented more than a hundred years ago among groups like the Kwakiutl, Haida, and Bella Coola of British Columbia. While Northern California has often been included within the Northwest Coast culture area (see Ames 1994; Kroeber 1939; Matson and Coupland 1995:3; Suttles 1990:10–11), the complexity of California coastal societies is much less known ethnographically. Because California attracted early and rapid settlement by Euro-Americans, its ethnographic and ethnohistoric records are incomplete. While California anthropologists have long been aware that many Native societies along the coast and major rivers showed significant elaborations in political organization, technology, and exchange (see Bean and King 1974; Bean and Lawton 1976; C. King 1976; T. King 1978), these have generally not attracted the attention of broader anthropological audiences (Gregg 1991:87). That California was home to sedentary, populous, politically complex hunter-gatherers has become increasingly apparent in recent years due in part to archaeological investigations that have provided insights into the lifeways of foraging peoples who existed in areas now densely populated by modern industrialized societies.

Broad recognition of cultural complexity in California was also delayed by a prevailing theoretical paradigm that equated hunting and gathering with cultural simplicity and tended to overlook signs of more elaborate adaptations. This view held sway in anthropology through the 1970s, but seminal essays in the early 1980s (for example, Koyama and Thomas 1981; Price and Brown 1985) reversed this trend and created an intellectual environment that encouraged discovery or recognition of culturally complex foragers—historically, ethnographically, and archaeologically. Although California is under represented in the early literature regarding forager complexity, archaeological research of the last decade or so has produced a number of important essays that elucidate cultural practices far more elaborate than those of simple band societies (for example Arnold 1987, 1991a, 1992a, 1992b; 1993b, 1995a; Fagan and Maschner 1991; C. King 1990; Lambert and Walker 1991; Lightfoot 1993) and illustrate clear diachronic progressions toward complexity (for example, Basgall 1987; Bouey 1987).

WHAT IS CULTURAL COMPLEXITY?

An unfortunate by-product of the paradigmatic shift toward recognition of cultural sophistication among foragers is the emergence of the term "complexity" as an often ill-defined cliché. The idea of cultural complexity is derived from comparative evaluation of the social and adaptive practices of the world's societies, and is a relative concept that might best be defined by what it is not. The antithesis of complexity is embodied in the social, economic, and political practices of mobile, nonpopulous hunter-gatherers who occupied many marginal environments (for example, deserts and arctic tundra) at the time of Euro-American contact. The California Coast, with its rich marine resource base, was not such a place, but a good example is provided by the Great Basin Shoshone (a group described by D. Thomas [1981:19] as one of the least affluent of all the world's foragers) who practiced a relatively simple form of hunter-gatherer adaptation. The Shoshone were a typical band society. They congregated in politically autonomous associations of two or more family groups in a defined territory within which they made seasonal movements. The band's territory was fully open to all members and was occasionally defended against trespass by others, but organized warfare was rare. Division of labor was based almost wholly on age and gender, and craft specialization was absent; men hunted and fished, while women gathered plant foods and attended to children. Storage was practiced, but stores were insufficient to accommodate long-term sedentism. Leadership statuses were commonly achieved rather than ascribed, and there was little disparity in wealth. Membership in bands was fluid, and maximum population was usually no more than fifty people per group, although spatially concentrated resources sometimes temporarily attracted more populous, multiband settlements. Each household was a self-sufficient unit (Steward 1938:44). Some groups traded for foodstuffs and/or shell money, but others practiced little or no intergroup exchange (Steward 1938:45). Kin reckoning was bilateral, lineal descent groups were absent, and nuclear households were the norm.

Cultural complexity, in contrast, is marked by sociopolitical practices and institutions traditionally associated with crop-based adaptations, but now also recognized for hunter-gatherers in many parts of the world, particularly coastal and other relatively rich and/or highly variable environments (Keeley 1989; R. Kelly 1995:293; Price and Brown 1985). Traits of complexity are perhaps most clearly delineated in the well-known cultural evolutionary models of Fried (1967), who defined rank and stratified societies as more complex than bands, and Service (1962), who defined bands, tribes, chiefdoms, and states. While these categories are no longer employed in a strictly evolutionary sense, they are still useful as heuristic devices that define clusters of social and economic traits of increasing complexity (Arnold 1996a:4; Creamer and Haas 1985). Tribal societies are marked by heavy reliance on storage, sedentism, large settlements (commonly 250 to 300 people and up to 1000 in some cases), and high population density. Social organization includes large extended households and lineal descent groups. Organized warfare is more common than among mobile foraging groups (Lenski and Lenski 1974:193), which affects some occupational specialization related to defense, warfare, and trading. Concepts of property ownership are more highly developed, resulting in some inequality in the distribution of resources. Exchange is more elaborate than the generalized reciprocity typical of egalitarian band societies. Wealth objects exist (R. Kelly 1995:294), and exchange tends to involve these status goods rather than nonbasic resources (Creamer and Haas 1985:738). Among so-called "Big-Man" tribal systems of ethnographic Polynesia and Melanesia, surpluses are used to establish and maintain positions of temporary authority (Sahlins 1963), often via competitive feasting. Chiefdoms are distinguished from tribes by permanent social inequality and centralized political authority. They have clearly defined social hierarchies that are often marked by stratification and, in some cases, slavery. They are composed of economically interdependent communities, united under the power of a paramount chief. Systems of redistribution allow chiefs to accumulate significant wealth and to distribute resources within the polity. The anticipated archaeological signatures

Table 1.1 Ethnohistoric complexity among Native societies of the California Coast

TRAIT	NORTH COAST*	SAN FRANCISCO BAY**	CENTRAL COAST***	SOUTHERN COAST NO. BIGHT†	SOUTHERN COAST SO. BIGHT††
Sedentism (low residential mobility)	+	?	?	+	+
Large settlements (>200 people)	-	+	-	+	?
Population density (>5 persons/mi²)	11.0	-	-	21.6	-
Sophisticated maritime technology (Oceangoing watercraft)	+	-	-	+	-
Advanced storage technology and high dependence on storage	+	+	?	+	+
Warfare or high frequency of inter-group conflict	+	?	+	+	+
Marked inequality in distribution of property	+	-	-	+	-
Unilineal descent groups	+	+	+	+	+
Craft specialization	?	-	-	+	-
Social stratification	+	-	-	D	-
Slavery	+	-	-	-	-
Ascribed leadership statuses	+	?	-	+	+
Hierarchical political organization	-	-	-	+	-
Intensive intergroup or monetized exchange	+	-	-	+	-

* Tolowa, Yurok, Wiyot, Pomo; ** Coast Miwok, Ohlone; *** Esselen, Salinan, northern Chumash; † Chumash, Gabrielino; †† Luiseno, Kumeyaay
+ = definitely present in at least one group; - = absent; ? = uncertain; D = disputed
Sources: Keeley 1989, Strong 1929, Kroeber 1925, Schalk 1981, Heizer 1978, Harrington 1942

of tribes and chiefdoms have been discussed by Creamer and Haas (1985), O'Shea (1984), and Peebles and Kus (1977).

CULTURAL COMPLEXITY AT CONTACT ALONG THE CALIFORNIA COAST

The ethnohistoric record indicates that social elaborations beyond those of simple bands were present among many California coastal societies at the time of contact (table 1.1). Historically, this record is most compelling for the coastal area north of Cape Mendocino (figure 1.1) due to its linkage with the Northwest Coast culture area. The Yurok, in particular, were highly sedentary, had a stratified society complete with slavery, were organized into descent groups, engaged in competitive feasting, and had highly developed concepts of private property and wealth, particularly the ownership of "treasure" or valuable heirlooms passed from one generation to the next (Bean 1978; Pilling 1978). A comparable portrait of complexity has emerged more recently for the Chumash of Southern California who had an elaborate maritime adaptation based on intensive ocean fishing and acorn storage. Early ethnohistories (for example, A. Brown 1967; Kroeber 1925; Landberg 1965) seem to have underestimated Chumash cultural elaborations, but more recent studies (for example, J. Johnson 1988; C. King 1990) emphasized extremely large settlements, high population density (C. King 1976, 1982), craft specialization (Bean 1978), and a hierarchical form of political organization (Grant 1978b:510). In a unique situation for California, these ethnohistoric interpretations have been bolstered in the Chumash area by strong archaeological support for complexity, including evidence for ascribed political statuses, hierarchical political organization (Martz 1984, 1992), craft specialization, and intensive trading (Arnold 1991a, 1992a, 1992b). Elsewhere in California, intricate mosaics of incomplete ethnohistoric documentation and archaeological findings of varied quantity and significance suggest complexity. In the San Francisco Bay area and along the Central Coast, the ethnohistoric record is poor, but archaeological findings are providing some evidence of wealth accumulation and social inequality (see Hylkema, chapter 13), albeit more weakly elaborated than among the Chumash or Yurok. In general, for the time of historic contact, permanent social inequality seems to have been less pronounced on the Central Coast (Coast Miwok, Ohlone, Esselen, Salinan) and the southern bight (Luiseno, Kumeyaay), where societies were less populous and more mobile (table 1.1, figure 1.1).

THEMES IN THE STUDY OF EMERGENT COMPLEXITY

While the archaeological record has been used to supplement incomplete ethnohistoric records in California, archaeological research has been pursued more broadly in California and elsewhere (see Ames 1991, 1994; Arnold 1996a, 1996b; Byrd 1994; Campana 1994; Hayden 1990; R. Kelly 1991; Lightfoot 1993; Renouf 1991, among others) to explore the processes underlying the emergence and

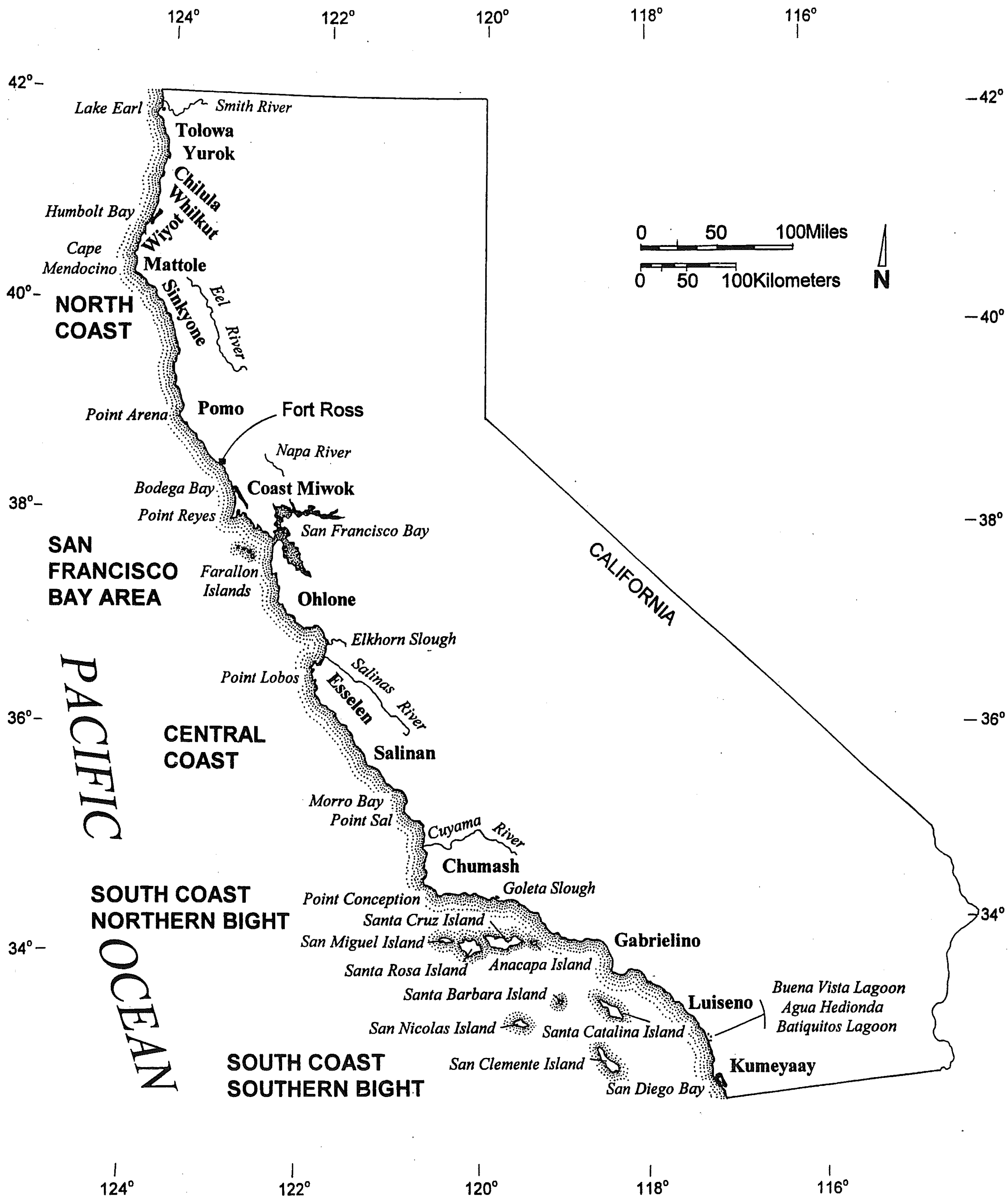


Figure 1.1 The California Coast, with major geographic features and general tribal territories

evolution of complexity. This research agenda was fueled in the 1980s and 1990s by the growing recognition that social inequality, previously linked to the Neolithic revolution, was widespread among prehistoric foraging populations (Arnold 1996a:3) and seems to have greater antiquity than previously thought (Campana 1994:1). In the simplest of terms, researchers worldwide have sought to determine how, when, and why various traits of complexity arose by looking more intensely at hunter-gatherer populations rather than simply at agriculturalists (Arnold 1996a:3). The range of complexity among its coastal societies makes California particularly interesting in that broad explanatory models need to consider not only those societies with significant cultural and social elaborations but also those with more limited complexity. Chapters in this volume address these issues to varying degrees, with the caveat that archaeological and ethnohistoric data are sketchy for some parts of the California Coast. In recognition of this, several chapters (see Glassow in chapter 11, Jones and Ferneau in chapter 12, Hylkema in chapter 13, Lightfoot and Luby in chapter 14, and Dowdall in chapter 15) touch only briefly on complexity and instead emphasize overviews of ethnohistory, Late Holocene cultural chronology, subsistence, and settlement. Virtually all the chapters show strong influence from cultural ecology, highlighting topics of chronology, environment, and population. Limitations of strict cultural ecological or adaptationist perspectives recognized elsewhere in studies of emergent complexity (for example, Bender 1985; Maschner 1991) are acknowledged in this volume, with alternative foci on power, labor, gender, ritual, and ethnicity.

Cultural Chronology

Issues of cultural chronology underlie the debate regarding emergent complexity in nearly all the chapters in this volume. Most apparent are differences of opinion concerning when signs of cultural elaboration appeared. Some authors (for example, Erlandson and Rick, chapter 10) see the roots of complexity as lying farther back in the Holocene and emerging gradually. Munns and Arnold (chapter 8) and Hildebrandt and Levulett (chapter 16) instead, envision a cluster of complex traits emerging together after AD 1000. Kennett and Conlee (chapter 9) envision a similarly abrupt emergence slightly farther back in time, about AD 700. Anchoring these debates are numerous richly detailed regional and local cultural chronologies (figure 1.2) with a wide range of theoretical underpinnings. California archaeology has long been anchored by tripartite cultural schemes owing to seminal chronologies developed by D. Rogers (1929) for the Santa Barbara area (Oak Grove, Hunting, and Canalino cultures); Lillard, Heizer, and Fenenga (1939) for Central California (Early, Middle, and Late horizons); and M. Rogers (1939) for the San Diego area. Early syntheses (for example, Heizer 1949) argued for the applicability of a single three-part sequence for the entire state, but subsequent research (that is, Fredrickson 1974a; Gerow 1968) revealed significant regional variation as early as the Middle Holocene. Fredrickson (1974a) proposed alternative (albeit still tripartite) chronological nomenclature for Central and Northern California (Paleoindian, Archaic, and Emergent periods), abandoning the traditional Early, Middle, and Late divisions. Because California shell bead types show tremendous similarity in temporal distributions over wide areas of California, most California archaeologists have not entirely abandoned the traditional Early, Middle, and Late chronological structure. Indeed, the present day cultural sequence for the Santa Barbara Channel area (C. King 1990; see figure 1.2), based largely on bead and ornament types, is divided into these familiar subdivisions.

For most of the California Coast, the Late Holocene is synonymous with the traditional Middle and Late periods, the dating of which varies slightly from region to region, but the Middle period, distinguished from the preceding Early by the first appearance of *Olivella* saucer beads, is generally thought to have begun between 1500 and 500 BC. All regions of California show significant cultural changes marking the end of the Middle period some time between about AD 600 and 1300. These include the appearance of new bead types (Class M *Olivella* rectangles in the north and Class E lipped *Olivella* beads in the south), arrow points, and pottery (on the extreme South Coast). Some (for example, Arnold 1992a, 1995a) also argue that sophisticated watercraft (oceangoing canoes in the north and plank canoes in the south) appeared at this juncture as well (although see Davenport et al. 1993; Gamble and Russell, chapter 7, this volume). Dating of the Middle–Late Transition varies considerably depending on which cultural or artifactual traits are emphasized and which geographic region is considered. For the classic Central California bead sequence, there are three alternative dates for the beginning of the Late period (Bennyhoff and Hughes 1987): circa AD 300 (scheme A2), AD 900 (scheme B1), and AD 1000 (scheme B2), although most recent research favors the AD 900 date (see Hylkema, chapter 13; Milliken and Bennyhoff 1993). In the Santa Barbara area, the Late period begins circa AD 1300. Some local sequences also include a discrete phase marking the Middle-Late Transition: AD 700 to 1200 in the San Francisco Bay area (Hylkema, chapter 13, this volume), AD 1000 to 1250 on the Central Coast (Jones 1993), and AD 1150 to 1300 in the Santa Barbara area (Arnold 1992a). On the North Coast, Frederickson (1974a) posed a transition from the upper Archaic to the Emergent periods circa AD 1000 based largely on changes in adaptation, not specific artifact types. Subsequent research on the North Coast has sought to define specific cultural assemblages within that temporal framework (figure 1.2).

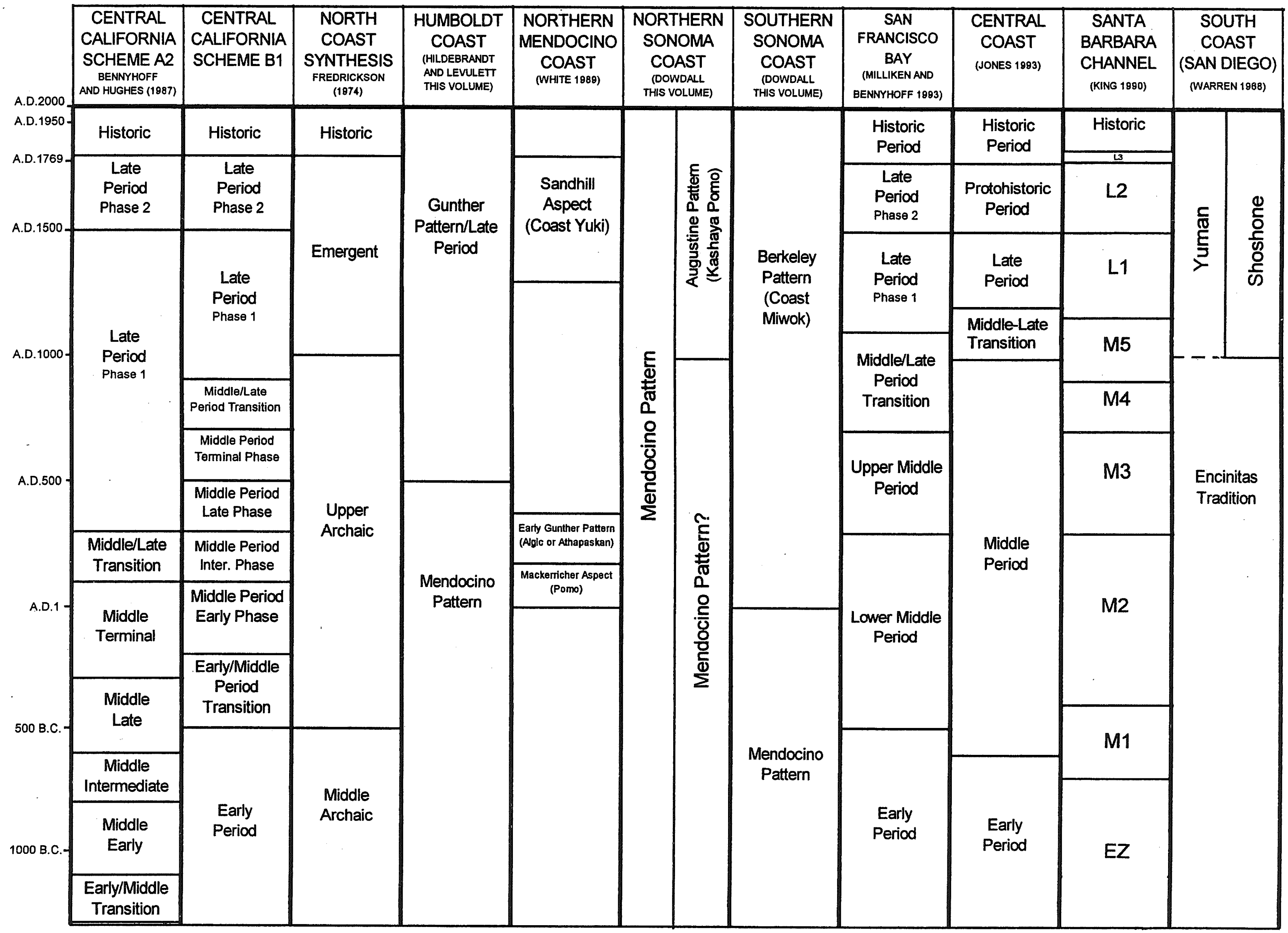


Figure 1.2 Late Holocene (3500–present) chronological sequences for the California Coast

Adding to the intricacies of California culture history is the problem of radiocarbon calibration. All the seminal California cultural sequences were developed on the basis of stratigraphic excavation and seriation before the advent of radiocarbon dating. Radiocarbon dates were first applied to most regional sequences in the 1960s. By the late 1990s thousands of Late Holocene dates had been obtained from the coast (see Breschini et al. 1996). This abundance is problematic, however, in that research of the last two decades (for example, Stuiver and Reimer 1986; Stuiver, Pearson, and Braziunas 1986) shows that the radiocarbon and calendric time scales are not synchronous, due largely to changes through time in the natural levels of atmospheric ^{14}C. Fortunately, radiocarbon dates can be brought into line with the calendric scale through a series of corrections readily made using the Stuiver and Reimer (1993) computer program. These corrections have been made systematically only recently, however, so that the bulk of the California coastal radiocarbon record, including dates used to define seminal chronologies, consists of uncalibrated and uncorrected dates. In the two previous volumes on California coastal prehistory, this problem was dealt with by referring exclusively to the radiocarbon time scale (that is, dates were referred to in Radiocarbon Years Before Present [RYBP]). Because the Late Holocene ends with known historic events, there is an intrinsic obligation in this present volume to focus on calendric time. We therefore encouraged authors to correct dates for isotope fractionation and marine and terrestrial ^{14}C inequities through use of Stuiver and Reimer (1993) and to present calendar ages in years BC or AD. While the volume emphasizes corrected dates and calendric time, longstanding cultural historical frameworks that pre-date recognition of the radiocarbon/calendric discrepancy have in most cases not been revised. Also, in some cases regional radiocarbon databases were not calibrated.

Environment

Environment has long been a major theme in theories of hunter-gatherer complexity, and virtually all chapters in this volume include extensive descriptions of regional environmental settings. In the landmark 1968 volume, *Man the Hunter*, Suttles (1968:56) attributed the high population density and complexity of Northwest Coast foraging societies to the richness and variability of the region's marine and riverine habitats. Bean (1978:681) and Bean and Lawton (1976) in turn attributed the high population density and social complexity of Native California at least partially to the extraordinary energy potential of California environments. This synchronic conceptualization held sway among California anthropologists for nearly two decades until sufficient paleoenvironmental and archaeological data began to accumulate, allowing development of diachronic perspectives on environment and complexity. Diachronic modeling began in earnest in 1987 when Basgall (1987) and Bouey (1987) argued that the key resource fueling the emergence of cultural elaborations in Native California was the acorn and that intensified acorn exploitation went hand in hand with increasing cultural complexity. These influential papers temporarily directed attention away from coastal habitats and environmental variability, but this situation was reversed in 1992 with the publication of Arnold's important papers (1992a, 1992b) on emergent complexity among the Chumash of Southern California. Arnold took a strong and very different position regarding the chronology and causes of emergent complexity. She argued that foragers living on Santa Cruz Island were negatively affected by a severe El Niño-like decline in marine productivity circa AD 1150 to 1250, which increased production of shell beads and created an opportunity for elites to promote and control craft specialization, thus reinforcing their power and creating a permanent hierarchical organization. This was a significant departure from longstanding views of the California environment as rich, stable, and nurturing. As demonstrated by the now widely recognized El Niño/La Niña/Southern Ocillation (ENSO) cycle (see Dayton and Tegner 1990), the California Coast is subject to wild swings in productivity. This is consistent with a newly emerging characterization of California's Mediterranean climate as the antithesis of stability in which dramatic flux may be the norm, not the exception (M. Davis 1995). Arnold's (1992a) chapter, in particular, and her characterization of Late Holocene environmental variability have been the foci through the 1990s of debate regarding complexity in coastal California (Arnold 1997; Arnold, Colten, and Pletka 1997; Colten 1994, 1995; Jones and Hildebrandt 1995; Kennett and Kennett 2000; Raab and Bradford 1997; Raab and Larson 1997). The debate continues in this volume in chapters by Raab et al. (chapter 2), Byrd and Reddy (chapter 4), Munns and Arnold (chapter 8), Kennett and Conlee (chapter 9), and Erlandson and Rick (chapter 10). Some of these authors challenge Arnold's characterization of the Middle to Late Transition (Kennett and Conlee [chapter 9]), while others evoke environmental flux as a significant agent of change but not necessarily one that prompted increased complexity (Gallegos [chapter 3]; Koerper, Mason, and Peterson [chapter 5]; Glassow [chapter 11]; Jones and Ferneau [chapter 12]). Several chapters focus on environmental variability between about AD 800 and 1400, a period known as the Medieval Climatic Anomaly (Stine 1994; T. Jones et al. 1999) (Kennett and Conlee [chapter 9], Munns and Arnold [chapter 8], Glassow [chapter 11], Jones and Ferneau [chapter 12]), and point to likely intervals of demographic problems in Late Holocene prehistory. Others,

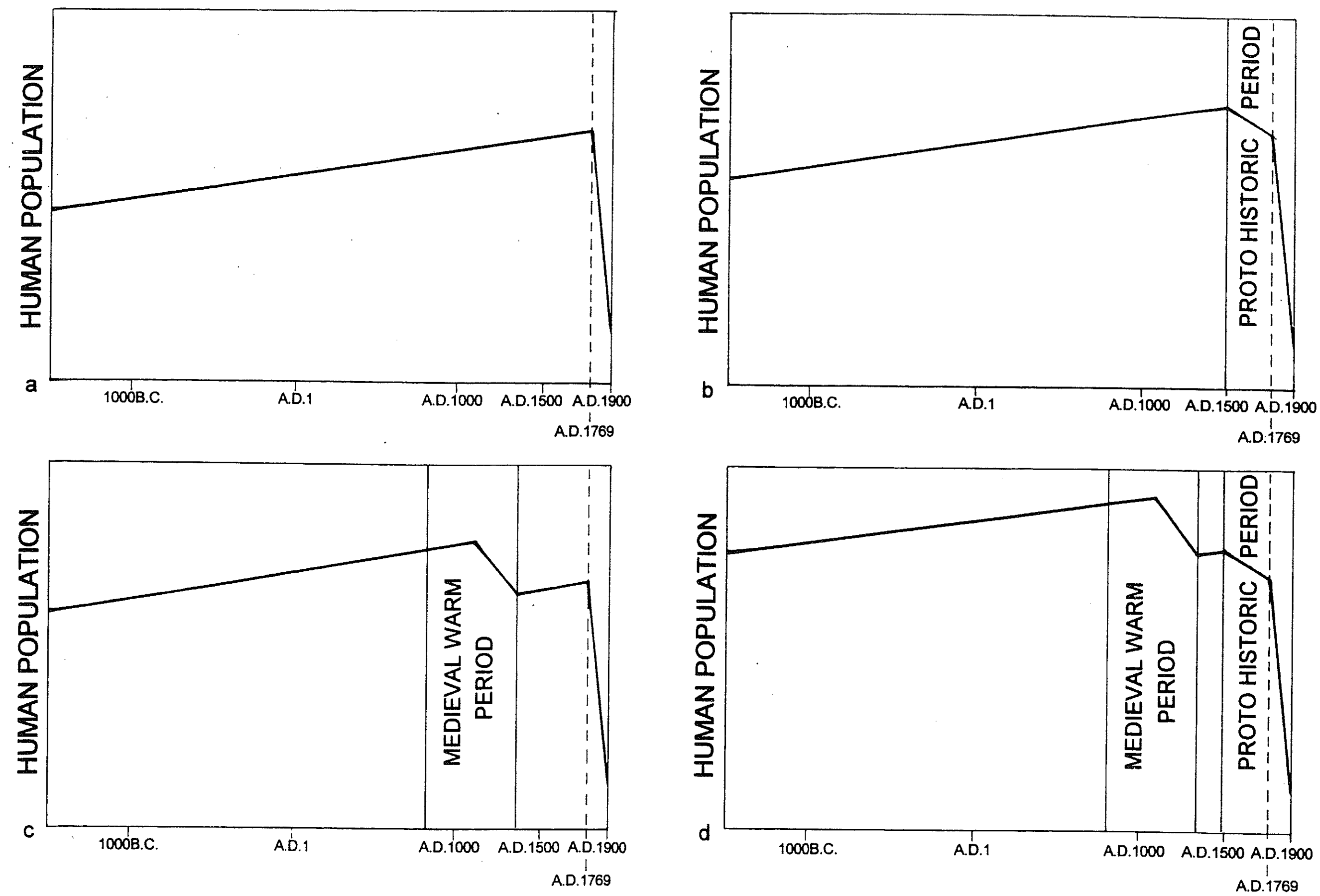


Figure 1.3 Four models of Native American population trends for the Late Holocene, California Coast

mostly those focused on Northern California, do not consider climatically induced cultural change in any detail (see Hylkema [chapter 13], Dowdall [chapter 15], Hildebrandt and Levulett [chapter 16]), at least in part because Late Holocene paleoenvironmental sequences are lacking for their regions.

Population Demographics

Characterizations of California coastal environments as rich, diverse, and/or highly variable are made more profound by consideration of actual relationships among the resource base, human population trends, and processes of cultural development. Two contrasting views of coastal richness and population have been spawned by cultural ecology, both of which are represented in this volume. The first, which dominated thinking up to 1981 or so, emphasized the "affluence" of coastal hunter-gatherers, with the idea that a richness of resources allowed populations to become more dense and develop more complex cultural expressions (Koyama and Thomas 1981; B. Fagan 1995:253). Cohen (1977, 1981) developed a very different perspective, suggesting that coastal foragers in temperate latitudes were not so much affluent as they were overcrowded. Affluence may have existed at the time of initial colonization, but growing populations would have rapidly stressed economic systems, forcing development of more complex social arrangements to meet increasing subsistence demands. Cohen's ideas have been widely embraced in California despite Baumhoff's (1963, 1981) demonstration that California Native societies seem to have operated below carrying capacity, at least at the time of historic contact. Cohen's ideas have also been linked with microeconomic theories of intensification and optimal foraging (for example, Basgall 1987; T. Jones 1991, 1992; Hildebrandt and Jones 1992; Broughton 1994b; Erlandson 1991a; Raab 1992). Nearly half the chapters in this volume allude to the process of economic intensification (broadening of the diet, with greater labor investment, as a larger number of lower ranked foods are exploited) in connection with emergent complexity.

Papers by Basgall (1987) and Arnold (1992a, 1992b) should again be recognized as seminal in their treatment of demographic stress. Arnold's model, while going well beyond a simple prime mover scenario, is consistent with the overcrowding hypothesis insofar as it links complexity with demographic stress, not affluence. Basgall (1987) instead, envisioned stress and complexity building incrementally in response to population growth. Except for Glassow (chapter 11) and Koerper, Mason, and Peterson (chapter 5), most chapters in this volume treat human population, population growth, and population "pressure" more implicitly than explicitly. Best estimates for the aboriginal population of what is now the state of California when Spanish colonists arrived in AD 1769 are between 310,000 (S. Cook 1976:43) and 350,000 (Baumhoff 1963), for a mean density of 2.2 people/mile^2. Most coastal tribes showed much higher population densities, however, including the Chumash, whose population density has been estimated at 21.6 (table 1.1).

Several alternative trajectories of population may have preceded the demographic situation of AD 1769. One not directly proposed in any chapter, but implied by several, is that the Native population was at its pinnacle in 1769 following incremental growth through the Holocene (figure 1.3a). This incremental growth was reversed precipitously after direct contact with Europeans in AD 1769. Many California scholars (for example, Chartkoff and Chartkoff 1984:235, 256; Erlandson and Bartoy 1995; Forbes 1969:25; Meighan 1981:35; Preston 1996, 2002) suspect, however, that European diseases impacted Native Californians well before the Spanish established a permanent presence along the Southern and Central California Coast. Exposure could have occurred during any of the pre-Mission contacts between Native Californians and early explorers (see Early Contact and the California Protohistoric Period below), or contagion could have spread from centers of earlier New World settlement to California through human-to-human transmission. Preston (1996) suggested that Old World diseases probably had devastating effects on Native California peoples centuries before Europeans established permanent colonies. He provided a detailed account of the specific European diseases that had spread throughout most of the New World by the early 16th century (for example, chicken pox, measles, small pox, yellow fever, and tuberculosis, among others) and argued further that the aboriginal population of California probably reached its peak early in the 16th century and declined thereafter (figure 1.3b). Most coastal archaeologists probably agree with Preston's analysis, and would (at least in theory) recognize the Protohistoric period in California archaeology, from about AD 1519 (the year Cortez landed in Mexico) to AD 1769, as a distinctive demographic interval. Unfortunately, the Protohistoric period is not easily recognized in California archaeological sites because ^{14}C dates near the historical era have rarely been calibrated and lack precision. Nonetheless, Protohistoric decline represents another possible direction in the population history of Native California (figure 1.3b). Several chapters suggest that demographic problems during the Protohistoric period may have come on the heels of an earlier decline during the Medieval Climatic Anomaly (see Glassow [chapter 11], Jones and Ferneau [chapter 12]; see also T. Jones et al. 1999) (figures 1.3c, d).

Sedentism and Mobility

Linkages between sedentism and complexity have been recognized since Boas's first studies of the Northwest Coast, and the relative mobility of California prehistoric foragers also has a lengthy history of debate. Discussions of sedentism began in earnest in California in the mid-1960s when Curtis (1965), Owen (1964, 1967), and Warren (1967) argued alternatively for semi sedentism and full sedentism for Early Holocene peoples on the Southern Coast. Since then, debates concerning mobility have tended to focus more on Binford's (1980) settlement classification system with its mobile foragers and sedentary collectors (see Breschini and Haversat 1980, Hildebrandt 1984). In applying this scheme, diachronic trends toward a collector strategy are generally interpreted as signs of increasing sedentism, usually in the absence of stronger empirical evidence (for example, seasonality data) for year-round occupation of single settlements. In some cases, (for example, the Chumash, Yurok), ethnohistoric accounts strongly suggest year-round site use, but for most of the rest of coastal California, the ethnohistoric record is ambiguous, and definitive archaeological evidence for relative mobility has been difficult to isolate. Nonetheless, the importance of sedentism is not lost on the authors of this volume, nearly all of whom posit diachronic trends toward decreasing mobility, usually as precursors to social elaboration. Because of the difficulties in establishing permanence of settlement empirically, however, very different opinions regarding the timing of emergent sedentism are expressed. This divergence suggests that mobility and settlement remain critical issues in the archaeology of the California Coast.

Power, Political Hierarchy, and Labor

Permanent, centralized political authority, of course, is a key feature of social and adaptive complexity. Indeed, Arnold (1996a, 1996b) defines hereditary hierarchical leadership and the ability to control resources and labor as the singular defining characteristics of cultural complexity. For Arnold, in other words, only chiefdom-level political organization represents significant complexity. Her definition has value for the Chumash—the only group in coastal California to achieve this level of political sophistication unequivocally (table 1.1), and Arnold (1991a, 1992a, 1992b) has consistently attempted to define the chronology and causes underlying the emergence of this structure for this group. In their contribution to this volume, Munns and Arnold (chapter 8) make the clearest and most definitive statement concerning the emergence of permanent social inequality. Relying on the remarkable archaeological record from Santa Cruz Island, Munns and Arnold acknowledge that signs of complexity consistent with tribal levels of political organization—sedentism, ascribed status (marked by elaborate juvenile burials), and violence—were apparently in place as early as the Middle period. They propose, however, that signs of more significant social inequality and hierarchy—intensive craft specialization and exchange, along with a major disparity in the distribution of mortuary goods—appeared only after AD 1100. They argue for a fundamental reorganization of labor, leadership, and allocation of resources that placed permanent power in the hands of elites and allowed specialization in the manufacture of plank canoes and shell beads. Intensive production of the latter, indicated by profuse deposits of beads, bead-manufacturing detritus, and bead-making drills (Arnold 1987), provides some of the most compelling evidence for occupational specialization in Native California. Kennett and Conlee (chapter 9) argue, however, that intensified production of shell beads began earlier in the Chumash area, about AD 650.

Other evaluations of social inequality focus exclusively on mortuary associations, specifically on disparity in the distribution of wealth items within cemeteries as an indication of inequality in the distribution of wealth and power, and the occurrence of wealth objects in juvenile graves, suggesting inherited status. Hildebrandt and Levulett (chapter 16) show significant inequity in the distribution of prestige items (imported obsidian bifaces and shell beads) in a post-AD 1000 cemetery on the Northern California Coast. This cemetery also showed signs of ascribed status, correlating nicely with the social inequality observed on the North Coast ethnographically. In the San Francisco Bay area, Hylkema (chapter 13) describes a more equitable distribution of wealth objects among Late period graves, suggesting a more egalitarian social situation. In contrast with earlier times, the Late period in that region shows a significant increase in the mean number of shell beads interred per individual, but a majority of graves included wealth objects. Some measure of social inequality, however, was suggested by burials with inordinately high numbers of beads (approximately 2000 per interment), and richly adorned juvenile graves. Similarly limited mortuary evidence for inequality and ascribed statuses is reported for the Central Coast (Jones and Ferneau [chapter 12]), and the Southern California Bight (Koerper, Mason, and Peterson [chapter 5]; Byrd and Reddy [chapter 4]; Gallegos [chapter 3]).

Ritual

Close relationships between political and ritual authority in pre-state societies are common (Aldenderfer 1992), as exemplified by ritualized feasting (potlatches) on the Northwest Coast and the temporary power gains in so-called Big Man economies of New Guinea and elsewhere. The possibilities of ritual-related influences on power structures is touched on briefly in several chapters in this volume, but is most strongly developed by Lightfoot and Luby (chapter 14). Alluding to an earlier study by Luby and Gruber (1999), they, suggest that San Francisco Bay shell mounds are not merely accumulations of dietary debris, but instead represent ritualized mortuary feasting and social aggrandizement. Elites are thought to have sponsored periodic gatherings at these locations to enhance their status with feasting in honor of ancestors. Through this process, the mounds were further thought to take on a symbolic significance for the local inhabitants (see also Lightfoot 1997). The abandonment of many of these mounds at the end of the Middle period is argued to represent a significant transformation in regional symbolic and ritual systems.

Gender

Over the last decade, discussions of gender in prehistoric California have emphasized the Milling Stone horizon—a culture apparently so uninvolved with hunting that males must have done a significant amount of gathering (Erlandson 1994:266; T. Jones 1996; McGuire and Hildebrandt 1994)—and bedrock mortar features associated with intensive acorn processing by women (Jackson 1994; McCarthy 1993). The hallmark of complex Late Holocene economies in Native California was a gender division of labor in which women specialized in intensive processing: plant foods in terrestrial settings and fish on the coast. In a situation not unlike that of horticultural societies, basic adaptive success was probably more dependent on female rather than male labor. Whether this situation resulted in higher status for females is uncertain, as is the timing of the appearance of such specialization. T. Jones (1996) argued for a Middle Holocene emergence as a result of population circumscription, while Hollimon (1990) suggested it was a Late Holocene phenomenon in the Santa Barbara Channel area. Raab et al. (chapter 2) point out that change in the importance of female subsistence efforts may have affected birth rates among these societies, increasing the rates of population growth.

Ethnicity

While studies of power, labor, gender, and cultural complexity are relatively recent in California coastal archaeology, considerations of ethnicity date back nearly a hundred years to the culturally particularistic studies of Franz Boas and his student, A. L. Kroeber. This emphasis has maintained its usefulness in California largely because of a mosaic-like distribution of Native language families that almost certainly

Table 1.2 Chronology of Late Holocene ethnolinguistic group movements along the California Coast

TRIBE	LINGUISTIC AFFIL.	ARRIVAL ON COAST (EST.)	PREV. ESTABL. GROUP	REFERENCE
Tolowa	Athapaskan	AD 1300	Karok (Hokan-speakers)	Hildebrandt and Levulett, this volume, ch. 16
Yurok	Algic	AD 1100-1300	Karok (Hokan-speakers)	Hildebrandt and Levulett, this volume, ch. 16
Wiyot	Algic	AD 900	Karok (Hokan-speakers)	Hildebrandt and Levulett, this volume, ch. 16
Mattole	Athapaskan	AD 1300	Karok (Hokan-speakers)	Hildebrandt and Levulett, this volume, ch. 16
Sinkyone	Athapaskan	AD 1300	Karok (Hokan-speakers)	Hildebrandt and Levulett, this volume, ch. 16
Pomo	Hokan	AD 1000	Yukian-speakers?	Dowdall, this volume, ch. 15; Fredrickson 1984
Coast Miwok	Utian	AD 1	Yukian-speakers?	Dowdall, this volume, ch. 15; Fredrickson 1984
Ohlone	Utian	AD 800-1200*	Hokan-speakers	Jones and Ferneau, this volume, ch. 12
		2000 BC**	Hokan-speakers	Moratto 1984
Gabrielino	Uto-Aztecan	600 BC	Hokan-speakers?	Gamble and Russell, this volume, ch. 7; Moratto 1984
		AD 600	Hokan-speakers	Koerper, Mason, and Peterson, this volume, ch. 5
		4000 BC	Hokan-speakers	Drover and Spain 1972

*Arrival into Monterey Bay area
** Arrival into San Francisco Bay area

reflects a complex history of group movements, in-migrations, and replacements (Kroeber 1925, 1955a). At the time of historic contact, six major linguistic stocks and twelve language families were represented along California's shoreline, and many local prehistories incorporate explanations for the coexistence of vastly different languages (often immediately adjacent to one another) that emphasize in-migrations of one group or the other. Developed within particularistic frameworks, chronological models unraveling the history of these migrations are profuse in Central and Northern California, and often posit very different settlement histories. While some (for example, R. Hughes 1992) have warned against the simplistic correlations between ethnicities and material culture expressed in such models, many of the group movements thought to contribute to the complex California linguistic mosaic are still seen as Late Holocene phenomena. Chapters in this volume are evenly divided into those considering ethnic replacements (Levulett and Hildebrandt [chapter 16], Dowdall [chapter 15], Jones and Ferneau [chapter 12], Gamble and Russell [chapter 7]) (table 1.2) and those that do not (Lightfoot and Luby [chapter14]; Hylkema [chapter 13]; Glassow [chapter 11]; Erlandson and Rick [chapter 10]; Kennett and Conlee [chapter 9]; Munns and Arnold [chapter 8]; Vellanoweth et al. [chapter 6]; Koerper, Mason, and Langenwalter [chapter 5]; Byrd and Reddy [chapter 4]; Gallegos [chapter 3]; Raab et al. [chapter 2]). In most of the latter cases (for example, chapters on the Chumash), the archaeological and linguistic records suggest ethnic continuity through the Late Holocene. In several cases, however, major changes in regional Late Holocene archaeological records strain the limits of credibility as simple adaptive adjustments by single-resident ethnic groups.

Intergroup Relations: Trade and Warfare

Far-flung trade networks involving shell beads are a well-known characteristic of prehistoric California. Studies of the last two decades or so have shown that obsidian was also exchanged over equally wide distances as beads with comparable regularity. While there is some evidence for distant movement of beads and obsidian during the Early Holocene (Jackson and Ericson 1994); beads made from marine shells first appear in the Great Basin in significant numbers during the Middle Holocene (Hughes 1994:369). Some (for example, Fredrickson 1974a; Jackson and Ericson 1994) argue for an incremental increase in exchange practices thereafter, consistent with gradually increasing complexity. Others (for example, Munns and Arnold, chapter 9) suggest a punctuated pattern of trading with a significant increase after circa AD 1150. C. King (1976) suggested that the sophistication and intensity of bead exchange placed Native California at a level of complexity akin to agriculturalists. Gamble and Russell (chapter 7) support this view, while Munns and Arnold also envision the intense island-mainland exchange of the Chumash area as consistent with significant complexity. Most other regions of California represented in this volume show evidence of less intensive trading. Jones and Ferneau (chapter 12) argue that long-distance exchange peaked at the end of the Middle period when drought-related environmental problems disrupted intergroup relations.

Less well known outside of California are signs of violence and warfare among prehistoric coastal societies (Keeley 1996:viii). These indications were brought to light most convincingly by Lambert and Walker (1991), who illuminated signs of violence among prehistoric mortuary populations in Southern California and argued that these peaked during the Middle period. Similar evidence is reported in this volume from San Francisco Bay (Hylkema, chapter 13) and the Central Coast. While signs of violence never seem to exceed roughly 10% of any cemetery population, they nonetheless suggest a level of intergroup conflict beyond that usually associated with band societies.

Early Contact and the California Protohistoric Period

One final issue unique to the Late Holocene involves the Protohistoric period (ca. AD 1519–1769), when California Natives had brief but direct contact with European explorers. The chapters in this volume focus on California's precontact era, which officially ended in AD 1769 when Gaspar de Portolá and Junipero Serra marched into Southern California to establish the first Spanish mission at San Diego. This was the first of 21 missions established in Alta California between AD 1769 and 1823 (Castillo 1978:100). Sporadic contacts between Native Californians and Europeans actually took place much earlier, however. In AD 1542, for instance, three Spanish ships commanded by Juan Rodriquez Cabrillo sailed up the California Coast and encountered Natives at several locations, including the Channel Islands (Erlandson and Bartoy 1995). The English adventurer, Sir Francis Drake, landed on the coast north of San Francisco Bay in AD 1579; Sebastian Cermeno wrecked his ship at Drake's Bay in AD 1595. The Spanish merchant, Sebastián Vizcaíno, in AD 1602 to 1603 was the last documented European pre-Mission explorer to view the California Coast (see Wagner 1929).

The history of contact for Northern California coastal tribes beyond the limits of the Spanish Mission system occurs later and is more culturally diverse. Eager to fend off Russian interests in lands at the northern limits of their colonies, the Spanish funded two sea expeditions that landed in Trinidad Bay (near Eureka): the first in AD 1775 (commanded by Don Bruno de Hezeta), and the second in AD 1793 (commanded by Francisco de Eliza) (Heizer and Mills 1952:19). The English Vancouver expedition landed in Trinidad Bay in AD 1793 (Heizer and Mills 1952:19). Later contact was spawned by the burgeoning trade in sea otter pelts that brought American (William Shaler in AD 1804) and Russian ships to the North Coast (Jonathon Winship in AD 1806). The Russians operated a colony at Fort Ross on the North Coast from AD 1812 to 1841, which brought about extensive contact among Pomo, Coast Miwok, Russians, and Aleuts, who were brought in by the Russians as laborers. Coastal California tribes located farther to the north appear to have been spared significant direct contact until the Gold Rush began in AD 1848 (Heizer and Mills 1952:74), but it is again reasonable to suspect that diseases reached there earlier.

Although a number of chapters in this volume discuss the Protohistoric period along the California Coast, including the possibility that Old World diseases impacted California's maritime peoples prior to the Mission period, individual authors have been asked to focus on precontact cultural processes. Erlandson, Jones, and Lightfoot are planning a volume dedicated to the archaeology of California's Native peoples following European contact.

VOLUME ORGANIZATION

In keeping with the format of the two previous works on California coastal prehistory in this series, this volume is organized geographically from south to north. The next two chapters, by Raab et al. (chapter 2) and Gallegos (chapter 3), begin near the California/Mexico border, the most xeric stretch of the California Coast. From there, coverage of tribes and territories moves progressively northward, with nine chapters devoted to the South Coast (generally south of Point Sal), one chapter to the Central Coast (between Point Sal and Monterey Bay), two to the San Francisco Bay area, and two to the North Coast.

Late Holocene San Clemente Island

Notes on Comparative Social Complexity in Coastal Southern California

L. Mark Raab, Andrew Yatsko, Thomas S. Garlinghouse, Judith F. Porcasi, and Katherine Bradford

Most archaeologists recognize the Late Holocene as a particularly dynamic period of culture change in coastal Southern California. From about 3500 years ago until European contact, distinctive new patterns of technology, economy, settlement patterning, and social organization emerged, forming the cultures of ethnohistoric record. Archaeologists remain far from consensus, however, about the origins of these patterns and the extent to which they affected various coastal groups. Debates about Late Holocene cultural origins captured significant attention during the last decade, with social complexity central to the issues under discussion. This focus is scarcely surprising, because social complexity has become an increasingly important topic in models of Southern California coastal prehistory.

During the first half of the twentieth century, archaeologists devoted most of their efforts to explaining the appearance of new culture traits, particularly in the realms of technology and economy. It was in this light that migrationist models gained favor, attributing culture change to the arrival of new peoples on the California Coast (Harrison and Harrison 1966; D. B. Rogers 1929; Warren 1968). With the appearance of cultural ecology in the 1950s, adaptationist scenarios emphasized in situ adaptations to the environment, rather than population movements, as sources of technoeconomic change (Meighan 1959). As the popularity of ecological models increased, hunter-gatherer studies experienced a widespread revival of interest in American anthropology during the 1960s. This trend encouraged greater archaeological interest in problems of social organization, including neo-evolutionary models that identified the emergence of chiefdoms as the crucial developmental link between "simple" and "complex" societies (R. Kelly 1995). As pointed out elsewhere (Raab 1996), neo-evolutionism and its search for the origins of chiefdoms quickly took hold in California, including the Chumash area of coastal Southern California. These models, bolstered mainly by ethnohistoric data, but also drawing on ideas from cultural ecology and a modest stock of archaeological information, achieved almost instant popularity with academics, Native Americans, and the public (Bettinger 1991; Bean and Lawton 1976; Landberg 1965; C. King 1976, 1990; Chartkoff and Chartkoff 1984).

Such evolutionary models cast social complexity in terms that essentially shape current discussions of this topic, namely the appearance of hereditary chiefs and a variety of ritual and economic specialists over which they held sway. The archaeological correlates of chiefdoms are usually described as a regional settlement hierarchy, including large and permanently settled "capital" villages or towns; the appearance of large cemeteries, reflecting status-differentiated mortuary customs; specialized production of many types of crafts; and extensive elite-controlled regional trade networks (Arnold 1992a, 1995b; Chartkoff and Chartkoff 1984; B. Fagan 2000; C. King 1990; Martz 1984).

With an interest in social complexity firmly established, model building during the 1990s advanced along quite different lines than those popularized by neo-evolutionists. These developments reflected not only changing theoretical perspectives in archaeology generally but also a rapidly increasingly volume of archaeological data available to coastal researchers. Neo-Marxists attributed complexity in the Chumash area to coercive control of crafts production and redistribution of food surpluses by what amounted to a powerful over-class (Arnold 1992b, 1995a), rejecting the neo-evolutionary notion of chiefs as benign managerial elites. These models also assigned an important role to stressful paleoenvironmental forces, an important shift away from neo-evolutionary scenarios that assumed an essentially stable and consistently productive natural environment. A combination of sea temperature flux and severe droughts was postulated as triggering events in the rise of Chumash chiefdoms on the northern Channel Islands between about AD 1100 to 1300 (Arnold 1992a, 1995b).

Finally, evolutionary ecologists or advocates of other selectionist perspectives weighed into the widening debate about culture change during the last decade, suggesting that resource intensification, climatic deterioration, violent competition, and socioeconomic cooperation all played a role in transforming the Late Holocene cultural landscape. These models offered a basic challenge to both neo-Marxist and neo-evolutionary scenarios. Arguing for declining levels of foraging efficiency and severe climatic deterioration during the Late Holocene, these theorists questioned the idea that social power was derived from the redistribution of food surpluses, since widespread drought and often low levels of foraging efficiency seem unlikely circumstances for the production of large, disposable food supplies. Moreover, evolutionary ecologists pointed to relatively severe health problems and high rates of interpersonal violence in precisely the same regions where redistributive political economies were supposed to have brought about improved living conditions (Broughton and O'Connell 1999; T. Jones et al. 1999; Kennett and Kennett 2000; Raab 1996; Raab and Larson 1997).

These debates have produced generally beneficial results, encouraging productive new lines of thought and research. Just the same, archaeological research in coastal Southern California continues to reflect misleading stereotypes and remains far from exploring the substantial degree of variability that existed in Late Holocene cultural patterns across the region as a whole. As we saw in the preceding summary of theoretical developments, the Chumash area casts a long shadow over discussions of Late Holocene cultural complexity. Some measure of this influence can be seen in the bibliography by Holmes and Johnson (1998), where the Chumash region is revealed as one of the most extensively researched and reported in all of California.

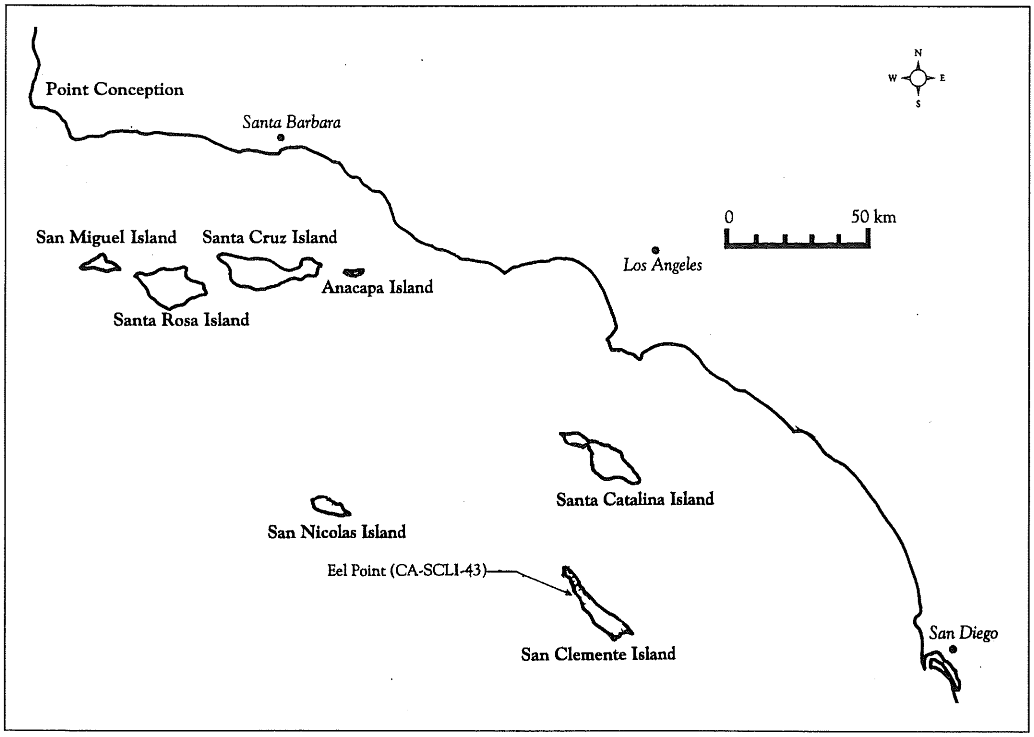
The Protohistoric Chumash, including the occupants of the northern Channel Islands, are routinely described as some of the most complex foragers in North America, if not the world (Arnold 1992a, 1995b; Chartkoff and Chartkoff 1984; B. Fagan 2000; Glassow 1996c; C. King 1990; Moratto 1984). Unfortunately, this characterization may be perceived as a cultural template for describing cultural-evolutionary trends among all Southern California coastal groups. If so, the results are likely to be unfortunate. Even a cursory comparative examination of coastal Southern California archaeology makes it difficult to identify a "typical" pattern of cultural development. Consider, for example, that while the Chumash area is frequently described in terms of a cultural climax featuring high degrees of social complexity, some archaeologists envision a virtual anti-climax at the southern end of the California bight owing to Late Holocene siltation of the large coastal lagoons of the San Diego County Coast. Byrd and Reddy (chapter 4, this volume) reject this coastal abandonment model, arguing that some degree of social ranking may have existed among groups of the San Diego Coast. Nevertheless, the Late Holocene archaeological record of this region reflects little evidence comparable to the mortuary ceremonialism, craft specialization, settlement pattern dynamics, and other patterns thought to signal complexity in the Chumash area.

Between San Diego County and the Chumash region, the Gabrielino Indian area offers another challenge to our understanding of Late Holocene cultural developments. Although reconstructions of Gabrielino prehistory have been modeled for decades on socioeconomic patterns similar to those ascribed to the Chumash (Bean and Smith 1978; McCawley 1996), Gabrielino archaeology reflects a comparatively modest stock of data collected, analyzed, and reported under modern conditions. Whether the Late Holocene Gabrielino area closely replicated the dynamics linked to social complexity in the Chumash case is probably best regarded as an open question and an excellent subject for future research. Part of the ambiguity of Gabrielino archaeology arises from questions about the nature of Late Holocene cultural developments on the southern Channel Islands. As we shall see below, the southern islands were scarcely a clone of the northern Channel Islands and Santa Barbara Coast with regard to the cultural traits linked to social complexity among the Chumash.

Generalizing in any fashion about prehistoric cultural differences across coastal Southern California is hazardous, of course, in that our understanding of the regional archaeological record is undoubtedly biased in a number of ways. For instance, heavy urbanization of the mainland Gabrielino area and the comparatively small amount of archaeological research conducted until recently in the southern Channel Islands make it difficult to know exactly how this region compares to the Chumash case. Still, archaeological investigations prior to extensive urbanization, a growing body of contract research, and substantial advances in the southern Channel Islands archaeology in recent years make it increasingly difficult to dismiss differences of archaeological patterning between the Chumash region and other areas as merely the result of differential data recovery or preservation.

All of these questions show that rigorous comparative research on Late Holocene cultural variability is overdue in coastal Southern California. In this discussion, we try to frame a context for such studies. Our analysis is centered in the southern Channel Islands, focusing in particular on Late Holocene settlement and subsistence patterns on San Clemente Island. This seems a useful approach for several reasons. San Clemente

Figure 2.1 San Clemente Island and the Southern California Bight area



Island escaped most of the destructive effects of urbanization that plague the archaeological record of the adjacent mainland coast, preserving an extraordinary record of maritime culture change. Cooperative archaeological research programs with several academic institutions, numerous field schools, and contract research efforts during the last decade have made San Clemente Island one of the most systematically studied of the Channel Islands (Raab, Bradford, and Yatsko 1994; Raab and Yatsko N.D.).

As a result of these advances, increasingly detailed archaeological comparisons can be made between the northern and southern Channel Islands; comparisons that may be useful for gauging maritime cultural variability across Southern California. The northern Channel Islands clearly were integral to Late Holocene cultural trends in the Chumash area. Indeed, northern islands research was pivotal in establishing many of these trends, often making the results of this research a proxy of Late Holocene cultural developments in the Chumash region as a whole (Arnold 1992a; Broughton and O'Connell 1999; Colten and Arnold 1998; Kennett and Kennett 2000; Raab and Larson 1997). It may be instructive for this reason to compare aspects of Late Holocene culture change on San Clemente Island with trends documented in the northern islands. This comparison reveals a more complex pattern of cultural similarities and differences across Late Holocene coastal Southern California than many archaeologists currently recognize.

SAN CLEMENTE ISLAND

San Clemente Island is the southernmost and fourth largest (148 km^2) of the eight Channel Islands of Southern California (figure 2.1). Located 77 km (48 miles) from the Palos Verdes Peninsula on the mainland, San Clemente Island has been a military reservation since 1934. The island is not accessible to the public, and until recently was infrequently visited by archaeologists. Two complementary sources of data are employed in our discussion. One is the Eel Point archaeological site, focus of an intensive series of investigations during the last decade. The other is derived from an island-wide archaeological survey and site testing program based on a 15% probability sample of San Clemente Island's surface ("Legacy Survey"). Comparison of these two data sets affords an instructive basis for examining Late Holocene cultural patterns.

Eel Point

The Eel Point site (SCLI-43), located on the central west shore, encompasses at least 2 ha of dune deposits on an erosion-resistant cape of volcanic rock (Raab, Bradford, and Yatsko 1994). The first recorded archaeological investigation of Eel Point was a brief test excavation conducted by McKusick and Warren (1959). During the 1980s, two UCLA field schools were conducted at Eel Point. This work produced a large collection of fish bone and artifacts, as well as a series of 24 radiocarbon dates (Salls 1988). A doctoral dissertation on the prehistoric marine fisheries of coastal Southern California featured a detailed analysis of the fish remains collected by UCLA archaeologists (Salls 1988).

The UCLA investigations and three subsequent field seasons by archaeologists from California State University, Northridge and the Natural Resources Office, Naval Air Station North Island, uncovered well-preserved cultural deposits as much as 3.2 m deep (Raab, Bradford, and Yatsko 1994). Eel Point contains one of the longest and best-preserved sequences of maritime cultural change on the Pacific Coast of North America (Erlandson 1994; Porcasi 1995; Salls 1988; Raab and Yatsko 1992; Raab, Bradford, and Yatsko 1994). The excavations conducted there in 1994, 1996, and 1999 afforded a cultural chronology spanning most of the Holocene, recorded cultural features such as living surfaces and habitation structures, and launched ongoing reconstruction of long-term maritime techno-economic trends (Andrews 2000; Fiore 1998; Garlinghouse 2000; Porcasi 1995; Porcasi, Jones, and Raab 2000; Raab and Yatsko 1992).

Based on 49 ^{14}C dates collected by the authors between 1994 through 1999, the occupation of Eel Point is currently known to range from about 6200 BC to AD 1400. All the ^{14}C dates cited in this discussion have been fully corrected and calibrated using the computer program published by Stuiver and Reimer (1993). Shell dates have been corrected for the marine reservoir using a local offset of 225±35 years. We also note that a significant feature of the Eel Point chronology is an apparent hiatus in site occupation between about 4000 and 6000 BC. The cause of this hiatus is not known (Raab, Bradford, and Yatsko 1994). Despite this hiatus, a comparatively fine-grained record of maritime economic change can be charted across most of the Holocene. In constructing the Eel Point chronology, cultural strata with overlapping ^{14}C dates (one standard deviation) were combined for analytical purposes. The rationale for combining strata in this fashion is two-fold. First, cultural strata with overlapping dates cannot be resolved meaningfully into separate behavioral events. Second, it must be recognized that sampling errors inevitably introduce "noise" into behavioral reconstructions based on midden deposits. Accordingly, our objective here is to identify robust trans-Holocene behavioral trends rather than stake interpretations on every up- or downswing of artifact or faunal frequencies.

Legacy Site Survey

The Legacy Heritage Resources survey, funded by a grant to Andrew Yatsko, Natural Resources Office, Naval Air Station North Island from the US Department of Defense, was based on a statistical probability sample that covered approximately 15% of the island's surface (Raab and Yatsko N.D.). A test-excavated sample of 25 sites recorded during this survey, representing essentially all the site types and topographic settings typical of the island, yielded 60 radiocarbon dates. These dates, part of a study of Late Holocene settlement patterns on San Clemente Island, range from about 3000 BC to AD 1825. Of the Legacy ^{14}C dates, 9 had ranges at one standard deviation that overlapped one or more other dates from the same site or cultural stratum, leaving a sample of 51 dated cultural strata.

Overall, it is possible to gain an impression of Late Holocene cultural trends on San Clemente Island from a comparatively long and detailed cultural sequence at the Eel Point site and an island-wide, statistically controlled sample of 51 discrete cultural components. Although it is certainly desirable to have a larger sample of dates and sites, the available data afford a reasonable basis for reconstructing at least large-scale cultural trends. When these data are combined with a variety of other archaeological information from San Clemente Island, a useful model of Late Holocene settlement trends can be reconstructed.

LATE HOLOCENE DEMOGRAPHIC TRENDS

Several California researchers have suggested that ^{14}C date frequencies afford useful insights into paleodemographic patterns (e.g., Breschini, Haversat, and Erlandson 1996; Erlandson 1994; Glassow 1996c; Glassow, Wilcoxon, and Erlandson 1988). The essential idea is that, all things being equal, one might logically expect a prehistoric human population, as it expanded or contracted in size, to have created a correspondingly larger or smaller number of discrete archeological sites or cultural components. Assuming that regional sampling of ^{14}C dates reflects this variation in a reasonably accurate fashion, the frequency of ^{14}C dates can be viewed as a proxy of the number of cultural components that existed in a given unit of time. The difficulty with this approach is, of course, that all things are seldom equal. The power of a sample of dates to reflect accurately something as complex as a regional archaeological record is subject to many sources of error (see Glassow 1996c for a detailed discussion). Biased selection of sites or samples for dating, the small sample of dates for many time periods, variable deposition of datable materials across time, differences in the number of people who occupied various sites, and settlement dynamics that produced greater or lesser numbers of sites or cultural components regardless of the actual population size are all potential problems.

All of these difficulties acknowledged, the available San Clemente Island ^{14}C data yield useful information. The Legacy Survey's probability sample eliminates a good deal of bias in the selection of sites for dating, thus helping to ensure that sites from all of the island's topographic settings and periods of occupation contribute to our understanding of cultural patterning. As we have pointed out elsewhere, site preservation on San Clemente Island is frequently excellent (Raab, Bradford, and Yatsko 1994), eliminating differential preservation as a major influence upon selection of sites for dating. At the same time, any chronological trends identified in the Legacy data need not be viewed in a vacuum but can be evaluated in light of other lines of archaeological evidence.

To begin this pattern recognition, we plotted the frequency of mean ^{14}C dates (cultural components) in calendar

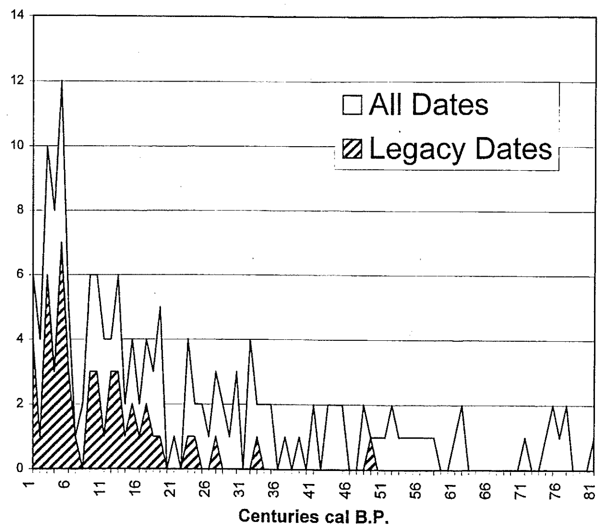


Figure 2.2 Archaeological ^{14}C components per century, San Clemente Island

years before present from the Legacy Survey (figure 2.2). For comparative purposes, figure 2.2 also presents the frequency of total known ^{14}C components from San Clemente Island. At least 225 ^{14}C dates are known from San Clemente Island, based on data from Breschini et al. (1996), Byrd (2000b), Byrd and Victorino (1999), Raab, Bradford, and Yatsko (1994), Gallegos (1994), Salls (1988), and other reports on file at the Department of Anthropology, California State University, Northridge. A total of 106 dates make up the island-wide sample provided in figure 2.2. This reduced sample reflects a number of factors, including exclusion of the Legacy Survey dates, elimination of multiple dates from individual cultural components, and exclusion of dates of uncertain context and laboratory processing.

Demographic Change

Several interesting patterns can be seen in figure 2.2. The Legacy and island-wide samples reflect substantially similar trends for the Late Holocene but different patterns for the Middle to Early Holocene time range. The Legacy sample conspicuously lacks components older than about 3000 BC despite the fact that a cultural component on the order of 6000 BC is well documented at Eel Point (Garlinghouse 2000; Raab, Bradford, and Yatsko 1994). This finding does not necessarily weigh against the adequacy of the Legacy sample. It may be that Middle to Early Holocene cultural components on San Clemente Island were much less numerous than during the Late Holocene, thus requiring a large sample of dates to discover cultural components with an age of 3000 BC or more.

Figure 2.2 conforms generally to trans-Holocene frequency distributions of ^{14}C dates seen from other California coastal localities and from California as a whole (Breschini, Haversat, and Erlandson 1996). As an indicator of relative population size, the Legacy sample could be interpreted to mean the island's prehistoric population was relatively sparse until the Late Holocene, when a fluctuating but generally increasing population reached its maximum size by about AD 1350 to 1450. In other words, increasing population density was the clearest paleodemographic trend on San Clemente Island during the Late Holocene. This pattern is familiar to California archaeologists. Glassow (1996c:101), for example, shows that the trans-Holocene frequency of ^{14}C dates in the Santa Barbara Channel area peaked between about 2000 and 500 years ago.

The causes and consequences of this seemingly robust pattern of Late Holocene demographic expansion have been viewed in various ways by theorists of culture change. Neo-evolutionists, for example, often assumed that culture change was fueled by essentially Malthusian dynamics. It was assumed that ancient peoples, like all human populations, tended toward exponential population increase—growth that created a need for additional food supplies. Based on this assumption, it was easy to imagine population pressure as the impetus behind the technological and social-organizational improvements that drove cultural progress. The Southern California Coast was viewed as particularly accommodating to these dynamics, based on the notion that tapping the combined resources of the land and sea produced exceptionally bountiful results. Thus, a rapid increase in the size of Late Holocene coastal populations has been viewed as both the cause and effect of a highly successful Late Holocene culture climax (Chartkoff and Chartkoff 1984; C. King 1990; Landberg 1965). Since dynamics of this sort are both vague and potentially circular, the role of population growth in fostering culture change remains uncertain. However, other San Clemente Island data suggest that the forces behind Late Holocene demographic expansion may have been quite different than traditional models have led us to believe.

MARITIME RESOURCE INTENSIFICATION

Foraging Efficiency and Culture Change

If the Late Holocene was a time of demographic expansion, recent research suggests the paradoxical possibility that this growth was linked to resource scarcity rather than abundance. The evidence for this conclusion can be seen in studies of resource intensification that are grounded in principles of evolutionary ecology. Briefly, evolutionary ecologists stress that Darwinian selection processes are powerfully influenced by the energetic efficiency of the food quest (Broughton and O'Connell 1999; Cohen 1989a, 1989b; R. Kelly 1995; Smith and Winterhalder 1992). Different foraging strategies, operating at varying levels of energetic efficiency, are thought to engender a spectrum of technological, economic, and social organizational adaptations on a synchronic level, while directional changes in cultural patterning can be expected in the long run, depending on the propensity of some adaptations to produce more descendants than competing cultural arrangements (R. Kelly 1995; Smith and Winterhalder 1992).

For archaeologists, the energetic basis of selection frequently is evaluated through diet-breadth or prey-choice models, as reconstructed from dietary remains. Along these lines, several researchers have recently argued that, on a trans-Holocene time scale, coastal foraging patterns in California often reflect a loss of foraging efficiency (Broughton 1994a, 1994b, 1997; Broughton and O'Connell 1999; Raab 1992; Glassow 1996c). Contrary to the glowing assessments offered by traditional models of Late Holocene coastal adaptation, the long-term trajectory of many California foraging adaptations was marked by overexploitation of high-ranked food items, leading to resource depression and shifts to more costly resources. Dynamics of this kind have been identified for many food resources used by prehistoric coastal populations in California, including acorns (Basgall 1987; Wohlgemuth 1996), shellfish (Botkin 1980; Bradford 1994; Jones and Richman 1995; Raab 1992; Raab and Yatsko 1992), fish (Broughton 1994b, 1997; Raab et al. 1995; Salls 1988), sea mammals (Hildebrandt and Jones 1992; Jones and Hildebrandt 1995; Porcasi, Jones, and Raab 2000), and land mammals (Broughton 1994a, 1994b, 1997).

Foraging efficiency models have relevance beyond dietary matters. The changing energetic efficiency of ancient foraging adaptations has been correlated with profound changes in the social organizational and health status of human populations in many parts of the world (Cohen 1989a, 1989b). Similar patterns have been identified by recent research as aspects of Late Holocene culture change in coastal Southern California (see Broughton and O'Connell 1999). Included are an increasingly gender-based division of labor (T. Jones 1996; McGuire and Hildebrandt 1994; Walker and Erlandson 1986) and elevated rates of disease and violence (Lambert and Walker 1991; Lambert 1993; Raab and Larson 1997).

In previous studies on San Clemente Island, three major marine resource classes point to a progressive trans-Holocene loss of foraging efficiency: sea mammals, shellfish, and fish. Some of the best, though by no means the only, evidence of this trend comes from the Eel Point site. Sea mammal hunting on the Southern California Coast involved a wide range of species, including sea otters (*Enhydra lutris*), small cetaceans (mainly dolphins and porpoises), seals, and sea lions (Pinnipedia). Although representatives of all of these taxa are included in the Eel Point faunal assemblage (Porcasi 1995; Porcasi, Jones, and Raab 2000), our attention in this discussion is focused primarily on seals and sea lions. These species generally are identified as contributing the bulk of meat from sea mammal hunting in Southern California (Colten and Arnold 1998; Glassow 1980; Hildebrandt and Jones 1992) and at the Eel Point site (Porcasi 1995; Porcasi et al. 2000). This finding does not imply that patterns of seal and sea lion hunting are completely understood. As compared to fishing, a comparatively small number of reports treat the relative contributions of pinnipeds to the subsistence base across time, and the factors that may have contributed to such trends (e.g., Colten and Arnold 1998; Erlandson 1994; Glassow 1996c; Porcasi, Jones, and Raab 2000). Hildebrandt and Jones (1992) offer perhaps the most detailed model to date of the ecological dynamics that affected Southern California pinniped hunting.

The Hildebrandt and Jones' (1992) model weighs into a debate about the timing and causes of the distribution of pinniped populations on the Pacific Coast of North America. During the historical era, pinniped populations were largely restricted to remote offshore rocks and islands. All agree that the seasonal vulnerability of seals and sea lions to terrestrial predators played a role in this pattern. Both the Guadalupe fur seal (*Arctocephalus townsendi*) and the California sea lion (*Zalophus californianus*) populations give birth to their pups at rookeries on the Channel Islands during the summer (Riedman 1990). Pinnipeds are highly vulnerable to terrestrial predators during these periods. In their breeding colonies, these animals could have been killed by prehistoric hunters armed with nothing more than clubs. If frequently attacked, however, pinnipeds will abandon their rookeries for more remote locations. The killing of large numbers of females and juveniles also poses a risk of resource depression.

Simply stated, Hildebrandt and Jones argue that:

> the depletion of seal and sea lion populations and their restriction to offshore rookeries and haulouts is an anthropogenic phenomenon not restricted to the historical era. Rather, the process of extirpation . . . is one that began with the initial prehistoric settlement of coastal environments. We derived these conclusions from seal and sea lion population ecology, optimization theory, and dated faunal assemblages from the California and Oregon coasts. In combination, these data suggest a process of human overexploitation which has affected the character of hunter-gatherer intensification within this region (Hildebrandt and Jones 1992:361).

Hildebrandt and Jones (1992:363-367) go on to argue that, in addition to making pinniped meat increasingly scarce, this process encouraged elaboration of sea mammal hunting gear, including harpoons and boats, as the need to hunt pinnipeds under more demanding offshore conditions increased.

Figure 2.3 plots trends in sea mammal hunting and fishing at Eel Point across much of the Holocene. The weight of all fish and the frequency of sea mammal bones per m^3 per cultural stratum were used as general measures of hunting

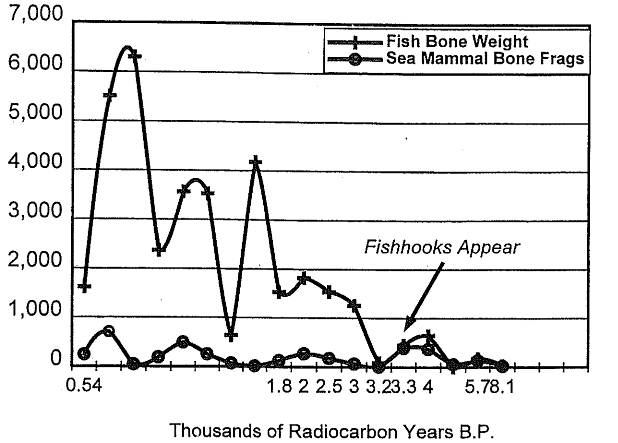


Figure 2.3 Plot of fish bone weight (g/m³) and sea mammal bone (NISP/m³) at Eel Point, San Clemente Island

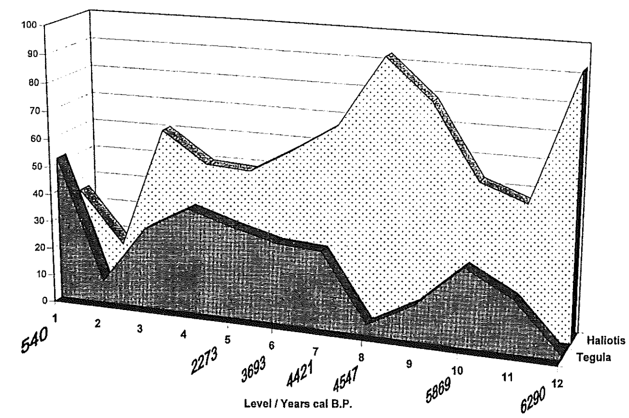


Figure 2.4 Percentage of *Haliotis* and *Tegula* yield by level, unit B, Eel Point

and fishing intensity across time. We should stress that our objective is not reconstruction of dietary yield but merely to gauge the relative intensity of bone deposition across time. The patterns have been corrected for cultural strata with overlapping ^{14}C dates (Raab, Bradford, and Yatsko 1994; Raab et al. 1995), with average densities calculated for contemporaneous cultural strata.

Porcasi, Jones, and Raab (2000) and Garlinghouse (2000) identify a number of interesting trans-Holocene trends in the Eel Point archaeofaunal assemblage. Patterns of sea mammal hunting at Eel Point lend support to models of optimal foraging. The highest levels of sea mammal hunting are found in the Early and Middle Holocene, with the relative magnitude of pinniped hunting declining in the Late Holocene. The vast majority (85.5%) of pinnipeds at Eel Point are California sea lions and Guadalupe fur seals, both migratory breeders whose rookeries would have been high-priority targets of human hunters. Over 90% of identifiable pinniped bone elements are derived from females and juveniles (Porcasi 1995; Porcasi, Jones, and Raab 2000). These data clearly indicate a pattern of predation centered on breeding colonies. These data support the models advanced by Hildebrandt and Jones (1992) and Broughton (1994a), showing that pinniped hunting declined after the Middle Holocene, while sea otter hunting sharply increased.

The diachronic pattern of fishing at Eel Point contrasts sharply with sea mammal hunting. Although our treatment of fish bone here is intended merely to examine overall changes in bone density within the midden deposits, intensification of fishing at Eel Point is one of the most dramatic trends observable in the site's faunal assemblage. The upper line in figure 2.3 plots the weight of fish bone (gm/m³) in cultural strata ranging in age from approximately 6000 BC to AD 1400. While this plot reflects the "noise" that one might expect from sampling midden deposits, the trend toward intensification of fishing during the Late Holocene is unmistakable. This pattern parallels the finding of other regional researchers that fishing became increasingly important during the Late Holocene (Andrews 2000; Glassow 1980; Orr 1968; Reinman 1964; Salls 1988; Tartaglia 1976; Vance 2000).

A study by Garlinghouse (2000) of shellfish collecting at Eel Point reinforces the findings of other researchers regarding the vulnerability of shellfish stocks to harvesting pressure by humans. Analysis of shellfish remains from one of the deepest excavation units at Eel Point, Unit B, is instructive. Garlinghouse (2000) found that California mussels (*Mytilus californianus*) produced the bulk of shellfish meat during the Early Holocene at Eel Point but declined sharply in importance after the Early Holocene. It is not clear whether this decline reflects the resource-depression dynamics described by Jones and Richman (1995) for other California coastal locations, changing marine environmental conditions, or a combination of factors. Perhaps more instructive are trans-Holocene patterns involving the largest and smallest species of shellfish collected at Eel Point. The largest shellfish by far were abalones (*Haliotis* sp.), while the smallest were black turban snails (*Tegula* sp.) at about 1/100 to 1/1000 the meat yield of abalones per individual. There is a general decline in abalone meat yield across time, while *Tegula* assumed generally a greater dietary role after about the mid-Holocene (figure 2.4).

Other evidence of resource depression comes from San Clemente and Santa Catalina Islands, where abalone yields declined under the impact of harvesting pressure, and smaller shellfish, such as the black turban and the wavy turban (*Astraea undosa*) made up shortfalls in subsistence needs (Raab 1992; Bradford 1994). Similarly, studies of black abalones (*H. cracherodii*), the most frequently exploited abalone species on San Clemente and Santa Catalina Islands, show that the mean size of these organisms declined under human predation (Raab 1992; Raab and Yatsko 1992).

The declining pattern of shellfish productivity reported by Garlinghouse and others echoes the findings of many other researchers in coastal California. Botkin (1980) was one of the first to argue that, based on a study in the Malibu area, overexploitation of shellfish followed a trajectory predicted by optimization principles. Glassow (1996c) reported that yields of the California mussel were under enough harvest pressure by the Late Holocene to force shellfish collectors in the Vandenberg area to increase the proportion of small turban snails in their diet. There can be little doubt that shellfish populations were sensitive to harvest pressure in many coastal locations.

The Eel Point shellfish data reinforce the findings of an earlier study by Raab (1992) of small "*Tegula* midden" sites on San Clemente Island. As pointed out by Raab and Yatsko (1992), the island's wide-ranging marine terraces contain a density of small shell-bearing sites that frequently range between 200 to 300 per km^2. The cultural deposits of these sites often are no more than 10 to 15 m in diameter and 30 cm deep. A detailed study of three of these sites found that crushed *Tegula* shells constituted upwards of 70% of midden contents by weight. Raab (1992) and Raab and Yatsko (1992) showed that these *Tegula* middens were created by short-term occupations dedicated essentially to the collection and consumption of black abalones and *Tegula*. Moreover, each site reflected collecting cycles in which consumption of *Tegula* increased to offset declining consumption of the larger and more productive black abalones. While sites of this kind may have been occupied throughout the span of human occupation of San Clemente Island, there can be little doubt that most of these sites date to the Late Holocene. Of the 51 components dated by the Legacy Survey, 49 fall into this category, and all date to the Late Holocene.

DEMOGRAPHIC EFFECTS OF INTENSIFICATION

Patterns of Maritime Intensification

Based on the foregoing review, trans-Holocene foraging patterns at Eel Point were marked by two robust dietary trends: (1) the contribution of pinnipeds and shellfish declined over time, particularly during the Late Holocene, while (2) the importance of fish and sea otters increased markedly during the Late Holocene (Porcasi 1995; Porcasi, Jones, and Raab 2000; Raab et al. 1995). Once again, this pattern generally conforms to the predictions of optimization models that focus on prey choice in California coastal environments during the Late Holocene (Broughton 1994a, 1994b, 1997; Broughton and O'Connell 1999; Jones and Hildebrandt 1995; Hildebrandt and T. Jones 1992; Raab and Yatsko 1992). It appears that biological constraints played a major role in these trends. Pinnipeds and shellfish were vulnerable to overexploitation, the former because of the vulnerability of breeding colonies to attack by human hunters, and the latter because of slow shellfish growth rates and limited intertidal habitats. Fishing, in contrast to pinniped hunting and shellfish collecting, was the only major subsistence activity that could be made increasingly productive by investing more labor in exploiting a wider range of marine habitats using a broader range of fishing techniques (Andrews 2000; Raab et al. 1995; Salls 1988; Vance 2000).

The impact of these dynamics for Late Holocene San Clemente Island was dramatic. As we report elsewhere (Raab, Bradford, and Yatsko 1994), the oldest known circular shell fishhooks at Eel Point are dated to 1280 BC, but a perforated abalone disk dated to 1550 BC is almost certainly a hook blank (Vance 2000). This conclusion rests on the observations that this specimen is similar in size and shape to hooks and hook blanks identified from more recent strata, and the fact that there is no known tradition on prehistoric San Clemente Island of shell disk or ring ornaments comparable to the northern Channel Islands (C. King 1990). While circular shell hooks may have appeared at Eel Point about 3500 years ago, they were certainly present in substantial numbers by about 3000 years ago (Vance 2000). This date is between one and two millennia earlier than many previous estimates of the first appearance of circular single-piece shell hooks in the Channel Islands region (Glassow 1980; C. King 1990; Koerper et al. 1995; Strudwick 1986; Vance 2000).

The quantity of fish bone increased steadily in Eel Point middens after the appearance of shell hooks (figure 2.3). It seems doubtful that hooks alone account for this trend, because they undoubtedly were employed with watercraft, nets, traps, gorges, spears, and other gear. Just the same, it appears that the use of shell hooks increased exploitation of certain marine habitats and fish species. Although a wide range of species was cataloged by Salls (1988:723-725) at Eel Point, California sheephead (*Semicossyphus pulcher*), rockfish (*Sebastes* sp.), and bass (*Paralabrax* sp.) account for over 90% of the fish assemblage in all time periods. Another study of trans-Holocene fishing trends at Eel Point by Andrews (2000) found that small to medium-size fish made up most of the catch (ca. 0.25 to 2 kg), typically from kelp beds or nearshore rocky reefs. The advent of circular shell hooks seems to have been particularly important in increasing this production (Salls 1989:183-188; Strudwick 1986:133-135). This utility may help explain why circular shell hooks were adopted when bone fish gorges ("bipoints") and other fishing gear had proved successful for millennia.

About 1000 years ago, otter hunting at Eel Point increased rapidly to the highest levels recorded for the Holocene (Porcasi 1995; Porcasi, Jones, and Raab 2000). This pattern is similar to one described by Broughton (1994a) for Late Holocene sites around San Francisco Bay. The increase in otter hunting could be explained in a number of ways, but it seems likely that increased fishing, particularly in the kelp beds, brought human fishers into more frequent contact with otters. At the same time, otters were also exploited for their pelts, and Late Holocene trade networks may have placed a premium on otter hunting. Judging from the Eel Point evidence, sea mammals and shellfish were the highest ranked marine food resources, but they declined in productivity through the Holocene. During the Late Holocene, a major realignment of the foraging effort took place around activities related to fishing.

Tegula Middens and Eel Point

The contrast between Eel Point and the *Tegula* middens is stark. Eel Point contains a variety of cultural features (hearths, occupation surfaces, house floors, and burials), midden deposits rich in many kinds of faunal, and a wide range of bone, shell, and stone artifacts. The Late Holocene cultural deposits at Eel Point amount to tens of thousands of cubic meters (Raab, Bradford, and Yatsko 1994; Raab et al. 1995). Based on the density and diversity of cultural materials, Eel Point is reasonably viewed as a large and comparatively permanent residential base (Andrews 2000; Fiore 1998; Porcasi, Jones, and Raab 2000; Salls 1988; Vance 2000). Rarely more than 600 m² in extent, shallow *Tegula* middens typically contain few discrete cultural features and a limited range of artifacts and faunal remains (Byrd 2000b; Byrd and Victorino 1999; Raab 1992).

Data presented in reports and previously published discussions allow us to gauge the relative intensity of fishing and shellfish collecting in the *Tegula* middens and at Eel Point. As noted, it is possible to estimate changes in maritime economic behavior at Eel Point across about 8000 calendar years. To date, only three *Tegula* middens on San Clemente Island (SCLI-1318, -1319, and -1325), located about 4 km north of Eel Point, have been studied in comparable detail (Raab 1992). These *Tegula*-bearing sites contain Late Holocene and Protohistoric cultural components. Site SCLI-1318 produced calibrated dates of AD 865 and 1655; site SCLI-1319 yielded dates of 350 BC and AD 1660. From one to four 1 m² excavation units were placed in these sites (Raab 1992). Although ^{14}C dates were not obtained for site SCLI-1325, the character of its shell-bearing deposits and the presence of circular shell fishhooks leave little doubt that it dates to the Late Holocene. At Eel Point, a sample of faunal data from three cultural strata of a 1 x 2 m excavation unit (2N/35E; Garlinghouse 1995, 2000; Raab et al. 1995) can be compared with strata in the *Tegula* middens. The temporal overlap of the cultural strata that may be compared between the *Tegula* middens and Eel Point is not precise, but all strata postdate the appearance of

Table 2.1 *Tegula* shell and fish bone (gm/m³) in *Tegula* middens and contemporaneous Eel Point cultural strata

Unit/Strata	*Tegula*/CYBP	*Tegula*	Fish Bone	Ratio
SCLI-1318*				
0–10 cm	295 ± 50	3,524.2	10.0	352:1
10–20 cm	1,085 ± 50	6,642.0	14.7	452:1
20–30 cm		3,947.6	7.8	506:1
SCLI-1319				
0–10 cm		7,148.6	15.7	455:1
10–20 cm	290 ± 50	43,332.7	48.2	899:1
20–30 cm	2,296 ± 50	67,092.8	239.6	280:1
30–40 cm		32,206.6	173.4	186:1
SCLI-1325				
0–10 cm		18,641.7	229.3	81:1
10–20 cm		65,330.0	620.0	105:1
20–30 cm		66,750.0	379.6	176:1
30–40 cm		50,850.0	170.7	298:1
40–50 cm		28,850.0	78.3	368:1
50–60 cm		2895.8	8.5	341:1
SCLI-43 (Eel Point)**				
Unit 2N/35E:				
Stratum 5/6***	1,967 ± 90	1,460.0	1,415.9	1:1
Stratum 7	2,566 ± 60	2,850.0	707.7	4:1
Stratum 8	3,230 ± 90	1,786.0	1,258.0	1.4:1

* Data from Raab 1992
** Data from Raab et al. 1995b
*** Combined strata owing to overlapping radiocarbon dates, Raab et al. 1995b.

circular shell fish hooks, and all strata fall within the Late Holocene, during which fishing was rapidly intensifying on San Clemente Island.

Table 2.1 shows that fish bone density in the three *Tegula* middens varies from 0.009 to 0.6 kg/m³, with an average of 0.15 kg/m³ for all strata. The density of *Tegula* shell in the same strata ranges from a low of 2.9 to 67 kg/m³, with an average of 22.4 kg/m³. As these data suggest, some strata consist almost entirely of crushed *Tegula* shell. In the three comparable strata from Eel Point, we find a nearly opposite pattern with regard to the exploitation of *Tegula* and fish. Table 2.1 shows that *Tegula* range from 1.5 to 2.8 kg/m³, with an average of 1.6 kg/m³ for all three strata. In the same strata at Eel Point, fish account for 0.7 to 1.4 kg/m³, with an average of 1.1 kg/m³.

Is it possible that the differences between Eel Point and the *Tegula* middens merely reflect depositional scale? In other words, could it be that more of everything was deposited at Eel Point simply because that site sustained a larger population than any of the *Tegula* middens, leaving open the possibility that the relative importance of fishing and shellfish collecting was proportionally comparable at all sites? The ratios of *Tegula* to fish bone in Table 2.1 argue against this possibility. In the *Tegula* middens, these ratios range from a low of 81:1 to a high of 899:1. At Eel Point, the ratio of *Tegula* to fish bone ranges from 1:1 to 1.4:1 (Garlinghouse 1995, 2000; Raab et al. 1995). Fish appear to have made a considerably larger contribution to the meals consumed at Eel Point compared to remains found in the *Tegula* middens. Although we have not presented the data here, much the same pattern exists for sea mammal consumption (Porcasi 1995; Porcasi, Jones, and Raab 2000; Raab 1992).

Another trend with regard to *Tegula* consumption is worth noting. Summarizing trans-Holocene patterns of shellfish collecting at Eel Point, Garlinghouse (1995:8) concluded that:

> The overall density of shellfish, based on total adjusted shell weight per cubic meter from each level, demonstrates a gradual decrease from the earliest-dated levels. The overall trend in diversity of the shellfish assemblage, as measured by weight, yield and MNI, follows a downward slope indicating a gradual narrowing of the diet breadth. As indicated by the shellfish assemblage, at least, islanders apparently did not expand the diet breadth by exploiting an increasing variety of different molluscan resources; rather, the islanders intensified production of *Tegula*, a previously underemphasized resource, while deemphasizing the exploitation of other species.

The pattern described by Garlinghouse at Eel Point presents an interesting contrast with the *Tegula* middens. During the Late Holocene, even though shellfish collecting at Eel Point increasingly focused on *Tegula*, the amount of *Tegula* consumed accounted for a decreasing proportion of total midden constituents. Once again, these data create a strong contrast in dietary patterns between the *Tegula* middens and Eel Point.

Though limited, the data examined above hint at intersite differences in subsistence behavior too pronounced and too consistent with larger technoeconomic trends to be dismissed as sampling error. It seems reasonable to hypothesize that the foraging patterns reflected in the small *Tegula*-rich middens primarily involved shellfish collecting and consumption, while Eel Point was the scene of a much greater emphasis on fishing and sea mammal hunting. Assuming that these two subsistence modes were contemporaneous, the *Tegula* middens and Eel Point appear to be components of a bifurcated Late Holocene settlement-subsistence system that included large, relatively permanent sites such as Eel Point where fish and sea mammals were major staples, and many small, temporarily occupied satellite loci where shellfish provided the bulk of the provisions consumed on site.

Resource Intensification and Division of Labor

Several lines of evidence suggest that changes in the division of labor during the Late Holocene might be an important component of the patterns observed in the current study. Researchers increasingly believe that gender-based divisions of labor probably changed over the Holocene, with the patterns observed among historical California Indian groups having arisen during the Late Holocene. Bettinger (1991), Walker and Erlandson (1986), T. Jones (1996), and McGuire and Hildebrandt (1994) argued that labor demands imposed by new foraging practices should be viewed as a logical cause of the widely documented division of labor that existed in aboriginal California. In general, males fished and hunted larger game animals; females hunted smaller game and collected a wide range of plant foods. Increasing expenditures of labor to gather and process small, dispersed food items; rising labor demands in the face of resource overexploitation; and increased efforts to produce and maintain a widening array of specialized tools and weapons all argue for an increasingly complex division of labor. In coastal California 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 (T. Jones 1996:245).

As in other parts of California, fishing was an increasingly important aspect of subsistence on San Clemente Island during the Late Holocene. Undoubtedly, males and females and persons of various ages were engaged in fishing, but it seems likely that intensive fishing, particularly employing watercraft, increasingly involved males. It is worth noting that an elaborate fishing kit, including complete and partially formed circular shell fish hooks, hook production tools, and shell hook preforms, was part of a male burial on San Clemente dated to about AD 800 (Salls 1988:100–101). Although this single case does not warrant the conclusion that men alone engaged in fishing, it is consistent with the possession of fishing gear by at least some males during the Late Holocene.

The increasing importance of fishing and some aspects of sea mammal hunting (sea otters, for instance) may help account for the comparatively intense deposition of fish and sea mammal remains at Eel Point, particularly if these activities involved frequent use of watercraft. The range of species found in the Eel Point fish assemblage suggests that a good deal of fishing was conducted in kelp beds, likely with the aid of boats (Raab et al. 1995; Salls 1988). Palsson (1991), in a global ethnographic survey, showed that intensive fishing strongly correlates with coastal sedentism because a centralized base of operations makes for efficient deployment of watercraft. Manufacture, maintenance, and storage of an increasingly diverse array of fishing and hunting gear are also managed effectively at a major base of operations. Processing of fish catches is also a logical activity at this kind of site. Salls (1988:375) found large numbers of fish skull and tail bones and correspondingly small numbers of mid-body vertebrae in certain parts of the Eel Point site. Also noting copious quantities of ash and a general absence of bone charring, Salls (1988:375) argued that parts of the site were used to smoke or dry fish.

Eel Point's presence as a base for fishing and hunting does not explain the existence of the *Tegula* middens. Some of the intensification trends reflected at Eel Point may offer insights into this problem, however. A logical implication of declining foraging efficiency is a need for more frequent and wide-ranging foraging trips. Men and women are capable of equally high levels of stamina in pursuit of such a subsistence strategy, but young children are not (R. Kelly 1995:261–270). In many societies, foraging patterns allow children and their caregivers, often including the children's mothers and adults of both sexes, to search for food (R. Kelly 1995).

As foraging trips take these collectors more than a few kilometers from a residential base, the group needs sites to rest and prepare meals. Such sites have many of the qualities that Meehan (1982) documents for the "dinner time camps" of northern Australia: they offer an expedient facility for adults and their dependent children to prepare meals while foraging for shellfish. Intensive foraging for both terrestrial and marine resources seems a logical source of the thousands of *Tegula* middens that dot San Clemente Island's landscape (Raab 1992). The collecting of abalones and *Tegula* primarily, and only a comparatively small amount of fishing, appears to have provided the provisions required in these camps. It also seems logical to suppose that the *Tegula* found at Eel Point may have been produced during such trips.

Intensification and Population Growth

California archaeologists routinely describe the Late Holocene landscape as relatively densely populated, particularly in coastal regions. This tradition has deep historical roots. Kroeber (1925:884–885) estimated that California, accounting for about 5% of the area of the contiguous United States, contained somewhere between 16 to 19% of its prehistoric population. Based on the traditional models examined earlier, demographic expansion during the Late Holocene was the cause of this remarkable population density. But how do archaeologists know that this was true of the Late Holocene? Fundamentally, the large number of Late Holocene archaeological sites or cultural components within many regions of the state are said to warrant this conclusion. Figure 2.2, with its steep rise in Late Holocene sites and cultural components, shows a microcosm of this pattern. Yet, if we look to San Clemente Island for an understanding of the underlying causes of this pattern, there may be reasons to question traditional thinking.

We are not arguing against the conclusion that population increased in California during the Late Holocene. A variety of data appear to point to Late Holocene population growth. From our point of view, studies of resource intensification in California offer some of the best evidence of demographic expansion. These studies do not deny that foraging efficiency was probably influenced by a number of nondemographic factors, such as environmental change and technological innovation. Still, "whenever technological improvements increased the resource base, the population could be expected to increase until the balance between costs of morbidity/mortality and population-control maintenance was restored" (Hayden 1981:523). The progressive resource depression seen in many areas of Late Holocene California appear to make little sense apart from stresses caused by imbalances between population size and vital resources.

If we hypothesize that such imbalances were widespread in Late Holocene California, including the Southern California Coast, some interesting questions arise. One of these is whether traditional models seriously misconstrue the archaeological evidence of population growth. As we saw earlier, traditional models argue that high levels of natural resource abundance, made even more productive by Late Holocene "improvements" in the division of labor and technology, fueled a rapid population increase. Against this interpretation, a growing body of data concerning resource intensification, including the San Clemente Island data we presented, implicates increasing resource scarcity as a more likely cause of a diversified division of labor and, ironically, new plateaus of population growth as social and technological innovations tapped new sources of subsistence. These two scenarios clearly have quite different cultural-evolutionary implications.

Consider, for example, the substantial body of bioarchaeological data that has emerged from the Santa Barbara Channel area during the last decade. A large body of data from this area points to depressed health conditions in the wake of Late Holocene population expansion and culture change (Lambert 1993; Lambert and Walker 1991; Raab and Larson 1997). These data are at odds with traditional interpretations that paint a picture of the Late Holocene as a culture climax of unqualified adaptive success (Raab 1996).

An even more basic problem, perhaps, is understanding the true nature of Late Holocene population growth. The San Clemente Island data drive home a basic problem that is likely to be involved in estimating the true size of Late Holocene population growth. The fundamental difficulty is this: how do we differentiate those attributes of a settlement-subsistence system that point to population size and not merely to the population's division of labor or seasonal logistics? Erlandson (1997b) addressed this problem in the context of the Middle Holocene Santa Barbara Coast, illustrating how a detailed understanding of the functional variability of sites within a regional settlement system is essential to realistic reconstruction of demographic trends (see also Erlandson et al. 1992). Based on a similar perspective, we hypothesized that the *Tegula* middens and large, structurally complex sites such as Eel Point were complementary aspects of a Late Holocene settlement pattern forged by intensification dynamics that included depressed shellfish stocks and a greatly expanded emphasis on fishing.

If our model is correct, a large number of *Tegula* middens could have been created in a comparatively short span of time by the same population that occupied Eel Point. The result could be a highly inflated estimate of population growth during the Late Holocene, if one treated each Late Holocene cultural component as an independent indicator of population size. Archaeological research clearly benefits from achieving the highest possible degree of temporal resolution, but this problem cannot be solved merely by radiocarbon dating more sites. Given what appears to be the emergence of an expanding division of labor during the Late Holocene in many regions of California, the problem outlined here may be more widespread than many archaeologists recognize.

DISCUSSION AND CONCLUSIONS

New areas of consensus may be emerging about some of the larger cultural and environmental dynamics that shaped the Late Holocene Southern California Coast. Among these is increasing recognition of the importance of resource intensification trends, despite the continuing debate about this topic. Colten and Arnold (1998:682), for instance, rejected optimal foraging models and intensification dynamics as influences on culture change: "The data we introduce here suggest that this kind of model does not accurately describe marine mammal exploitation, technological change, or sociopolitical complexity in the southern coastal region of California." Colten and Arnold (1998:685–686) also concluded, based on one of the most extensive discussions of northern Channel Islands faunal assemblages in print, that: "These data show that Early assemblages are dominated by shellfish and marine mammals, Middle period assemblages are roughly equally divided between fish, shellfish and marine mammals, and Late period assemblages are predominantly fish." And, "While a decrease in marine mammals over time is consistent with diet breadth optimal foraging models, and models suggesting over-exploitation, it is unlikely that change in this relatively small part of the faunal assemblage would stimulate major technological or social change" (Colten and Arnold 1998:695).

We agree with Colten and Arnold that culture change cannot be explained on the basis of a single activity or resource, such as sea mammal hunting. Even so, debate about the relative importance of sea mammal hunting should not draw attention away from larger patterns of maritime intensification and the correlation of these patterns with broader cultural and bio-archaeological trends. On that account, one point seems clear: the general pattern of trans-Holocene intensification described by Colten and Arnold (1998) for the northern Channel Islands virtually mirrors that of Eel Point and a number of other California coastal localities cited earlier.

Colten and Arnold's assertions to the contrary, it makes little sense to dismiss resource intensification as a significant factor in Late Holocene culture change. To do so we must ignore apparent correlations among resource intensification, technological innovation, settlement pattern shifts, and changing rates of disease and interpersonal violence (Broughton and O'Connell 1999; T. Jones et al. 1999; Kennett and Kennett 2000; Raab 1996). To the extent that correlations of this kind enter into theorizing about Late Holocene culture change, we may be witnessing an important shift in archaeological thinking. Traditional models of California prehistory, as we saw earlier, often viewed the Late Holocene as a cultural climax, that is, scenarios that envisioned only highly successful modes of cultural adaptation. It seems increasingly evident that models of this kind offer no particularly realistic basis for explaining culture change.

Although we have not focused on Late Holocene paleoenvironmental research in this discussion, this topic deserves at least brief mention. A growing number of researchers believe declining foraging efficiency was not the sole source of stress widely felt by Late Holocene coastal populations. Recent discussions have noted evidence of episodes of extreme and persistent Late Holocene coastal droughts, notably during the so-called Medieval Warm Period, or between about AD 800 to 1300 (Arnold 1992a; T. Jones et al. 1999; Kennett and Kennett 2000; Raab and Larson 1997). Impacting populations already under stress from comparatively low levels of foraging efficiency, severe Medieval era droughts may have put some coastal populations at high risk for malnutrition, disease, and violence (T. Jones et al. 1999). For the northern Channel Islands, Kennett and Kennett (2000:390–391) offer the following assessment of these forces:

> Based on the available data, our current working hypothesis is that climatic instability and resource stress associated with persistent drought stimulated greater conflict and competition for access to perennial water sources on the islands beginning about AD 500. This situation promoted greater sedentism near perennial water sources and enhanced territorial behavior. Violent interaction and competition was exacerbated by the introduction of the bow and arrow sometime between AD 500 and 800. The favorable environmental conditions between AD 650 to 800

> undoubtedly promoted population increases at certain locations and the establishment of sedentary villages in more marginal locations in terms of water availability. More intensive fishing, production of non-food trade items and increased trade emerged after about AD 900 in the context of environmental and social instability as new behavioral strategies for dealing with subsistence problems associated with decreased mobility. Decreased settlement mobility and territorial behavior certainly would have exacerbated resource stress for some groups of people. In this context, more cooperative economic strategies (trade) became dominant after AD 1300 as violent interaction subsided regionally in the context of small and stable territories.

On San Clemente Island, Yatsko (2000) documented a major change in settlement patterning during the period from about AD 800 to 1300, using the Legacy Survey information and other data. Yatsko's study shows that upland portions of the island, geologically unsuited to holding water, contained few sites during this interval, while the number of sites increased near major water-holding canyons. Overall, it appears that San Clemente Island was sparsely populated or perhaps periodically depopulated during the Medieval Climatic Anomaly (Yatsko 2000). This trend may be discernable in figure 2.2, where the number of radiocarbon-dated cultural components plunges in the island-wide and Legacy samples between about AD 1100 to 1300, a break with what otherwise appears to be generally increasing Late Holocene settlement density on San Clemente Island. The statistical error associated with ^{14}C dates does not allow us to tell whether this trend reflects island abandonment, but lowered settlement density seems evident during the Medieval Climatic Anomaly. San Clemente Island lends support to the conclusion that periodic climatic stresses were pervasive during the Late Holocene in coastal Southern California.

If a consensus is emerging that Late Holocene populations experienced certain cultural and environmental stresses, it is important to avoid enshrining new stereotypes about culture change. It may be as mistaken to assume that all coastal groups responded alike to resource intensification and climatic pressures as it was for neo-evolutionists to conclude that all groups were relentlessly evolving toward greater adaptive success and cultural complexity.

On San Clemente Island there is little evidence for certain of the cultural reactions described above by Kennett and Kennett. Settlement patterning is a case in point. The Nursery site (SCLI-1215), with its house structures, extensive midden deposits and Late Holocene cemetery, attests to residential sedentism on San Clemente Island (Potter 1998; Raab, Bradford, and Yatsko 1994; Salls 1988). Semi-subterranean houses with whalebone roof structures appeared, however, around 5000 years ago at the Nursery site (Raab, Bradford, and Yatsko 1994; Salls et al. 1993). At Eel Point, superimposed house floors virtually span the Holocene (Fiore 1998). One has the impression that favored settlement locations were occupied over long periods of time on San Clemente Island, rather than a trend of establishing major new residential bases during the Late Holocene. If anything, the proliferation of the small *Tegula* middens described earlier reflect more expansive settlement dynamics during the Late Holocene than during previous time periods.

The Late Holocene southern Channel Islands also reflect interesting patterns regarding to evidence of interpersonal violence. Admittedly, this phenomenon is difficult to assess, because bioarchaeological data are far more limited from the southern Channel Islands than from the Santa Barbara Channel area. Some of the best data come from the Nursery site (SCLI-1215) on San Clemente Island, where a Late Holocene cemetery has been partially excavated and analyzed. Salls (1988:388–390) reported a date of 1490 ± 30 years (UCLA-2592) for a bone sample from one of the Nursery site burials (the source of the fishing kit mentioned earlier). Assuming mixed atmospheric and marine carbon sources (50% of each for the sake of simplicity), this sample produced a mean calibrated date (one standard deviation) of AD 830. Potter (1998) described 22 burials from this cemetery population, all apparently contemporaneous, based on mortuary patterns and degree of preservation. Potter (1998:14) found that "longer life expectancy and better general health for Late Holocene populations contrasts with that of the northern Channel Islands. In the southern Channel Islands, it appears that health was poor for the Middle Holocene samples and remarkably good for the Late Holocene sample. Also contrasting with the northern Channel Islands data is the temporal decrease of violence, as indicated by the lack of injuries present from interpersonal violence, in the Late Holocene sample."

To date, investigations on the southern Channel Islands (Kerr and Hawley 2000; Potter 1998; Titus 1987) have failed to find skeletal evidence of interpersonal violence comparable to the Late Holocene populations of the Santa Barbara Channel area (Kennett and Kennett 2000; Lambert 1993). Wounds attributable to the bow and arrow, a new and more lethal form of combat that appeared during the Late Holocene, are conspicuously absent in the southern Channel Islands skeletal populations studied to date. On San Clemente Island experience shows that small triangular stone arrow points are rare, while they are relatively common in Late Holocene archaeological deposits of the Santa Barbara Channel region (Glassow 1996c). Much the same distinction can be made with regard to patterns of disease and malnutrition, where Late Holocene populations of the Santa Barbara Channel area appear to have been at greater risk of disease and malnutrition than were the inhabitants of the southern islands.

The Nursery site cemetery population reflects no evidence of status differentiation with regard to the effort expended on grave preparation and treatment of the body or associated grave goods. This pattern contrasts with at least some Chumash coastal cemeteries of comparable age, where marked differences between burials can be seen for each of these variables (Martz 1984).

The brief examples given here do not adequately probe the cultural trends that distinguished the northern and southern Channel Islands during the Late Holocene. Even so, some differences seem worthy of comment. Where the clearest archaeological evidence of complexity can be seen in coastal Southern California (e.g., status hierarchy in mortuary populations, settlement aggregation, and extensive trade in non-food items), these traits were part of a distinctive Late Holocene cultural pattern that appears to have emerged in the Santa Barbara Channel area. Probably not coincidentally, increased territoriality and violent competition were fundamental components of this pattern (T. Jones et al. 1999; Kennett and Kennett 2000; Lambert and Walker 1991). As LeBlanc (1999) and Keeley (1996) document, ancient warfare was a potent source of culture change, including many of the types of shifts seen in Late Holocene settlement patterning, technology, social organization, and human welfare of the Santa Barabara Channel area. Many of the dynamics linked to emergent social complexity, including violent conflict and intercommunity cooperation, can be seen as logical responses to a need for community defense, leadership in warfare, and diplomacy between warring communities. Beyond the archaeological evidence, J. Johnson (2000) provided ethnohistoric evidence for a substantial influence of warfare on Protohistoric Chumash social organization. Here we encounter a bit of irony: progress with a large price tag. Where neo-evolutionists equated increasing social complexity with cultural "improvements," it now appears that this trend imposed a substantial cost in human welfare, at least during the turbulent centuries between about AD 800 and 1300.

On the southern Channel Islands, where a strong pattern of warfare, territoriality, and health problems appears to be lacking, archaeological indicators of social complexity also appear to be more ambiguous. One example is regional trade in non-food items. Santa Catalina Island is a well-known source of steatite (soapstone) artifacts that were widely exchanged during the Late Holocene in coastal Southern California. Williams and Rosenthal (1993) examined modes of steatite artifact manufacture on Santa Catalina Island in light of arguments for specialized marine shell bead production on the northern Channel Islands. As compared to northern islands bead manufacture, Williams and Rosenthal (1993) concluded that there is little evidence involving specialized production or centralized control in the steatite trade. Overall, research on the southern Channel Islands to date appears to reflect a "weak complexity" pattern, at least in terms of the accepted archaeological correlates of social complexity in the northern Channel Islands.

Much of the mainland coast may reflect a pattern similar to the southern Channel Islands. If so, one of the crucial tasks for researchers interested in emergent social complexity is explaining why the distinctive constellation of enhanced territoriality, high rates of interpersonal violence, and depressed health conditions seen among the Chumash failed to become universal despite the fact that Late Holocene paleoclimatic and resource intensification stresses seem to have been pervasive. As Kennett and Kennett (2000) argued, this problem requires recognition that groups may employ a range of strategies for responding to stressful environmental and cultural conditions. These strategies may range from attempts to gain exclusive control over productive resources, sometimes employing violence, to cooperative modes of behavior involving sharing and reciprocity. Future research could profitably examine the cultural and environmental factors that promote differing responses across time and space. Instead of a monolithic march of chiefdoms toward social complexity, Late Holocene coastal Southern California probably contained a variable mix of both adaptive modes.

In any case, the data we have presented suggest that a diverse mosaic of responses to cultural and natural environments probably emerged during the Late Holocene in coastal California, including a wide spectrum of gradations in cultural complexity. Resource intensification and climatic deterioration may have imposed widespread stresses on the Late Holocene coast, but these hardly seem to have produced the same adaptive outcomes in the cases we examined here. Documenting this kind of variability and seeking to explain it in a regional comparative framework might be a productive research direction in the new millennium.

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Southern California in Transition

Late Holocene Occupation of Southern San Diego County

DENNIS R. GALLEGOS

The Late Holocene in San Diego County was marked by environmental change and the introduction of new cultural traits. From the Middle to Late Holocene, a warming climate and the loss of estuarine resources caused by sedimentation of coastal lagoons effected changes in settlement and resource exploitation patterns. Settlements generally shifted away from coastal lagoons to canyon settings with more dependable plant, animal, and water sources. In this paper, I focus on the southern portion of San Diego County—the area from Batiquitos Lagoon south to the border with Mexico (figure 3.1)—inhabited by the Kumeyaay at the time of historic contact. While earlier models (e.g., M. Rogers 1945; Shumway, Hubbs and Moriarty 1961; Warren and Pavesic 1963; Warren 1964) suggested whole or partial abandonment of San Diego County during parts of the Holocene, current evidence suggests this area was never abandoned. Continuous and overlapping radiocarbon dates suggest ongoing occupation for the past 9000 years. The most recent portion of this occupation span, the Late Holocene, is divided into two periods: the first from 3350 to 1300 years ago, and the second from 1300 years ago to Spanish contact, referred to here as the "Late period." The Late period is marked by introduction of the bow and arrow, pottery, obsidian from the Obsidian Butte source, and the practice of cremation. Settlement patterns show a marked increase in the frequency of milling stations in inland locations and an overall increase in the number of habitation sites. In conjunction with technological innovations that included improved hunting techniques and better processing and storage of foods, Late period trends reflect adaptation to changing environmental conditions, as well as economic intensification, with ongoing use of a more limited marine resource base and increased focus on terrestrial plant resources and inland habitats.

ENVIRONMENTAL SETTING

San Diego County, situated in the southwest corner of the United States, has a temperate climate that supports a wide range of coastal and inland plant and animal resources. From the onset of the Holocene, environmental change was probably gradual over the millennia, but abrupt major changes such as floods and droughts also occurred within relatively short periods of time. From about 10,000 to 3500 years ago, sea level rose approximately 20 m (Curray 1965), flooding coastal valleys and creating lagoons rich in shellfish and fish. About 3500 years ago, the sea reached its current level and coastal lagoons began to silt in, greatly reducing the availability of lagoonal resources (Gallegos 1985; Masters 1998; Miller 1966; Warren and Pavesic 1963). San Diego Bay was also created as a result of this rise in sea level, but siltation and habitat degradation of the bay did not occur owing to its unique setting, extensive freshwater runoff, and tidal flushing (Masters 1998).

Pine and oak pollen from Early Holocene coastal sites and lagoons suggests a cool, moist climate that became warmer and drier by the Late Holocene, as marked by coastal sage scrub vegetation on the hillsides and ribbons of riparian vegetation lining the river valleys (Axelrod 1967:103; Davis 1992; Gallegos and Kyle 1998; Gallegos et al. 1998; Heusser 1978; Kaldenberg 1982; Kyle, Schroth, and Gallegos 1990). By the Late Holocene, many former lagoons were transformed into saltwater marshes surrounded by coastal sage scrub. For each lagoon, this saltwater influx apparently moved the head of the freshwater flow up the canyon. Given drying conditions and loss of lagoonal resources, local populations abandoned mesas and ridge tops and relocated Late period villages to reliable freshwater sources.

As the lagoons silted in, estuarine mollusk populations declined and shellfish collection was directed instead toward

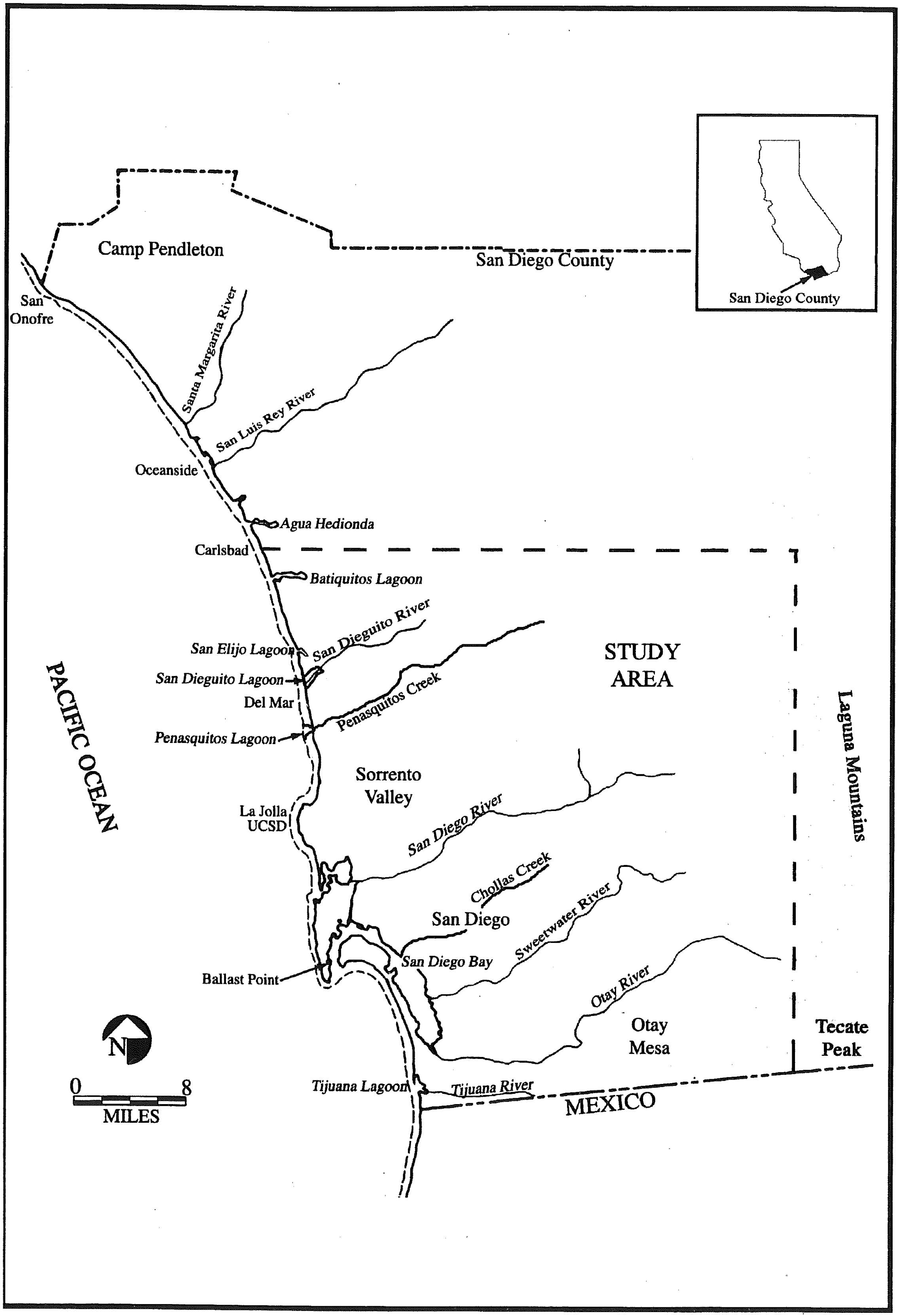


Figure 3.1 Map of San Diego County

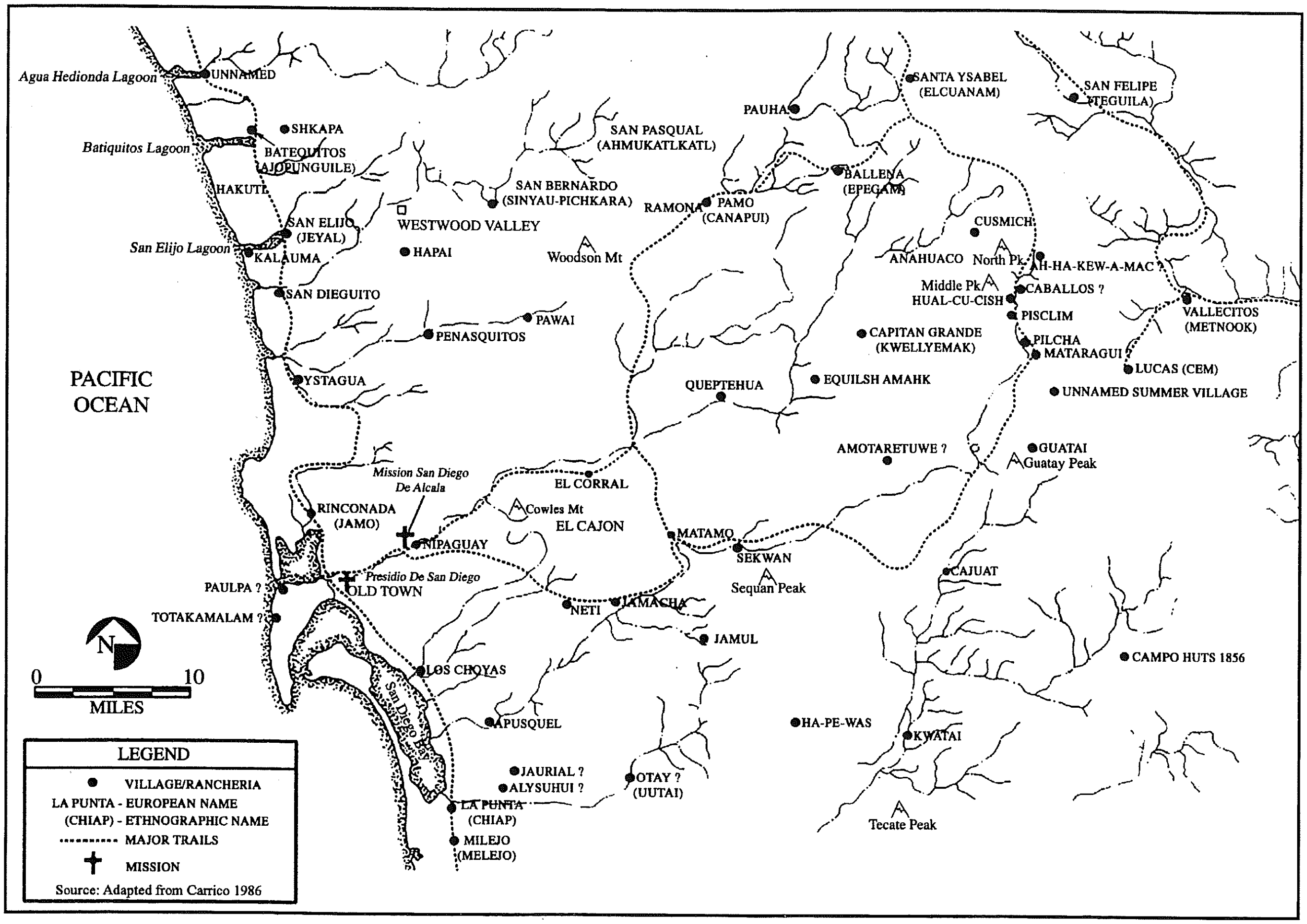


Figure 3.2 Ethnographic and historic villages of San Diego County

sandy beach and open coastal areas. Byrd and Reddy (chapter 4, this volume) document a shift after 4000 years ago along the northern San Diego Coast from estuarine shellfish to small *Donax* clams found in sandy beach habitats. This clam, the size of a fingernail, was probably used in soups. Ezell (1975) cited its use during the Great Depression of the 1930s, and refers to *Donax gouldii* as "Depression Clam." At the Ballast Point site (figure 3.1), *Donax gouldii* was a minor dietary contributor 5000 years ago (Gallegos and Kyle 1998), but it appears to have been a primary food source at the village of Ystagua about 3000 years ago (Carrico and Gallegos 1989; Ezell 1975; Gallegos, Kyle, and Carrico 1989).

For the village of Ystagua (SDI-4513 and SDI-4609) at Peñasquitos Lagoon (figures 3.1 and 3.2), the record of shellfish exploitation begins around 5000 years ago with *Chione* and *Argopecten* dominating the assemblages (Gallegos, Kyle, and Carrico 1989). About 3000 years ago, *Donax* was the most prevalent taxon, with *Mytilus* and *Chama* becoming dominant about 1000 years ago (Carrico and Gallegos 1989). These shifts from the collection of estuarine to sandy beach to rocky intertidal species over the past 5000 years provide additional evidence of Middle to Late Holocene environmental change.

At Ystagua (SDI-4609), prior to 1500 years ago, a major flood produced over a meter of sediment (Carrico and Gallegos 1989). This flood may have caused the reopening of small lagoon basins, such as Batiquitos Lagoon, as suggested by the increase in radiocarbon-dated sites containing primarily *Chione*, *Argopecten*, and *Ostrea* shell from about 1500 years ago to Spanish contact. This flood may also be what Aikens (1983) reported as a pollen and hydrologic peak 1250 to 1350 years ago. Additional evidence supporting a wet period for San Diego County during this general time is the radiocarbon date of 1580 years ago that identified a full stand of water at Lake Cahuilla in the Imperial Valley (Hubbs, Bien, and Seuss 1960:214). Hubbs reported "this is the oldest date so far ..." for Lake Cahuilla, roughly 100 miles long and 30 miles wide, just east of San Diego County.

ARCHAEOLOGICAL AND ETHNOGRAPHIC BACKGROUND

Initial occupation of San Diego County occurred over 9000 years ago (Moriarty 1967; Kyle, Schroth, and Gallegos 1998; Linick 1977; Warren 1968) at lagoon and river valley

As stated by R. White:

> Ecologically, the population filled its niche to the limits established by optimal conditions. The rancherias were regulated in location, area, and the population by distance, topographic features, and the flora and fauna natural to each relatively balanced territory. (1963:134)

Ethnographic accounts divide the Kumeyaay into four groups: coastal, hill, mountain, and desert (Drucker 1937a). Christenson (1990) identified the predominant choice for Late period site locations as valley areas, followed closely by hillsides and canyons. Valley settlements allowed access to a wide range of resources, from sea foods to inland valley and mountain items.

Late period archaeological sites are marked by small projectile points, pottery, cremation of the dead, and obsidian from the Obsidian Butte source in the Imperial Valley. Major food resources for the Kumeyaay included acorns, grasses, seeds of many kinds, rabbits, hares, deer, fish, shellfish, and other sea foods (Bancroft 1884; Carrico 1986; Englehardt 1921). Acorns and hares met minimal daily nutritional requirements (Christenson 1990), but a much broader diet is demonstrated in the ethnographic and archaeological record.

Acorns from black oaks, found above 1220 m., were preferred (Lee 1978; Luomala 1978). In the autumn, the western Kumeyaay met with the eastern Kumeyaay to harvest acorns, trade, exchange goods and food and conduct ceremonies (Christenson 1990; Lee 1978). Grass seeds were harvested in the spring (Bean and Lawton 1976; Luomala 1978). Rabbits could be hunted or trapped year-round throughout the county, but were generally larger and had better pelts in the fall.

Given the size of their territory and the diversity of its resources, the Kumeyaay could base their economy on maritime and terrestrial resources, depending on whether the village setting was coastal or inland.

Religious rites included ceremonies for birth and death, as well as coming of age, and:

> ...throughout the yearly life cycle to give respect to some aspect of nature, to purify one's body ....Upon death, the deceased was cremated....Funeral offerings would be dictated by gender and status...the deceased person's dwelling and most of his or her belongings were also burned (Carrico 1986:10).

SETTLEMENT PATTERNS

Although the archaeological record indicates continuous occupation for over 9000 years, fluctuations in the number of radiocarbon-dated sites suggest rising and falling popula-

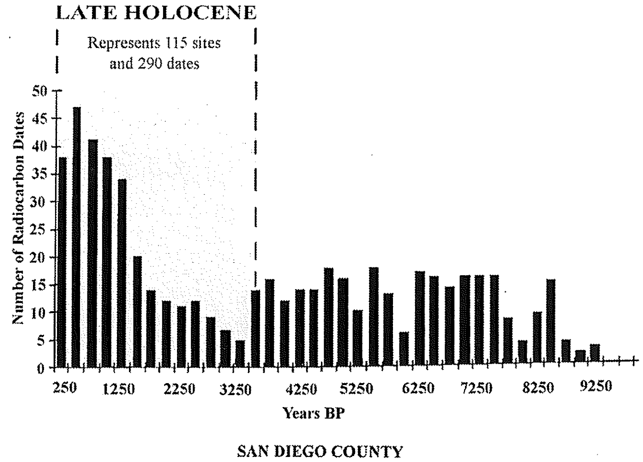


Figure 3.4 Temporal distribution of archaeological ^{14}C dates from San Diego County.
From Breschini, Haversat, and Erlandson (1996)

tion patterns (figure 3.4). While the decrease in radiocarbon-dated sites approximately 3250 years ago may be associated with the loss of lagoonal resources and the depopulation of coastal lagoons, the number of dated Late Holocene sites rises steadily after this date. True (1990) observed a change in San Diego area settlement patterns and milling tools from the Middle to Late Holocene: movement from ephemeral to perennial streams, and a shift from the use of only portable milling tools to both portable and bedrock milling tools. These changes suggest both movement to reliable water sources and increased exploitation of plant foods.

Late period settlement included two or more permanent base camps with associated special-purpose sites such as quarries or milling stations (True, Meighan, and Crew 1974; True and Waugh 1981, 1982). Most ceremonies took place at the winter base camp, occupied four to six months of the year. Acorn collecting and hunting occurred at the summer-fall camp, usually located near an oak grove (True, Meighan, and Crew 1974; True and Waugh 1981, 1982).

Few sites around Batiquitos Lagoon date to the period between 3350 and 1300 years ago. Of the radiocarbon-dated sites within 1.5 km of the lagoon, 15 date to the Early and Middle Holocene, three date between 3350 to 1300 years ago, and the remaining ten date to the Late period (figure 3.5). Early and Middle Holocene sites include both habitation and shellfish processing. From 3350 to 1350 years ago, habitation sites were located away from the lagoon, and Late period sites were devoted primarily to shellfish processing adjacent to the lagoon. Late period sites near the mouth of Batiquitos Lagoon and estuarine shellfish species support the premise that a smaller lagoon reopened after about 1500 years ago.

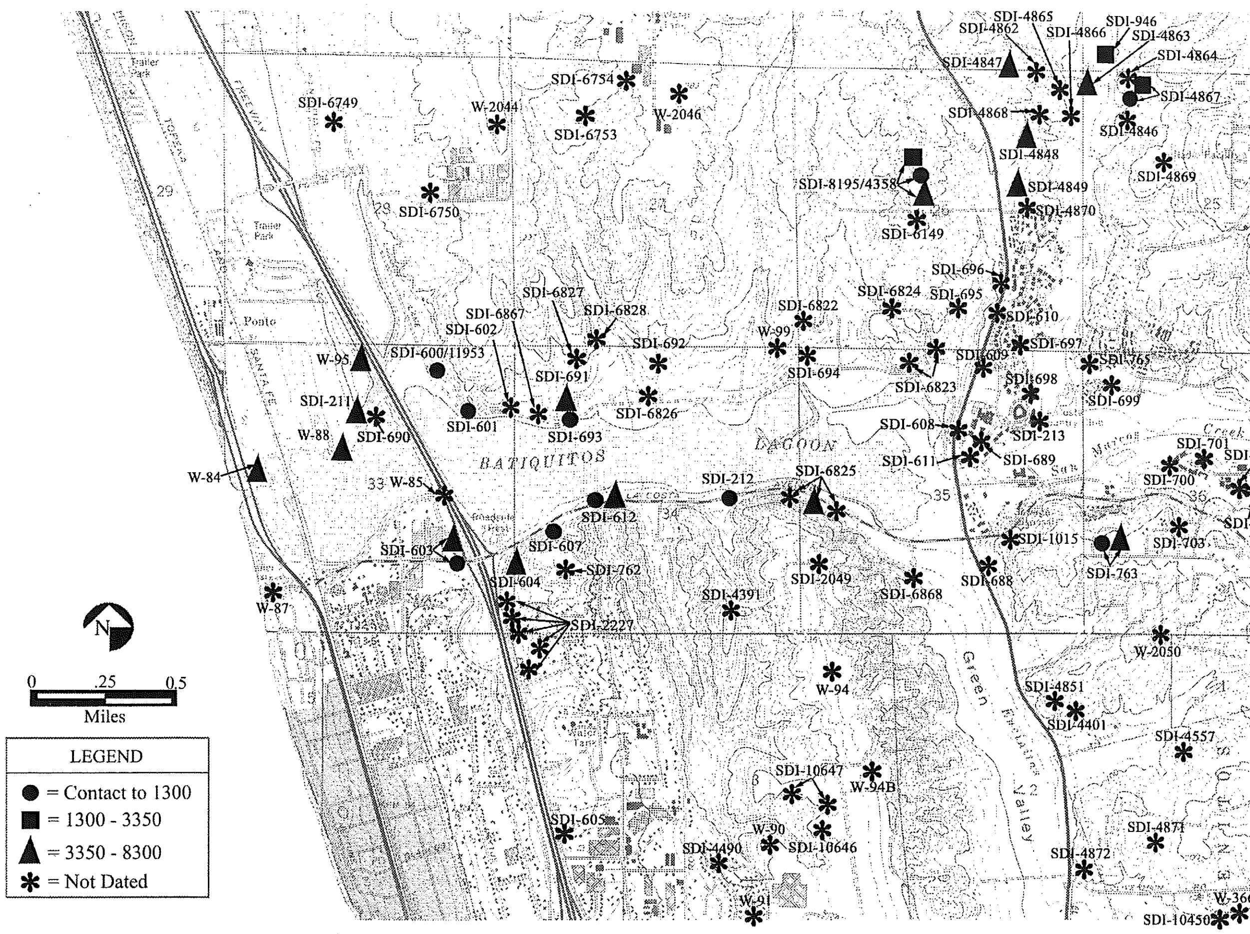


Figure 3.5 Map of ^{14}C dated archaeological sites in the Batiquitos Lagoon area

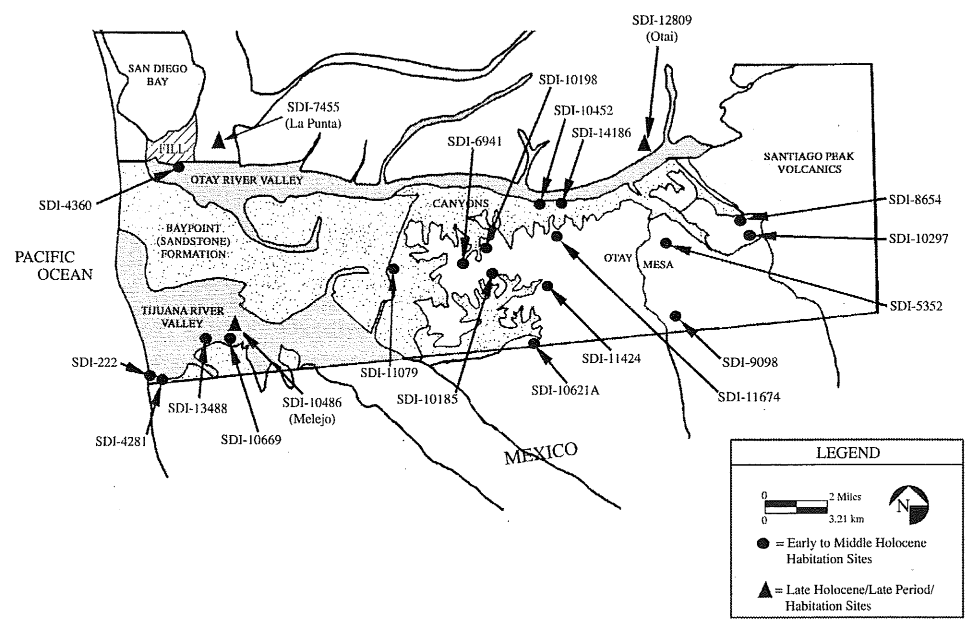


Figure 3.6 Spatial and temporal distribution of dated archaeological sites in the Otay area

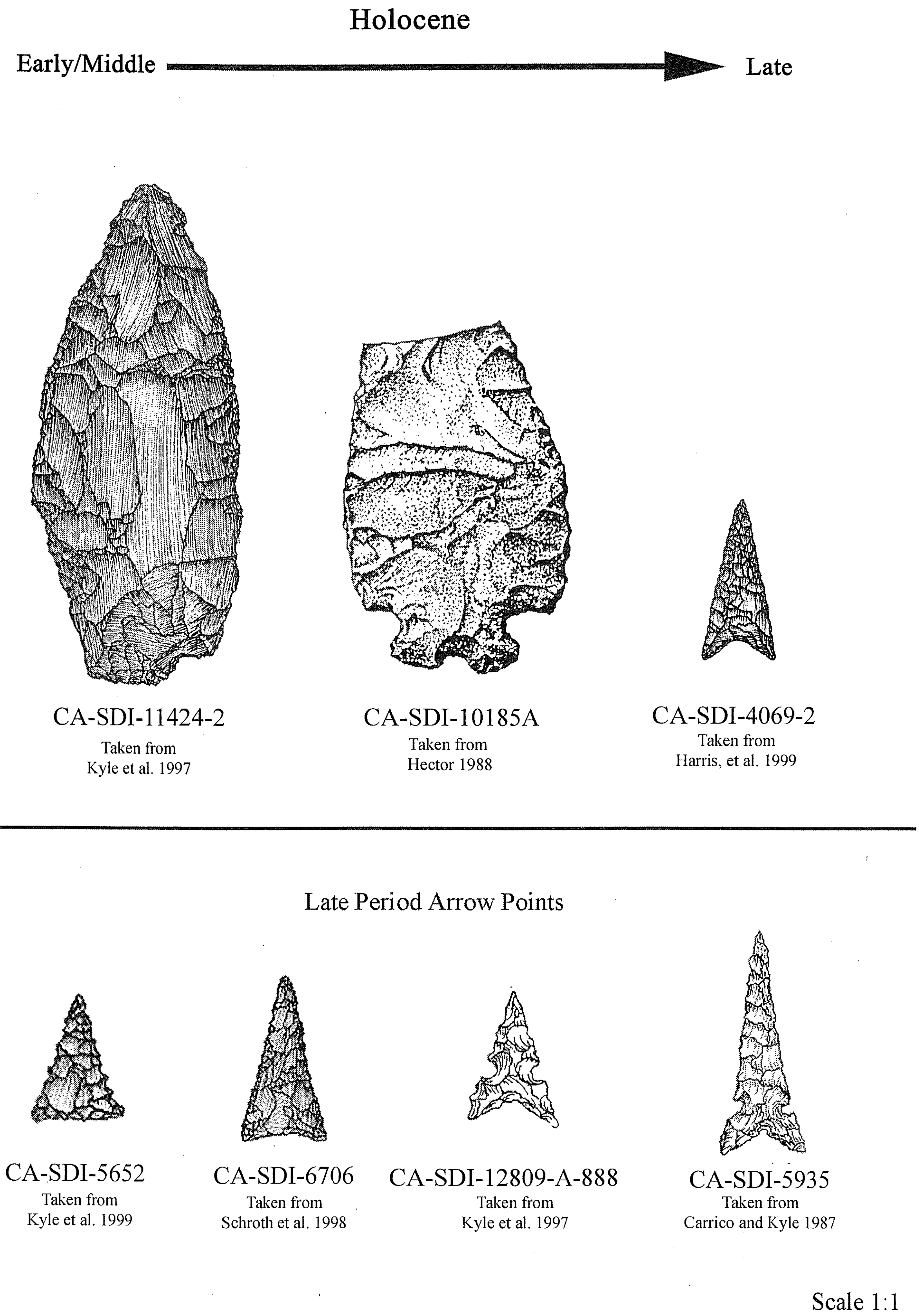


Figure 3.7 Holocene changes in biface types in San Diego County

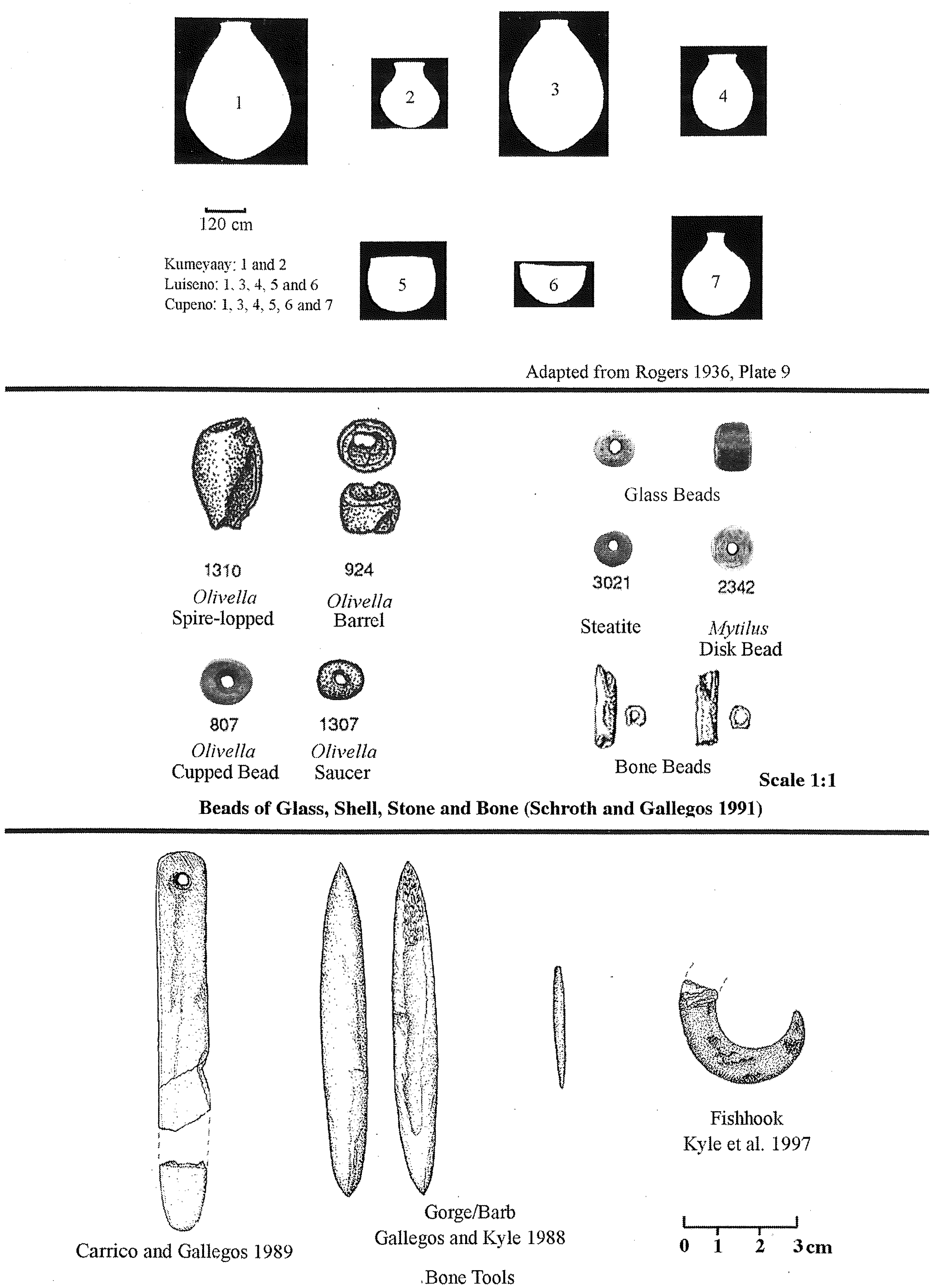


Figure 3.8 Late period artifacts: ceramic vessel types (top); beads (middle); and bone tools (bottom)

At San Diego Bay and along the San Diego River Valley, settlement during the past 7000 years has been continuous. This occupation is demonstrated by the Ballast Point site where cobble and flake tools, bone tools, milling tools, and evidence of shellfish, fish, small to large mammals, and plant food processing have been found.

For Otay Mesa, located between the Otay and Tijuana rivers north of the United States–Mexico border, Early and Middle Holocene habitation sites were located adjacent to lagoons and river valleys, and on the mesa. Late Holocene village sites were established along the Otay River Valley and adjacent to San Diego Bay and the Tijuana River Valley (figure 3.6) (Gallegos et al. 1998; Robbins-Wade 1990).

TECHNOLOGICAL CHANGE

Artifacts from the initial part of the Late Holocene (figure 3.7) appear to reflect more of a continuum of Middle Holocene utilitarian artifact types. Pottery, arrow points, and the change from burials to cremations are hallmarks of the Late period beginning circa 1300 years ago (figures 3.7 and 3.8). This period is also represented by a change from Coso obsidian to Obsidian Butte obsidian, increased use of inland resources of small game and acorns, bedrock milling features, and a settlement shift away from ephemeral streams to permanent water sources. These innovations need not be explained by a replacement population. Much of this change can be explained by in situ development and diffusion from neighbors, with improvements in hunting technology, food storage, and health measures such as cremation used to control disease.

Bow and Arrow

Once introduced, the bow and arrow traveled quickly across the continent, a major improvement in the hunting of small to large game and use in warfare. Certainly the Kumeyaay were not passive, as demonstrated by the report in AD 1542 that three of Cabrillo's sailors were wounded by arrows at San Diego Bay (Moriarty and Keistman 1968). Yohe (1992) identified the bow and arrow as having been introduced into western North America as early as 1600 years ago. Given associated radiocarbon dates, the bow and arrow were probably introduced into San Diego County between 1000 to 1300 years ago (Carrico and Taylor 1983; Kyle and Gallegos 1995).

A typology developed by True (1970) for San Diego County arrow point types was based primarily on basal configuration. Point types for the area are primarily variants of the Cottonwood triangular (concave, straight, and convex bases) and Desert side-notched (figure 3.7). Bifaces identified to the Hohokam culture and assigned to the Sacaton phase of the Snaketown excavations were also reported (Carrico and Kyle 1987; Carrico and Taylor 1983; May 1974). Figure 3.7 also shows the change from Middle Holocene large points and knives, and atlatl-dart points to the Late Holocene/Late period small arrow points.

Pottery

Pottery items include utilitarian storage vessels and bowls (figure 3.8), as well as clay smoking pipes. The earliest dates for ceramics in San Diego County are about 950, 1150, and 1270 years ago (Berryman 1981; Carrico and Taylor 1983; May 1976; Moriarty 1966). Moriarty's (1966) work at the Spindrift site (SDI-39/UCLJ-M-6) in La Jolla identified two superimposed occupational components. Shell from the basal level of the upper component was radiocarbon-dated to 1270 years ago and "probably approximates the time of introduction into this section of the coast of pottery and of more refined stonework..." (Hubbs, Bien, and Seuss 1962:235).

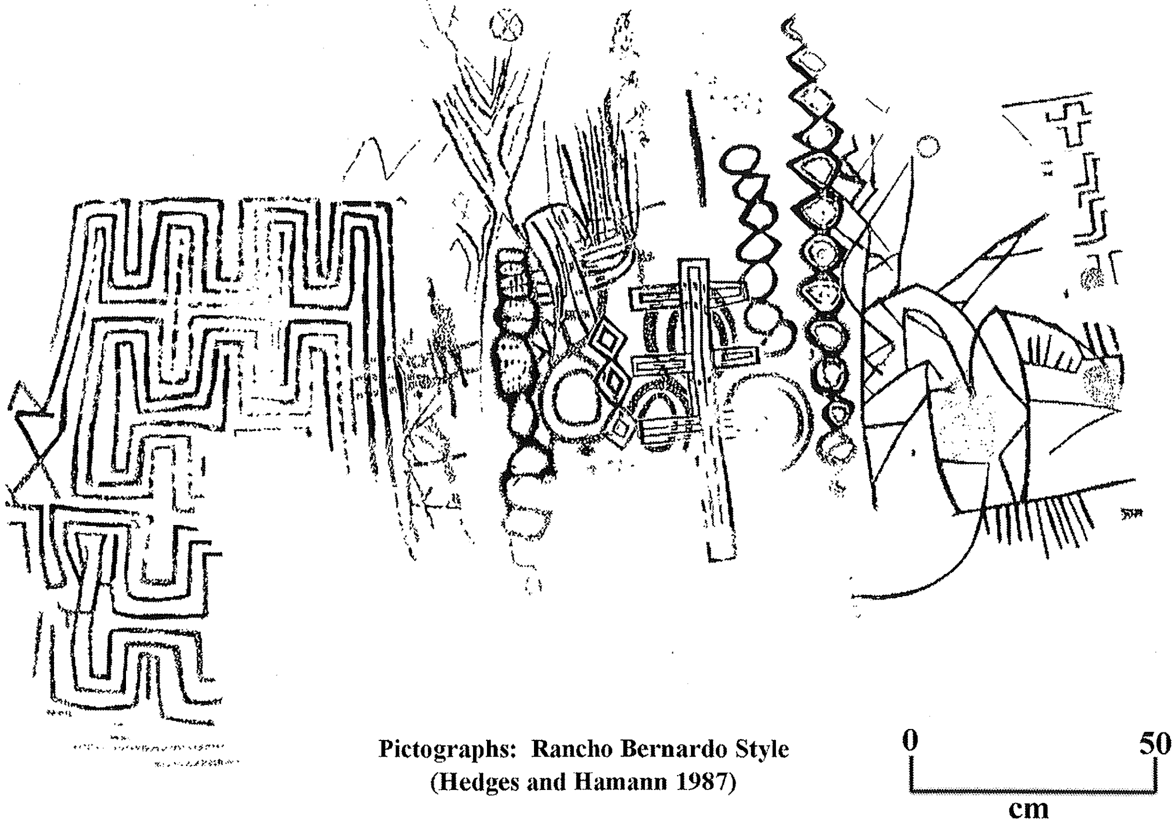
Obsidian

Obsidian from the Coso source near the southern Sierra Nevada Range dominated trade in obsidian during the Early and Middle Holocene. During the Late period, however, the source shifted to Obsidian Butte in the Imperial Valley (Ericson et al. 1989; Hughes and True 1985). This change may represent the more recent availability of the Obsidian Butte flow, or an altered territorial or trade orientation. In addition, obsidian from San Felipe, Mexico, has been identified at San Diego sites (McDonald, Serr, and Schaefer 1993; Robbins-Wade 1990; Winterrowd and Cardenas 1987).

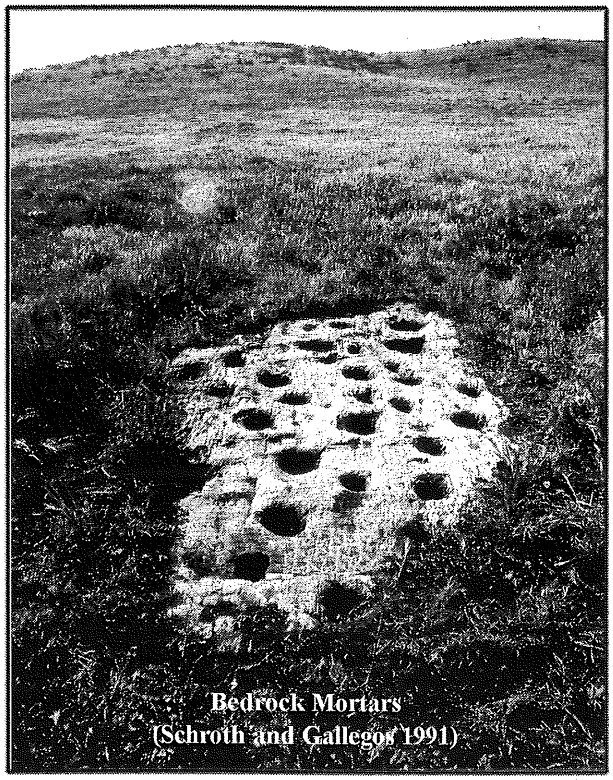
Burials and Cremations

The Early to Middle Holocene practice of burying the dead changed to cremation during the Late Holocene, between about 1000 and 1500 years ago. The youngest interment was reported from the village of Ystagua, where a burial dating to about 1500 years ago showed cranial fractures caused by blows to the head (Carrico and Gallegos 1989). Ezell (1975) reported two burials radiocarbon dated to 2020 years ago at Camp Pendleton. These burials were unusual in that (1) the head of one was covered by a whale bone, (2) they were associated with *Donax gouldii* shell, and (3) the individuals were placed on their backs, not in the usual flexed position. Based on the bone analysis, Ezell (1975) suggested dietary deficiencies.

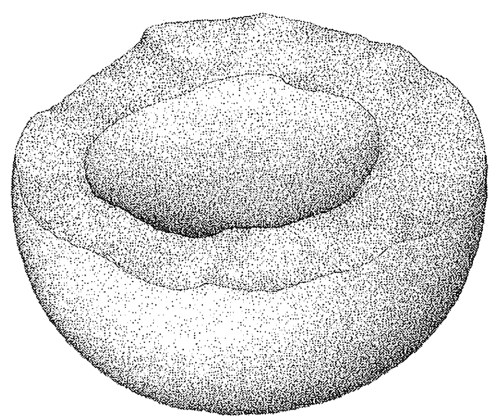
With perhaps somewhat large populations focusing on fewer reliable water sources, disease may have been a problem during the initial Late Holocene. In the Santa Barbara Channel area, stress indicators such as "a greater disease load" and fractures of the skull peaked around 1650 years ago (Lambert 1993; P. Walker 1989a, 1989b; Raab and Larson 1994). This date, as suggested by P. Walker (1989a) for the Santa Barbara Channel region, may be applicable to the San Diego



Pictographs: Rancho Bernardo Style
(Hedges and Hamann 1987)



Bedrock Mortars
(Schroth and Gallegos 1991)



Stone Bowl
28.6 L x 29.6 W x 14.0 H (cm), 13 kg
C-14 date of 805 +/- 50 on bone in bowl
(Kyle and Gallegos 1993)

Figure 3.9 Late Holocene pictographs (top), bedrock mortars (lower left), and stone bowl (lower right).

area and may help explain the introduction of cremation (for the purpose of reducing disease) into San Diego County.

Features

Late Holocene features include brush house structures, sweat houses, small cooking hearths, roasting pits, heating platforms, granary bases, milling slicks, bedrock mortars, and pictographs (figure 3.9).

LATE HOLOCENE VILLAGES

Late period settlement in San Diego County is commonly assumed to have had an inland focus (Christenson 1990). Based on her study of diet and land use patterning, for example, Christenson's (1990) concluded that a subsistence focus on acorns, grass seeds, and rabbits encouraged settlement inland. In AD 1769, however, Father Crespi noted that "All the port is well populated with a large number of Indians, too clever, wide-awake, and business-like for any Spaniard to get ahead of them ..." (Bolton 1926). These and other early Spanish accounts identified a high population along the coast and use of ocean, bay, and inland resources. On December 10, 1773, Palou reported that:

> Both the beach and the vicinity of the mission are very well populated with heathen, and in the district of about ten leagues [25 miles] there are more than twenty large villages, one of them being close to the mission (Bolton 1926).

Information concerning a few Late period villages is provided below.

Cosoy

On May 1, 1769, as part of the Portola expedition, Pedro Fages, Miguel Costanso, and Gorge Estorace landed at Ballast Point on San Diego Bay to find water:

> They traveled a matter of three leagues [approximately 7.5 miles] until reaching the banks of a river [San Diego River] hemmed in on both sides by a luxuriant fringe of willows and cottonwoods. Its channel would be about twenty varas [approximately 15 m] wide. It empties into an estuary which, at high tide, could take the launch and would make it convenient for taking on water.... A musket shot away from it [the river] and out of the woods, was found a town or hamlet [Cosoy, approximately one mile from east edge of bay] of the same pagans as those who were guiding our people.... (Hemert-Engert and Teggart 1910:118; translation and comments by Ezell and Ezell 1977)

Pedro Fages also noted for Cosoy in 1769 that: "The Indians have a rancheria consisting of some twenty-five families" (Engstrand 1975:6, 8).

Ezell and Ezell (1977) believed they had found Cosoy with the discovery of the Brown site (SDI-4675). The Brown site may well be part of the village of Cosoy, but additional Late Holocene sites (SDI-11767 and SDI-12126) may also represent the village (Kyle and Gallegos 1995; Pigniolo 1994). Excavations at these sites produced evidence for heavy reliance on shellfish, with secondary use of plants and animals (Kyle and Gallegos 1995; Pigniolo 1994). Basal radiocarbon dates for these sites range from 1290 to 1710 years ago, with Spanish contact reported in AD 1769 (Bolton 1926). The shellfish deposit at SDI-12126 was dense, producing 17 kg of shell within the 80 to 120 cm levels of a 1 x 1m unit. Bay species of *Chione*, *Argopecten*, and *Ostrea* predominated at both sites.

Ystagua

A number of excavations have been conducted at Ystagua, a village near the convergence of coastal canyons and the sediment-laden Peñasquitos Lagoon. That portion of Ystagua dated to the last 1000 years produced small terrestrial mammal, sea lion, bighorn sheep, antelope, and fish remains (Carrico and Taylor 1983; Carrico and Gallegos 1989). Milling tools, small points, beads, pottery, and obsidian from Obsidian Butte were also reported (table 3.1). Pottery finds included shallow bowls, small-to-large mouth bowls, and a portion of a pipe. Fish vertebrae were primarily from sardine, followed by shark, sheephead, tuna, and bass. These varied fish remains represent diverse habitats and identify a well-developed fishing technology. In all, 38 ^{14}C dates demonstrate nearly continuous occupation from 3000 years ago to historic contact (Breschini, Haversat, and Erlandson 1996; Carrico and Gallegos 1989).

La Rinconada de Jamo

At La Rinconada de Jamo, north of San Diego Bay, 21.7 m^3 of archaeological sediments were excavated (Winterrowd and Cardenas 1987). This study provided evidence of a maritime Late period village focused on exploiting coastal resources. For La Rinconada, early Spanish accounts and four radiocarbon dates identify occupation from approximately 2600 years ago to post-Spanish contact. The excavation produced 12,126 artifacts, 170 kg of shell and 9856 bone specimens (table 3.1). Obsidian was sourced to Obsidian Butte (n=9) and San Felipe, Mexico (n=1). The 40 arrow points were primarily Cottonwood triangular (n=28), with two Desert side-notched and 10 unidentifiable. Beads include 14 *Olivella* spire-lopped, six *Olivella* cups, two thin-lipped *Olivella* disks, and one *Haliotis* disk. The 166 ceramic artifacts are primarily vessel fragments (n=165) with one a pipe fragment, all of Tizon Brown ware. The shell was divided somewhat equally between *Chione*, *Argopecten*, and *Ostrea* from upper to lower levels, deriving predominantly

Table 3.1 Cultural Material Summaries for Three Village Sites

	YSTAGUA (Carrico and Taylor 1983) SDI-4609 (19.2 m³)	LA RINCONADA DE JAMO (Winterrowd and Cardenas 1987) SDI-5017 (21.7 m³)	OTAI (McDonald et al. 1993) SDI-12809 (110 m³)
ARTIFACT TYPE			
Debitage	7,111	11,558	75,000
Biface	157	58	683
Core/Cobble tool	20	151	578
Core	12	45	607
Flake tool	3	52	786
Groundstone Implement			
Mano	45	45	667
Metate	10	0	108
Pestle	0	0	0
Mortar	0	0	0
Discoidal	0	0	1
Shaped Stone	0	0	8
Quartz Crystal	0	1	7
Ceramic	1,552	166	14,919
Bone Artifact	12	26	7
Shell Artifact			
Shell Bead	68	23	387
Other Shell Item	6	1	15
TOTAL ARTIFACTS	8,996	12,126	93,773
Bone (NISP)	14,130	9856*	13,500
Shell (kg)	10.1	170.2	11.9
Basal Radiocarbon date (uncorrected)	1220 BP	2890 BP	1530 BP

*Estimate based on count from 1 of 16 units.

from a bay environment. Bone analysis identified abundant and diverse remains of fish, marine mammal, and small, medium, and large land mammals. Fish remains included 30 species taken from kelp beds, open ocean, and surf zone habitats. On the basis of faunal remains, this site is similar to the Ballast Point site and represents the maritime exploitation pattern begun over 6000 years ago.

Based on radiocarbon dates, both Ystagua and La Rinconada were initially occupied about 3000 years ago. They were situated adjacent to permanent water sources and close to a broad range of coastal and inland resources. The radiocarbon dates for three Late period village sites (La Rinconada de Jamo, Ystagua, and Cosoy) show initial village formation between about 3000 to 1200 years ago.

Otai

The village of Otai, with radiocarbon dates ranging from 1530 to 300 years ago, was situated on a low terrace adjacent to the Otay River Valley (figure 3.6). Here, McGowan's (1977) students excavated eighty-eight 5 x 5 foot units and one 9 x 9 foot block exposure. This work produced over 90,000 artifacts, 11,866 g of shell (primarily *Mytilus*) and 13,500 pieces of bone (table 3.1) (McDonald, Serr, and Schaefer 1993; McGowan 1977). Bone tools included awls, needles, antler flakers, a worked scapula, and a possible bird bone whistle. Shell artifacts included shell beads (n=387), worked clamshell (n=12), a *Haliotis* pendant, a fish-hook fragment, and a whole *Laevicardium elatum* shell used as a container. A stone pendant and a charred end of a wooden spear point, about 9 mm in diameter, were also recovered. Pottery types are primarily Tizon Brown ware with Colorado Buff and Parker Buff. Pottery vessel sherds revealed decorations that included painting and incising. Beads included trade beads, *Olivella* spire-lopped shell beads, a possible *Dentalium neohexagonum* tube bead fragment, and an *Olivella dama* shell bead from the Gulf of California (McDonald, Serr, and Schaefer 1993; McGowan 1977).

The work of McDonald, Serr, and Schaefer (1993) at Otai included ethnohistoric background research, review of previous work, and excavation of 27 1 x 1 m units. Their effort identified areas for everyday living activities, lithic production, shellfish processing, cooking, and ceremonies.

EARLY SPANISH ACCOUNTS

Based on early Spanish reports, Shipek (1989) believed the Natives advanced the production of certain plants through burning and water diversion. Cabrillo's log reported many fires as his ships continued north after leaving San Diego in October 1542. An account by Juan Crespi during the Spanish Expedition of 1769 noted that Sorrento Valley looked "to be nothing less than a cultivated cornfield or farm, on account of its mass of verdure" (Palou 1926, II:111). The rich greenery consisted of wild large-leafed calabashes and thickets of wild roses (Palou 1926, II:111). Another early account suggests plant cultivation, as it was reported that Spanish soldiers turned their horses into the Native's fields, which then ate up their crops (Jayme 1970:39).

A range of foods was reported. For example in AD 1769 Don Gaspar de Portola's expedition party reported trading for sardines and shellfish (Palou 1926). Father Junipero Serra wrote about "rafts made out of tules and formed like canoes with which they ventured far out to sea" (Englehardt 1920).

In AD 1769, the Spanish established the presidio and mission at San Diego near the village of Cosoy. Conflicts with the Spanish included an unsuccessful attack by the Natives on the San Diego Mission in August 15, 1769.

> They waited until there should be fewer soldiers .... Seeing this, all the heathen armed with their bows and good quivers of arrows, went to the mission ....The heathen burned their dead, as is their custom, and the weeping made by the women in the village, which was heard from the mission, lasted for many days (Bolton 1926).

On December 10, 1773, Palou reported ...and for defense [of the San Diego mission] there are inside the stockade two bronze cannons, one pointed toward the harbor and the other toward the village" (Bolton 1926). In August 1774, the mission was moved away from the presidio near Cosoy to Nipaguay (figure 3.2), where on November 5, 1775, it was sacked and burned. Eventually, through disease and disruption of established political and economic structures, the Mission system led to the decline of the traditional Kumeyaay culture.

SUMMARY AND CONCLUSIONS

Over the past 9000 years San Diego County has been continuously occupied. The environmental change from the Early/Middle Holocene to the Late Holocene included stabilization of sea level and degradation of lagoons with a concurrent loss of shellfish and fish, and the change from a cool/moist to warm/dry environment that reduced plant and animal resources. The period from 3350 to 1300 years ago was one of adaptation to the loss of shellfish and fish owing to silted lagoons and relocation of villages to dependable water sources. San Diego Bay, given its unique setting, remained open and productive for over 7000 years. Faunal material recovered from Late period coastal villages demonstrates continuous exploitation of marine resources from the Middle through the Late Holocene.

Innovation and adaptation during the Late period, from 1300 years ago to Spanish contact, resulted in increased occupation, diversification of resources exploited, intensified exploitation of plants as shown by the numerous milling tools and milling features, use of fire to increase crop yields, better exploitation of animal resources due to the introduction of the bow and arrow and use of nets, better storage of plant seeds through the use of pottery, relocation of camp sites away from ephemeral streams to permanent water sources, and a shift from burials to cremations, which helped control diseases and increase population.

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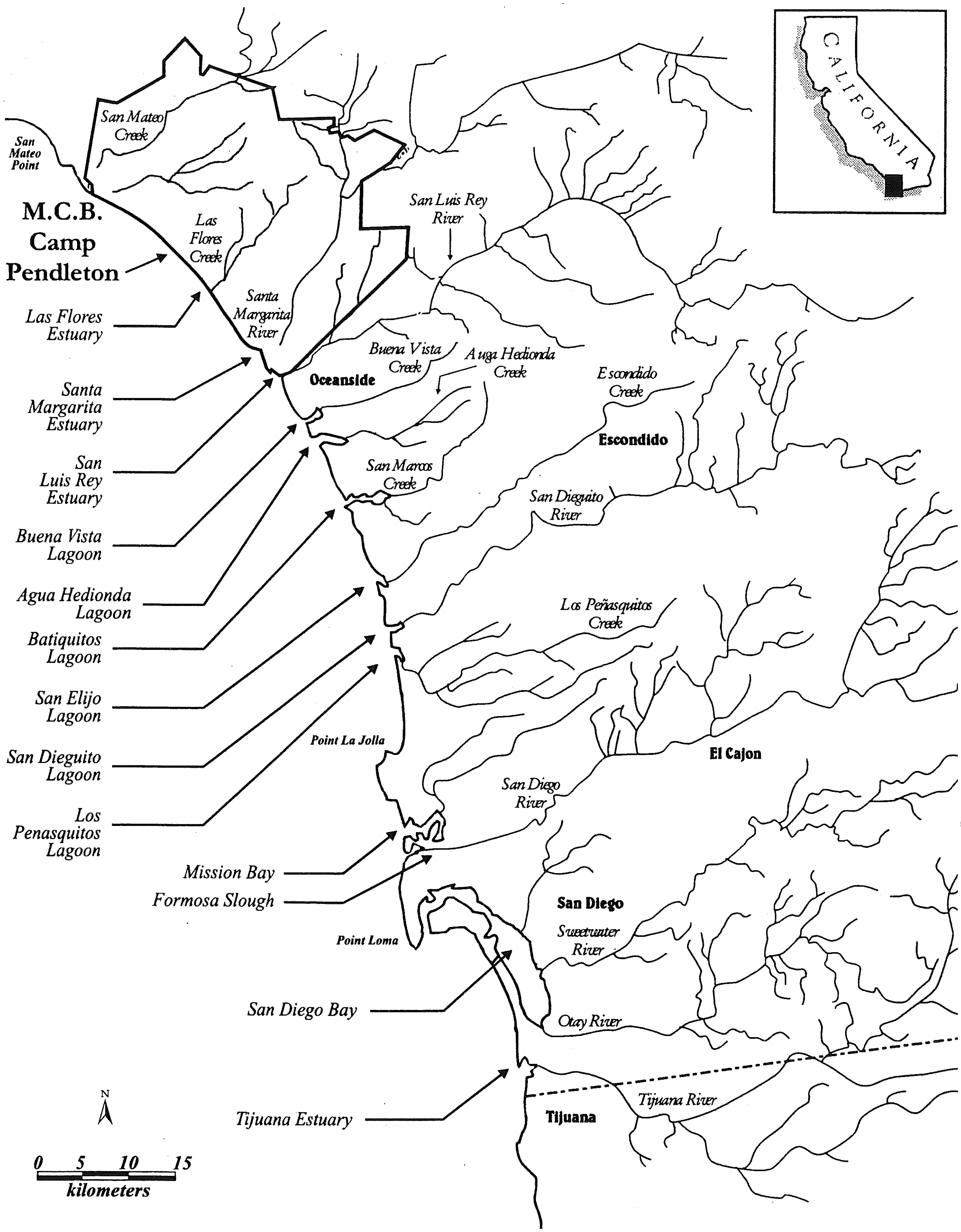


Figure 4.1 Map of San Diego County showing major lagoons

Late Holocene Adaptations along the Northern San Diego Coast

New Perspectives on Old Paradigms

Brian F. Byrd and Seetha N. Reddy

The San Diego region has long been a focus of archaeological studies of human adaptations to a dynamic coastal environment, particularly near the large estuaries of central San Diego County, such as Batiquitos and Agua Hedionda. The most widely accepted reconstruction states that Early and Middle Holocene coastal occupation entailed sizable semi sedentary populations focused around resource-rich bays and estuaries (for example, Gallegos 1985, 1992; Warren 1968). Then, near the onset of the Late Holocene, a major abandonment or depopulation of the coast occurred due to extensive siltation of local lagoons that caused a decline in shellfish populations (Masters and Gallegos 1997; Warren, True, and Eudey 1961). As a result, settlements were considered to have shifted inland to focus on terrestrial resource exploitation, with coastal occupation limited to seasonal or short-term occupation (Christenson 1992; Gallegos 1992; Smith and Moriarty 1985; Warren 1964).

Thus, Late Holocene coastal adaptations in the San Diego region often have been conceived almost as a cultural anticlimax, a perspective that contrasts markedly with research in the neighboring Santa Barbara Channel area, where during the Late Holocene cultural complexity was widespread and chiefdoms emerged in the Chumash area (for example, Arnold 1992a; Glassow 1996c). As a result, archaeologists working at opposite ends of the Southern California bight have often pursued different research agendas, and the topic of Late Holocene social complexity in the San Diego area has generated little research interest (for example, Erlandson and Glassow 1997; T. Jones [editor] 1992; Lightfoot 1993). This is an unfortunate situation since the local ethnohistoric record suggests a rich and complex cultural landscape which currently lacks strong continuity with the prehistoric coastal record.

When the Spanish established their missions in the late 18th century, the Luiseño and Juaneño peoples occupied the northern San Diego Coast and the Kumeyaay occupied the southern portion of the coast. Ethnohistoric reconstructions, using Mission period observations and records along with 20th century oral histories, indicate that the Luiseño had a moderate degree of social complexity and population density comparable to their northern neighbors, the Gabrielino. This development included strong territoriality, probable sedentary communities (including the outer coastal region), moderate to possibly large-size villages, patrilineal descent and patrilocal residence, extended family ownership of key resources, and village leaders and councils with hereditary positions, including war leaders.

In this chapter, we reevaluate the Late Holocene coastal record of the San Diego region (from 3500 years ago to historic contact) and provide a context for postcontact observations of local Native American cultures. We emphasize our recent multidisciplinary research on the northern San Diego Coast, especially the Camp Pendleton Marine Corps Base (MCB), which was largely unexplored until the last decade (Byrd 1998; Byrd and Reddy 1999; Reddy 1999a; Reddy and Brewster 1999). Late Holocene data from the central and southern San Diego Coast are also discussed (see Gallegos, chapter 3, this volume), but inland areas more than about 15 km from the coast are not addressed here.

New data concerning settlement and subsistence patterns along the northern San Diego Coast demonstrate that coastal occupation flourished throughout the Late Holocene and that it was both dynamic and locally innovative. Many of the larger coastal sites represent relatively stable sedentary coastal settlements. Highly situational Late Holocene littoral adaptations entailed exploiting of terrestrial plants and animals, shellfish, fish, and on occasion marine mammals.

Along the northern San Diego Coast, beginning around AD 700 (all calendar dates refer to calibrated ages) and becoming more highly developed after AD 1200, site density increased, the distance between major residential sites decreased, and numerous specialized short-term occupation sites appeared. At the same time that this strong logistically organized coastal settlement pattern developed, there was a shift toward increased reliance on smaller, less "optimal" resources (such as nearshore-schooling fish and small shellfish) and a more thorough exploitation of the littoral zone. This pattern suggests greater investment in the time needed to collect, process, and store smaller food resources, as well as a general loss of foraging efficiency. Such resource intensification, "a process by which the total productivity or yield per areal unit of land is increased at the expense of declines in overall caloric return rates" (Broughton 1997:846), results from consuming an increasingly broader range of lower ranked and less productive plant and animal species (Broughton 1994a, 1994b; Earle and Christenson 1980; Hayden 1981). These settlement and subsistence patterns in northern San Diego imply potentially profound changes in hunter-gatherer communities, and may be correlated with population pressure, increased territoriality, and greater settlement permanence. Moreover, these trends may have been important determinants of the cultural patterns evident in the ethnohistoric record.

MODERN SETTING AND PALEOENVIRONMENT

The coastal plain of San Diego County includes the nearshore area less than 180 m in elevation (Griner and Pride 1976). This coastal strip of raised Pleistocene marine terraces varies from 5 to 20 km wide and has a semiarid climate. Precipitation, concentrated in the winter, ranges from 22.5 to 40.0 cm per year. The county includes 130 km of shoreline, with larger drainages of various catchment sizes spaced every 3 to 15 km (figure 4.1). The southern third of the coastline is dominated by the Tijuana Estuary, San Diego Bay, and Mission Bay, while the central portion includes six main drainages, mostly with small catchments and associated lagoons. The northern third extends from the San Luis Rey River to San Mateo Creek and encompasses the Camp Pendleton MCB and three of the county's four largest drainages.

Coastal and Estuarine Paleogeography

The Pleistocene geography of this coastline differed greatly from today (Inman 1983; Kern 1995; Masters 1994; Orme 1993). Fast-paced sea level rise during the Late Pleistocene and Early Holocene shifted the shoreline eastward, inundating valley floors and creating steep, narrow bays (Inman 1983). As marine transgression slowed between about 6000 and 3000 years ago, complex low-energy coastal environments began to develop in drowned stream valleys. Thus, bays evolved into estuaries and lagoons, rocky shores declined, and sandy beaches began to be established (Nardin et al. 1981). The sea level rose another 1 to 2 m in the last 3000 years; estuaries continued to aggrade, and some were silted in and transformed into freshwater alluvial environments. At the same time, extensive sandy beaches evolved, initially in the north near Dana Point and then spreading southward to La Jolla, ultimately forming the extensive Oceanside littoral cell (Inman 1983). Throughout the Late Holocene, wave action eroded coastal cliffs at an estimated 0.01 to 0.5 m per year (Kern 1995; Muhs et al 1987).

This general paleogeographic reconstruction is based primarily on regional studies of shoreline and offshore data, as well as general models of late Quaternary coastal change related to sea level rise (for example, Inman 1983). While this summary applies in general to the region, the exact timing and magnitude of coastal habitat changes requires detailed local investigations. In particular, the ecological history of estuaries and lagoons is crucial to interpreting the Late Holocene archaeology for the San Diego area, since their demise is cited as the cause for the collapse of coastal adaptations (Gallegos 1992; Masters and Gallegos 1997; Warren 1964). Estuaries are, by nature, transient geological phenomena (for example, Emery 1967) that are extremely sensitive to localized short-term environmental change (for example, Davis 1992; Ingram, Engle, and Conrad 1996). Thus, detailed reconstructions of local coastal settings, using multiple data sets, are needed to model the relationship between environmental change and hunter-gatherer adaptations.

In the San Diego region, the precise history of individual drainage systems and their estuaries has rarely been reconstructed using independent data gathered solely for that purpose. Masters (1998, 1994) examined a variety of drilling logs to reconstruct the history of San Diego Bay and the San Luis Rey drainage, revealing two very different histories (see also Mudie, Browning, and Speth 1974). Most influential, however, was Miller's (1966) research at Batiquitos Lagoon, designed to test competing hypotheses posed by archaeologists concerning the timing of the Late Holocene lagoon closure (Hubbs, Bien, and Seuss 1962; Warren, True, and Eudey 1961; Shumway, Hubbs, and Moriarty 1961).

Miller's study significantly affected subsequent archaeological interpretations of Late Holocene coastal adaptations in the San Diego region. Her work (1966) at Batiquitos Lagoon recovered a 6500-year sedimentary sequence anchored by five ^{14}C dates on marine shell. Sedimentation rates were estimated as uniform from about 6500 to 4000 years ago, increasing dramatically between 4000 and 3000 years ago, then decreasing from roughly 3000 to 1000 years ago. The presence or absence of shellfish at varying depths, and the relationship of core depth to estimated sea level were used to infer whether the lagoon was open or closed. Miller (1966) suggested that the lagoon was closed from 3000 to 1000 years ago but reopened about 1000 years ago. Later dating of additional shell samples bracketing a 3 m section of this core indicated rapid sedimentation around 3500 years ago (Gallegos 1985; Masters 1983). Upwelling problems during coring suggest potential problems with sample integrity around 3500 years ago, however, which could skew these dating results (Miller 1966:245-246). Overall, the Batiquitos Lagoon sequence should be considered preliminary given the limited data available from a single core.

At present, there are no high-resolution records for individual estuaries, shifts in local paleovegetation are uncertain, and temporal variation in environmental history between estuaries is unknown. A recent project at the Las Flores paleoestuary at Camp Pendleton (Byrd 2000a; Byrd, Davis, and Pope 2000) yielded a well-dated, continuous sequence of Holocene deposits extending beyond 9000 years ago, and elucidated the complex physiographic history of this moderate-size drainage system. Freshwater lagoon deposits that occurred prior to 8100 years ago were buried by a long and varied sequence of alluvial sedimentation, with a series of buried paleosols marking periods of nondeposition on the coastal flood plain. Foster's pilot sediment coring study (1993) at San Elijo Lagoon revealed estuary deposits dating from 8000 years ago onward, with greater sedimentation prior to 4000 years ago followed by slower deposition. A detailed study of San Elijo Lagoon would provide a useful contrast to Batiquitos Lagoon, particularly since San Elijo was a fully tidal estuary system prior to the 1880s (Goodwin, Fishbain, and Naugles 1992).

Alluvial Sedimentation

Recent environmental research at Camp Pendleton provides insights into the character of Late Holocene alluvial sedimentation in coastal drainages. Studies along San Mateo and Las Flores creeks at Camp Pendleton have examined late Quaternary fluvial stratigraphy and chronology (Waters 1996a, 1996b; Waters, Byrd, and Reddy 1999), along with more limited investigations of fluvial, alluvial fan, and colluvial processes in 14 other drainages (Pearl and Waters 1998). These streams have incised the narrow (2 to 5 km wide) coastal plain while draining the Santa Margarita Mountains. Holocene alluvial fans, terraces, and adjacent colluvium occur along the stream banks. These drainages were generally open to the ocean due to high discharge, but with recent lower discharge these smaller systems now end in sloughs or alluvial deposits (Waters 1996a).

Two late Quaternary stream terraces occur at similar elevations above the San Mateo and Las Flores creek beds, and the terrace sediments have produced similar ^{14}C dated age ranges (2210 BC to AD 1290 and 2900 BC to AD 1450, respectively) (Waters, Byrd, and Reddy 1999). This aggradation was punctuated by periods of stability marked by four paleosols, the oldest of which is about 4000 years old. Initial cutting of these deep valleys probably began in the Late Pleistocene, followed by a long period of Holocene aggradation (Byrd, Davis, and Pope 2000), a period of channel instability and incision that created the upper terrace, more deposition, and finally the Late Holocene channel incision that created the lower terrace. These alluvial sequences frequently contain buried archaeological sites, and most valley floor sites dated between about 4000 and 2000 years ago are not visible using traditional archaeological survey techniques.

Paleovegetation Reconstructions

Late Holocene paleovegetation reconstructions in the San Diego region are very limited. A 4000 year record from a 4.75 m alluvial section in the lower reaches of Las Flores Creek provided a reconstruction of vegetation and climatic changes during the Late Holocene (Anderson and Byrd 1998). Five pollen zones were distinguished based on pollen concentration and composition (Anderson 1996). These zones correlate well with the section's six major stratigraphic units and three buried paleosols (Waters 1996a). The Las Flores Creek pollen results indicate that the environment near the end of the Middle Holocene was considerably different from modern conditions. Pollen from riparian plants, including cattail *(Typha)* and sedges *(Cyperaceae)*, were common between 4000 and 2600 years ago. Cypress *(Cupressus)*, or a closely related tree, may have grown along this riparian corridor, suggesting that a larger range for this plant and wetter conditions than today allowed this tree to grow at lower elevations. By 2600 years ago, a vegetation mosaic, including coastal sage, chaparral, and grassland communities, was established, and these conditions were then largely maintained. The most notable changes were elevated levels of *Chenopodium-Amaranthus* pollen resulting from human disturbance, and the introduction of exotic weed and tree species in the last century. On the central and southern San Diego Coast, shallow coring at Los Penasquitos Lagoon and Mission Bay documented similar climatic trends that may be time transgressive from north to south (Cole and Wahl 2000; Mudie and Byrne 1980).

CULTURE HISTORY

Although numerous culture histories have been used in the area, most sequences for the San Diego Coast distinguish four major cultural periods which we term Paleo-Indian, Archaic, Late Prehistoric, and Post-Contact (Christenson 1992; Meighan 1954; Moratto 1984; M. Rogers 1929, 1945; True 1966, 1980; Wallace 1955; Warren 1964, 1968). In this brief review of the Late Holocene, we discuss the Archaic, Late

Prehistoric, and Post-Contact periods.

Archaic Period

The Archaic period (similar to the Encinitas tradition and the Millingstone horizon) begins between 9000 and 8500 years ago and ends between 1300 and 800 years ago (Gallegos 1992; Moratto 1984; Rogers 1966). A distinction is often made between coastal shell midden sites (La Jolla complex) and inland non-shell midden sites (Pauma complex). Shell middens are generally characterized by flaked cobble tools, basin metates, manos, discoids, and flexed burials. Three temporal phases have been distinguished within the Archaic period (Moriarty 1966; Warren Siegler, and Dittner 1998).

Initial Archaic exploitation of the San Diego Coast is generally considered to have entailed sizable semisedentary populations focused around resource-rich bays and estuaries (for example, Gallegos 1992; Warren 1968). Shellfish were interpreted as a dietary staple; plant resources (both nuts and grasses) were an important dietary component, while hunting and fishing were less important. This adaptive strategy remained largely unchanged for several thousand years. According to Warren, True, and Eudey (1961:25) "the La Jolla complex reached its population and cultural climax between 7000 and 4000 years ago when shellfish were plentiful in the lagoons along the coast." Major changes in human adaptations occurred after 4000 years ago when extensive estuarine silting is believed to have caused a decline in shellfish populations. A major depopulation of the coastal zone was postulated, with settlements shifting inland to a river valley orientation, thus, intensifying exploitation of small terrestrial game and plant resources, possibly including acorns (Christenson 1992; Crabtree et al. 1963; Gallegos 1985, 1987, 1992; Masters and Gallegos 1997; M. Rogers 1929:467; Warren and Pavesic 1963; Warren 1968). The coast was abandoned or only seasonally occupied, with a possible slight increase in coastal occupation after about 1600 to 1200 years ago.

The major exception to this scenario is the San Diego Bay and Mission Bay areas (for example, Warren 1964, 1968) and more recently the Peñasquitos Lagoon/Sorrento Valley area (Gallegos 1992). Although refinements have been made based on new excavations (Gallegos 1987, 1992; Gallegos and Kyle 1998; Warren, Siegler, and Dittner 1998), the broad perception of the region's coastal adaptations has remained largely unchanged (Byrd 1998). Most interpretations about the timing of estuarine silting, decreased productivity at specific localities, and related effects on human settlement were based on inferences derived from excavated shell middens and not from independent paleoenvironmental data (Bull 1981; Bull and Norwood 1977; Carrico 1976). Alternative interpretations of Archaic coastal adaptations have been presented, suggesting that particular estuaries were open for considerable periods after 4000 years ago, that coastal populations migrated southward as coastal lagoons silted in, and that human populations continued to flourish along the coastal margin during the Late Holocene (Bull 1981; Byrd 1998; Hubbs, Bien, and Seuss 1962; Shumway, Hubbs, and Moriarty 1961:116-117, 124; Smith and Moriarty 1985).

Late Prehistoric Period

The Late Prehistoric period in the San Diego area is generally considered to have begun between about AD 700 and AD 1250 (Moratto 1984; M. Rogers 1945; Warren et al. 1998). Local cultural complexes have been distinguished for the northern area (San Luis Rey complex), southern coast (Yuman complex), and southern inland area (Cuyamacha complex). This period is characterized by the appearance of the bow and arrow (with small Cottonwood triangular and Desert side-notched arrow points) and ceramics, the replacement of flexed burials with cremations, the possible appearance of the mortar and pestle, and an emphasis on inland plant food collecting and processing, especially of acorns (Christenson 1990; McDonald and Eighmey 1998; Meighan 1954; M. Rogers 1945; True 1966; Warren 1968). The precise timing of these developments is still debated due to the poor chronological resolution and bioturbation in multicomponent sites (Griset 1996; McDonald and Eighmey 1998). Recent research has also revealed a persistence of inhumations through most of the Late Holocene in northern coastal San Diego.

Explanations for the origin of the Late Prehistoric period vary. Kroeber (1925:578) speculated that Shoshonean language speakers migrated from the deserts to the Southern California Coast at least 1000 to 1500 years ago. Some archaeologists have embraced this hypothesis and correlated it with the origins of the Late Prehistoric period (Meighan 1954; Warren 1968). M. Rogers (1929) initially discussed the Luiseño and Kumeyaay under the rubric of the Mission Indians and distinguished them from earlier shell-midden and scraper-maker cultures. M. Rogers (1945) later argued for continuity in occupation from the Archaic to the Late Prehistoric period, and distinguished three phases of shell middens. He believed that the Kumeyaay culture of 500 years ago resulted from an earlier migration of Yuman populations from the coast to the Colorado River (perhaps in response to an influx of Shoshone peoples in northern San Diego County), adaptation to this new riverine setting, adoption of traits from adjacent Southwest populations, and subsequent return to the coast at the onset of the Late Prehistoric period. Other scholars explain Late Prehistoric cultural developments as evidence of cultural continuity and the addition of new traits (True 1966, 1970; Warren 1964, 1968), population replacement (Bull 1987), or multiple factors that at play simultaneously (Moriarty 1966).

The San Luis Rey complex in the northern inland area was defined by Meighan (1954), refined by True, and generally applied to the north coast region (True 1966; True, Meighan, and Crew 1974; True, Pankey, and Warren 1991; True and Waugh 1982, 1983). Meighan (1954: Table 2) suggested that the San Luis Rey I phase began around AD 1400 and included small triangular arrow points, manos, portable metates, mortars, pestles, *Olivella* beads, and stone pendants. The San Luis Rey II phase differed only in the addition of ceramics and pictographs around AD 1750. True (1993:17) further hypothesized that sedentary villages with limited use of marine resources were situated in the lower portions of the San Luis Rey drainage. The Late Prehistoric period has therefore been paradigmatically linked with the subsequent ethnohistoric record, and direct historical analogies assume considerable adaptive stability for populations and linguistic groups, and their territorial extent as documented by Europeans.

Post-Contact Period and Ethnohistoric Context

The Post-Contact period began in AD 1769 with the Spanish establishment of the Mission San Diego de Alcalá. Spanish explorers first visited the San Diego area, however, in AD 1542 when Cabrillo landed at Point Loma along San Diego Bay. Portolá's AD 1769 expedition from San Diego to Monterey documented a series of coastal villages in the San Diego area, typically situated along the region's major drainages (Carrico 1977). Establishment of Mission San Juan Capistrano in AD 1776 and Mission San Luis Rey in AD 1798 further impacted traditional coastal settlement systems.

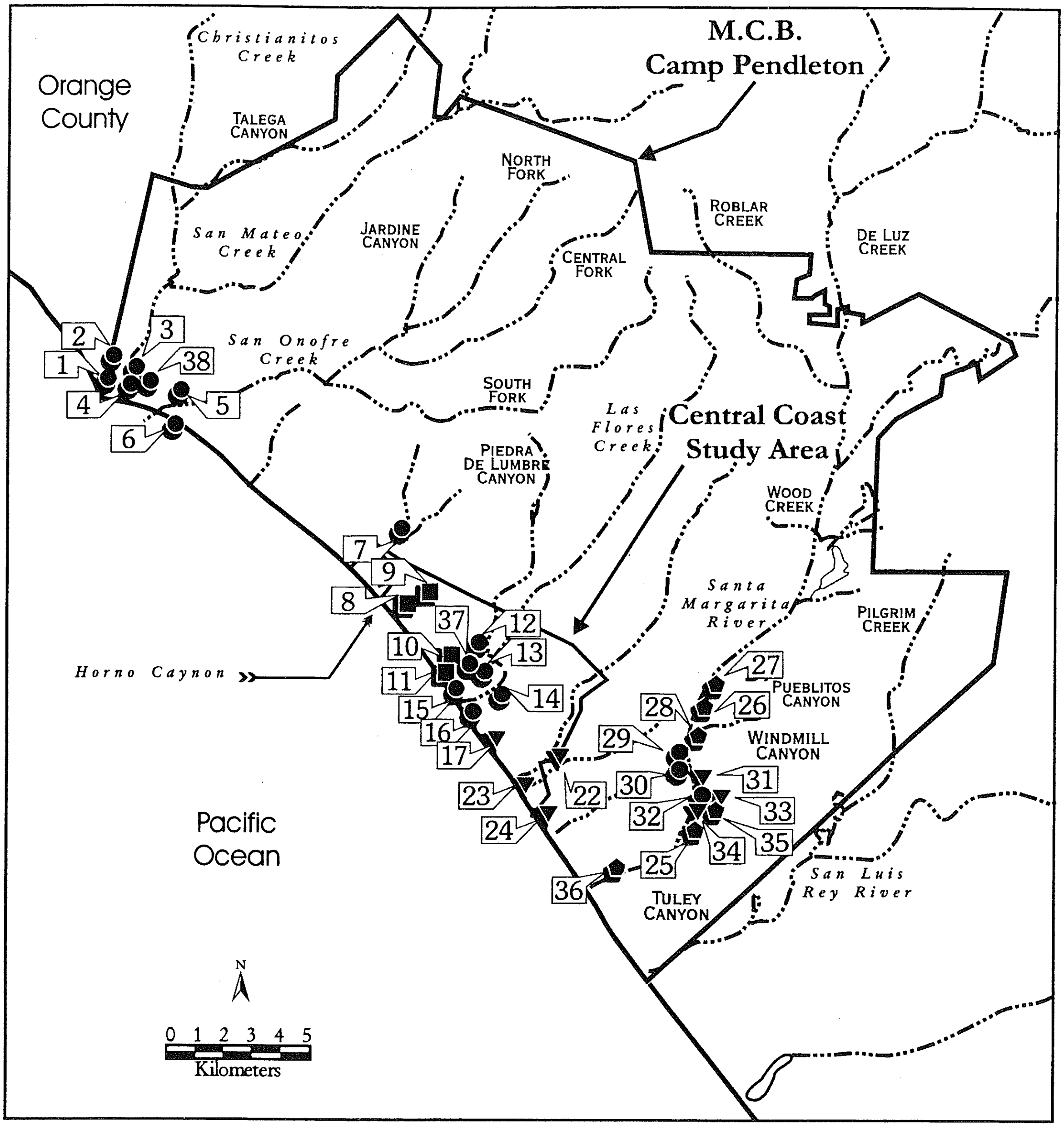
While Native peoples of the area may have been negatively affected by protohistoric transmission of diseases via sea visits and through contact with Native Americans in the Baja region (Erlandson and Bartoy 1995, 1996; Preston 1996), acculturation, assimilation, and the introduction of Old World diseases greatly disrupted and reduced Native populations. Consequently, and by the early 1800s, traditional coastal villages were largely abandoned (Carrico 1998). As a result, we know little about traditional coastal life, except what can be gleaned from Mission records. Nineteenth and twentieth century ethnohistoric records provide only limited insight into coastal adaptations, particularly concerning such issues as cultural complexity, population densities, and regional interaction. Such records reflect the perspective of remnant inland populations and their occasional seasonal exploitation of a littoral zone dominated and largely controlled by European settlers.

From north to south, coastal San Diego encompasses the territory of the Juaneño, Luiseño, and Kumeyaay peoples (Bean and Shipek 1978; Kroeber 1925:636; Shipek 1978). The Juaneño and Luiseño are Shoshonean speakers whose territory ranged from Agua Hedionda Lagoon (or possibly Batiquitos Lagoon) in the south to Aliso Creek in Orange County, to near Santiago Peak in the northeast, and to the Palomar Mountain area in the southeast. They are linguistically and culturally related to the Gabrielino and Cahuilla (Bean and Shipek 1978; Sparkman 1908). The terms Juaneño and Luiseño are derived from association with the San Juan Capistrano and San Luis Rey missions. Kroeber (1925:636) recognized Juaneño as a dialect of Luiseño, while Bean and Shipek (1978:550) and R. White (1963:91) viewed the Juaneño as part of the Luiseño on the basis of cultural and linguistic similarities. Since little is known about the coastal Juaneño-Luiseño (R. White 1963:19), our summary of ethnohistoric observations is largely based on inland Luiseño, a term we use to refer to both groups.

The Luiseño are considered one of the more complexly organized Native California groups, with noteworthy characteristics including a fairly rigid social structure and a moderately high population density (Bean and Shipek 1978). Maximum population estimates at Spanish contact range from 5000 (Kroeber 1925) to 10,000 (White 1963). With a territory extending almost 4000 km^2 (1500 mi^2), maximum population density estimates range from 1.25 to 2.5 persons per km^2 (3.3 to 6.7 persons /mi^2). White (1963) estimated that the Luiseño lived in about 50 villages of 200 individuals each, while Oxendine (1983), using Portolá expedition observations, indicated that village size was closer to 60. Recent research of mission records suggests that village size varied significantly in the eighteenth century, with larger villages, such as Topome along the Santa Margarita River, consisting of multiple clans (Johnson and Crawford 1999).

The Luiseño were divided into several autonomous lineages or kin groups based on patrilineal descent and a patrilocal residence pattern. Each Luiseño lineage was based around an autonomous village that held collective ownership over a well-defined territory for hunting and gathering purposes; trespassers were punished (Bean and Shipek 1978). Village territory may have ranged from as little as 10 km^2 along major drainages near the coast, such as the San Luis Rey River (Oxendine 1983:45), to as much as 100 km^2 elsewhere (White 1963). A variety of residential camps (for acorn gathering, etc.) and specialized localities occurred within each village territory (Oxendine 1983; White 1963). Estimated lengths of the annual stay at the main village vary, and True, Meighan, and Crew (1974) suggested a bipolar pattern with two permanent base camps, one in a major valley and another in the mountain region.

Strong differences in social status, ascribed leadership roles, and elaborate ritual paraphernalia existed (Bean and Shipek 1978; Sparkman 1908). Leadership included hereditary chiefs and council members who had specialized knowledge of and authority over specific religious, economic, and warfare issues. Leaders conducted elaborate ceremonies. Ritual and ceremonial specialists maintained ceremonial



Map Legend

- Major Residential Base
- Coastal Dinner Camps
- Coastal Limited Activity Locale
- Not Classified

Map Key

Site numbers (all CA-SDI- unless indicated)

1	ORA-22	14	10,728	27	12,628
2	8435	15	811	28	12,577
3	13,324	16	10,726	29	4417
4	13,325	17	14,519	30	4416
5	4411	18	4540	31	14,752
6	1074	19	14,495	32	14,170
7	4538	20	14,494	33	14,751
8	14,516	21	14,497	34	14,750/14,749
9	14,506	22	14,522	35	14,748
10	14,504	23	14,521	36	12,572
11	14,503	24	14,520	37	812
12	812/H	25	14,170	38	16,283
13	4536	26	14,060		

Figure 4.2 Map of Camp Pendleton showing the central coast survey area and the location of all dated Late Holocene outer coast sites

knowledge in secrecy and passed on the knowledge to only one heir (Winterrowd and Shipek 1986; White 1963). These leaders and specialists used fenced ceremonial structures located in the village center.

Economic activities, which took place at the community and extended household levels varied significantly between coastal and inland areas (Bean and Shipek 1978:552). Community-wide efforts included fire management for game drives and systematic use of fire to facilitate grasslands and increase key plant and animal yield. Such burning was regularly mentioned in early Spanish accounts (Bean and Lawton 1976; Blackburn and Anderson 1993). Acorns gathered in upland areas are considered the most important food source. Seeds from grasses, manzanita, sage, sunflowers, lemonade berry, chia, and other plants were also consumed, along with various wild greens and fruits. Deer, antelope, small game, and birds were exploited. Coastal marine animals utilized as food included sea mammals, fish, crustaceans, and mollusks. Nearshore fishing was done from light balsa reed or dugout canoes. Some accounts indicate that coastal communities exploited local shellfish in the winter (Sparkman 1908; White 1963), and during times of stress the interior Luiseño traveled to the coast to obtain shellfish, fish, and land mammals (White 1963). Bean and Shipek (1978) noted that most inland groups annually visited fishing and gathering locations on the coast when the tides were low or when inland resources were scarce, typically January through March.

Rigid sexual division of labor did not exist, but women generally collected plant resources and men hunted (Bean and Shipek 1978). Houses were dispersed throughout the villages. Lowland village houses were conical structures covered with tule bundles. Other structures included sweat houses, ceremonial enclosures, ramadas, and acorn granaries. Domestic implements included wooden utensils, baskets, ceramic cooking and storage vessels, and milling tools. Hunting implements included bow and arrow, curved throwing sticks, nets, and snares. Nets and hooks made of shell and bone were used for fishing.

To the south, the Yuman-speaking Kumeyaay (a.k.a. Digueño and Ipai-Tipai) occupied a much larger and more diverse environment, including marine, foothill, mountain, and desert zones (see Gallegos, chapter 3, this volume; Luomala 1978; Shipek 1982; Spier 1923). Considerable variability in social organization and settlement is noted, and the Kumeyaay claimed prescribed territories but rarely owned resources (Luomala 1976; Spier 1923). Some of the lineages occupied territories that required considerable residential mobility (Hicks 1963). Acorns are thought to have been a primary staple. Shipek (1982, 1989) argued that proto-agriculture of small-seed grasses, notably fire management activities, occurred prior to contact.

LATE HOLOCENE SETTLEMENT PATTERNS

Rigorous regional studies of outer coastland use patterns are generally precluded in the San Diego metropolitan area due to extensive urban development. The major exceptions to this trend are the Camp Pendleton area and the margins of Batiquitos Lagoon. Our discussion focuses on the northern San Diego Coast, followed by comparisons with its central and southern portions.

Northern San Diego Coast

During the last decade, considerable portions of the Camp Pendleton Coast have been surveyed and test excavations conducted at 44 pre- and postcontact Native American sites. Excavations include seven sites in the San Mateo and San Onofre drainages in northern Camp Pendleton, 25 sites in the central portion (Horno Canyon, Las Flores Creek, and adjacent coastal marine terraces), and 12 sites along the Santa Margarita River in the southern portion (figure 4.2). The extensively investigated central coast of Camp Pendleton is the focus of our discussion.

This central area covers a 9 km stretch, extends from 1.5 to 4 km inland, and encompasses 27.4 km^2. An intensive survey, with full coverage and ground cover clearance to discover less visible sites, has documented 41 prehistoric sites, including 29 (71%) on coastal terraces and 12 (29%) in alluvial deposits, particularly along Las Flores Creek (Byrd and Reddy 1999; Reddy 1998a, 1998b; Reddy and Brewster 1999). Of these, 25 tested sites provided a representative sample of different topographic settings and site types, including large shell middens and small to medium shell scatters (table 4.1) (Byrd 1996, 1997, 2000a; Ezell 1975; Rasmussen and Woodman 1998; Reddy 1999b; Woodman 1996). Broader patterns are emerging by combining data from tested sites near the mouths of San Mateo and San Onofre creeks (Byrd, Pallette, and Serr 1995; Reddy, Giacomini, and Serr 1996), with more limited work along the Santa Margarita River (Pignolio and Cleland 1996; Reddy 2000a; Reddy and O'Neill 2000; York et al. 1999; Welch 1978).

Late Holocene coastal sites include major residential bases and numerous specialized sites of varying size and makeup. A total of 143 ^{14}C dates have been obtained from 39 outer coast sites, 37 of which have Late Holocene occupation episodes (represented by 122 ^{14}C dates) (table 4.2, figure 4.3). Only 21 ^{14}C dates from 11 sites predate the Late Holocene, and only 2 sites lack a Late Holocene component. Many of the sites dating to the latter portion of the Middle Holocene also produced Late Holocene dates, suggesting persistent occupation. The vast majority (85%) of Late Holocene ^{14}C dates fall after AD 700, the earliest estimate for the onset of the Late Prehistoric period, and 65% postdate AD 1200. Thus, most coastal sites can be confidently assigned to the Late Prehistoric and Post-Contact periods, several include late Archaic occupations,

Table 4.1. Summary of excavated sites in the coastal Camp Pendleton area

CA-SDI-	DATED	TIME PERIOD	SITE TYPE	SIZE (M^2)	DOMINANT INVERTEBRATES	REFERENCE(S)
Northern Camp Pendleton - San Mateo and San Onofre Drainages (n=7)						
1074	Yes	LH	SM	113,900	*Protothaca*	Byrd et al. 1995
4411	Yes	LH	SM	13,800	*Donax* and *Protothaca*	Byrd et al. 1995
8435	Yes	LH	SM?	35,000	*Protothaca*	Byrd 1996; Reddy et al. 1996
13,324	Yes	LH	SM	202,000	*Protothaca*	Reddy et al. 1996
13,325	Yes	LH, pre-LH	SM	82,800	*Protothaca*	Byrd et al. 1995
16,283	Yes	LH	SM?	~15,000	*Protothaca* and *Tegula*	Byrd and Huntley (2002)
ORA-22	Yes	LH, pre-LH	SM	>100,000	*Protothaca*	Romani 1997, Byrd 1998
Central Camp Pendleton, including Las Flores Creek (n=25)						
811	Yes	LH, pre-LH	SM	311,225	*Donax*	Byrd 1996; Rasmussen and Woodman 1998
812/H	Yes	LH	SM	525,600	*Donax*	Woodman 1996
4536	Yes	LH	SM	4,125	*Donax*	Ezell 1975
4538	Yes	LH	SM	125,000	*Donax*	Byrd 1996
4540	Yes	LH	SS	1,000	*Donax*	Reddy 1999b
10,726-A	Yes	LH	SM	26,000	*Donax*	Byrd 1996, 2000
10,726-B (15,254)	Yes	LH, pre-LH	SM	26,000	*Donax* (LH) and *Chione* (pre-LH)	Byrd 1996, 2000
10,728	Yes	LH, pre-LH	SM	30,500	*Donax* (LP) and *Chione* (pre-LH	Byrd 1997
14,494	Yes	LH	SS	1,640	*Donax*	Reddy 1999b
14,495	Yes	LH	SS	1,620	*Donax*	Reddy 1999b
14,496	No	LH (?)	SS	14,840	*Donax*	Reddy 1999b
14,497	Yes	LH	SS	1,100	*Donax*	Reddy 1999b
14,498	No	LH (?)	SS	1,540	*Donax*	Reddy 1999b
14,499	No	LH (?)	SS	620	*Tivela*; *Donax*	Reddy 1999b
14,503	Yes	LH	SS	1030	*Donax*	Reddy 1999b
14,504	Yes	LH	SS	3480	*Donax*	Reddy 1999b
14,505	No	LH (?)	SS	13,070	*Donax*	Reddy 1999b
14,506	Yes	LH	SS	6,290	*Donax*	Reddy 1999b
14,508	No	LH (?)	SS	4,440	*Donax*	Reddy 1999b
14,516	Yes	LH	SS	1920	*Donax*	Reddy 1999b
14,518	No	LH (?)	SS	90	*Donax*	Reddy 1999b
14,519	Yes	LH	SS	1350	*Donax*	Reddy 1999b
14,520	Yes	LH	SS	640	*Donax*	Reddy 1999b
14,521	Yes	LH	SS	1430	*Donax*	Reddy 1999b
14,522	Yes	LH	SS	1820	*Donax*	Reddy 1999b
Southern Camp Pendleton - Santa Margarita River (n=12)						
4416	Yes	LH, pre-LH	SM	9,672	*Donax*, *Chione* and *Pecten*	Reddy 2000
4417	Yes	LH, pre-LH	SM	4,336	*Donax*, *Chione* and *Pecten*	Welch 1978
12,572	Yes	LH	SS	75,000	*Donax*, *Chione* and *Pecten*	Reddy and O'Neill 2000
12,577	Yes	pre-LH	SM	~50,000?	*Chione*	Pigniolo and Cleland 1996
12,628A	Yes	LH, pre-LH	SM	>480	*Chione* and *Anodonta*	York et al. 1999
14,060	Yes	pre-LH	SM	~14,000	*Chione*	Pigniolo and Cleland 1996
14,170	Yes	Lh	SM	>3000	*Donax* and *Chione*	York et al. 1999
14,748	Yes	LH, pre-LH	SM	>870	*Argopecten* and *Ostrea*	York et al.1999
14,749	Yes	LH	SS?	~560	*Argopecten* and *Ostrea*	York et al.1999
14,750	Yes	LH	SAS	~400	*Chione* and *Donax*	York et al.1999
14,751	Yes	LH	SAS	>800	*Chione*	York et al.1999
14,752	Yes	LH	SAS	>300	*Donax*	York et al. 1999

LH = Late Holocene; pre-LH = prior to Late Holocene; SM = shell midden; SS = shell scatter; SAS = shell and artifact scatter

Table 4. 2. Radiocarbon dates from sites in the coastal Camp Pendleton area*

CA–SDI–	PROVENIENCE	BETA–	SAMPLE TYPE	CONV. 14C AGE*	CALIB. DATE (± 1 SIGMA)	REFERENCE
Northern Camp Pendleton – San Mateo and San Onofre Drainages (n=22)						
1074	Unit 3, 40–50 cm	71126	Charcoal	580 ± 50 BP	AD 1300–1430	Byrd et al. 1995
1074	Unit 4, 60–70 cm	71127	Charcoal	610 ± 60 BP	AD 1280–1430	Byrd et al. 1995
4411	Unit 1, 30–40 cm	71128	Charcoal	470 ± 60 BP	AD 1420–1460	Byrd et al. 1995
4411	4020–1	136845	Shell	1500 ± 80 BP	AD 805–1000	S. Berryman
4411	2035–1	136846	Shell	850 ± 90 BP	AD 1420–1530	S. Berryman
8435	Hearth, section lower level	84214	Charcoal	1310 ± 90 BP	AD 600–905, 920–950	Reddy et al. 1996
8435	Unit IIId – upper phase	85409	Organic sediment	840 ± 70 BP	AD 1030–1290	Reddy et al. 1996
13,324	Unit 5, 90 cm	84365	Charcoal	770 ± 60 BP	AD 1175–1305	Reddy et al. 1996
13,324	Unit 7, 70–80 cm	84366	Charcoal	390 ± 50 BP	AD 1430–1645	Reddy et al. 1996
13,325	Unit 1, 70–80 cm	71130	Charcoal	2490 ± 70 BP	800–400 BC	Byrd et al. 1995
13,325	Unit 1, 70–80 cm	72206	*Protothaca* shells	2040 ± 70 BP	AD 190–530	Byrd et al. 1995
13,325	Unit 2, 60–70 cm	71131	Charcoal	3720 ± 70 BP	2310–1910 BC	Byrd et al. 1995
13,325	Unit 2, 60–70 cm	72207	*Protothaca* Shell	1830 ± 70 BP	AD 440–700	Byrd et al. 1995
16,283	R1, pond 1	124930	*Olivella* shell bead	810 ± 50 BP	AD 1670–1820	Byrd and Huntley 2002
16,283	R6, disk 1	124931	*Protothaca* shell	970 ± 80 BP	AD 1485–1665	Byrd and Huntley 2002
16,283	R9, disk 10	124932	*Protothaca* shell	920 ± 50 BP	AD 1545–1675	Byrd and Huntley 2002
16,283	R10, disk 13	124933	Sea mammal	1085 ± 40 BP	AD 1280–1345	Byrd and Huntley 2002
16,283	R17, disk 17	124935	Charcoal	360 ± 40 BP	AD 1470–1535, 1545–1635	Byrd and Huntley 2002
16,283	R18, disk 17	124936	Charcoal	340 ± 40 BP	AD 1485–1640	Byrd and Huntley 2002
16,283	R24, disk 18	124938	Sea mammal	660 ± 50 BP	AD 1290–1325, 1340–1390	Byrd and Huntley 2002
ORA–22	Area A–1, Unit 2, 50–60 cm	96149	*Protothaca* shell	400 ± 60 BP†	–	J. Romani 1997
ORA–22	Area B, Unit 2, 0–10 cm	103160	Shell	4070 ± 50 BP**	–	J. Romani 1997
Central Camp Pendleton,including Las Flores Creek (n=80)						
811	Unit 1, 70–80 cm	76211	*D. gouldii* shell	1560 ± 50 BP	AD 790–905	Byrd 1996
811	Unit 2, 80–90 cm	76212	*D. gouldii* shell	1740 ± 80 BP	AD 615–730	Byrd 1996
811	114/60–70, FAR I	?	Charcoal	2850 ± 130 BP	1200–835 BC	Rasmussen and Woodman 1998
811	116/60–70, FAR	?	*Chione* shell	2670 ± 70 BP	210–20 BC	Rasmussen and Woodman 1998
811	122/0–20	?	*D. gouldii* shell	1830 ± 60 BP	AD 710–875	Rasmussen and Woodman 1998
811	122/50–60	?	*D. gouldii* shell	1810 ± 70 BP	AD 720–905	Rasmussen and Woodman 1998
811	122/60–70	?	*D. gouldii* shell	1820 ± 60 BP	AD 720–885	Rasmussen and Woodman 1998
811	122/80–90	?	*D. gouldii* shell	2230 ± 80 BP	AD 280–495	Rasmussen and Woodman 1998
811	109/100–110	?	Pectinidae shell	2510 ± 70 BP	20 BC–AD 150	Rasmussen and Woodman 1998
811	115/240 cm,	?	*Pseudochama* spp. shell	4290 ± 80	2270–2005BC	Rasmussen and Woodman 1998
812A	STP 43, 20–40 cm	86597	*D. gouldii* shell	580 ± 60 BP	None	Woodman 1996
812A	STP 44, 20–40 cm	86598	*D. gouldii* shell	680 ± 50 BP	AD 1825–1950	Woodman 1996
812C	Unit 13, 20–30 cm	89382	*D. gouldii* shell	630 ± 60 BP	AD 1875–1950	Woodman 1996
812C	Unit 13, 50–60 cm	89379	*D. gouldii* shell	720 ± 60 BP	AD 1715–1950	Woodman 1996
812C	Unit 14, 70–80 cm	89378	*D. gouldii* shell	750 ± 60 BP	AD 1695–1950	Woodman 1996
812C	Unit 14, 90–100 cm	89374	*D. gouldii* shell	640 ± 50 BP	AD 1875–1950	Woodman 1996
812C	Unit 15, 30–40 cm	89384	*D. gouldii* shell	730 ± 60 BP	AD 1705–1950	Woodman 1996
812C	Unit 17, 60–70 cm	89381	*D. gouldii* shell	630 ± 60 BP	AD 1875–1950	Woodman 1996
812C	Unit 19, 140–150 cm	89385	*D. gouldii* shell	830 ± 60 BP	AD 1655–1800	Woodman 1996
812C	Unit 19, 170–180 cm	89380	*D. gouldii* shell	870 ± 60 BP	AD 1620–1705	Woodman 1996
812C	Unit 19, 190–200 cm	89333	*D. gouldii* shell	910 ± 70 BP	AD 1530–1690	Woodman 1996
812D	Unit 38, 20–30 cm	89376	*D. gouldii* shell	800 ± 60 BP	AD 1670–1835	Woodman 1996
812D	Unit 38, 40–50 cm	89377	*D. gouldii* shell	820 ± 60 BP	AD 1660–1820	Woodman 1996

continued

Table 4. 2. Radiocarbon dates from sites in the coastal Camp Pendleton area,* *continued*

CA–SDI–	PROVENIENCE	BETA–	SAMPLE TYPE	CONV. ^{14}C AGE*	CALIB. DATE ($\pm$ 1 SIGMA)	REFERENCE
Central Camp Pendleton,including Las Flores Creek (n=80)						
812E	Unit 24, 90–100 cm	89375	*D. gouldii* shell	660 ± 60 BP	AD 1835–1950	Woodman 1996
4416	Unit 1,50–60 cm	141930	*Chione*	7280 ± 80 BP	5860–5710 BC	Reddy 2000a
4536	Burial 15	LJ–3173	Shells (*Donax?*)	2120 ± 60 BP	?	Ezell 1975
4538	Unit 1, 40–50 cm	76213	*D. gouldii* shell	910 ± 60 BP	AD 1345–1515	Byrd 1996
4538	Unit 1, 40–50 cm	84168	Charcoal	570 ± 70 BP	AD 1290–1450	Byrd 1996
4538	Unit 5, 40–50 cm	84169	Charcoal	940 ± 70 BP	AD 985–1250	Byrd 1996
4538	Unit 5, 40–50 cm	76214	*D. gouldii* shell	1120 ± 70 BP	AD 1170–1405	Byrd 1996
4540	Unit 1, 10–20 cm	106338	*D. gouldii* shell	860 ± 40 BP	AD 1555–1820	Reddy 1999b
4540	Unit 1, 20–30 cm	106339	*D. gouldii* shell	78 ± 40 BP	AD 1665–1950	Reddy 1999b
10,726A	Unit 1, 70–80 cm	76215	*D. gouldii* shell	1270 ± 70 BP	AD 1015–1285	Byrd 1996
10,726A	Unit 1, 70–80 cm	84167	Charcoal	290 ± 70 BP	AD 1450–1685, 1740–1810,1930–1950	Byrd 1996
10,726A	Unit 12, 20–30 cm	130807	Sherd soot	180 ± 50 BP	AD 1660–1690, 1730–1810,1925–1959	Byrd 2000a
10,726A	Unit 12, 20–30 cm	130810	*Donax* shell	390 ± 70	None	Byrd 2000a
10,726A	Unit 13, 60–70 cm	130811	*Donax* shell	1300 ± 70 BP	AD 1030–1190	Byrd 2000a
10,726A	Unit 16, 40–50 cm	130812	*Donax* shell	1230 ± 70 BP	AD 1080–1260	Byrd 2000a
10,726A	Unit 18, 30–40 cm	130808	Sherd soot	410 ± 50 BP	AD 1470–1640	Byrd 2000a
10,726A	Unit 18, 30–40 cm	130809	Charcoal	200 ± 50 BP	AD 1655–1680, 1745–1805, 1935–1945	Byrd 2000a
10,726B (15,254)	Unit 5, 10–20 cm	76216	*D. gouldii* shell	810 ± 70 BP	AD 1455–1565	Byrd 1996
10,726B(15,254)	Unit 5, 60–70 cm	76217	*Chione* shell	6750 ± 90	5360–5215 BC	Byrd 1996
10,726B (15254)	Unit 5, 60–70 cm	76218	Charcoal	1090 ± 50 BP	AD 895–1005	Byrd 1996
10,726B (15,254)	Unit 5, 90–100 cm	84166	*Chione* shell	6870 ± 80	5445–5305 BC	Byrd 1996
10,726B (15,254)	Unit 21, 60–70 cm	130813	*Chione* shell	6800 ± 70	5450–5305 BC	Byrd 2000a
10,726B(15,254)	Unit 24, 20–30 cm	130817	*Donax* shell	710 ± 70 BP	AD 1515–1670	Byrd 2000a
10,726B (15254)	Unit 24, 50–60 cm	130814	*Chione* shell	6960 ± 70	5560–5460 BC	Byrd 2000a
10,726B (15,254)	Unit 28, 70–80 cm	130815	*Chione* shell	6980 ± 70	5600–5470 BC	Byrd 2000a
10,726B (15254)	Unit 29, 60–70 cm	130816	*Chione* shell	6700 ± 80	5600–5460 BC	Byrd 2000a
10,726B (15,254)	Unit 29, 10–20 cm	13818	*Donax* shell	870 ± 60 BP	AD 1420–1500	Byrd 2000a
10728A	Unit 3, Dep. 1, 0–10 cm	92913	*Chione* shells	7500 ± 60	6065–5845 BC	Byrd 1997
10728A	Unit 3, Dep. 1, 30–40 cm	91243	*Chione* shells	7200 ± 90	5845–5510 BC	Byrd 1997
10728A	Unit 3, Dep. 4, 60–77 cm	91244	*Chione* shells	7760 ± 100	6415–6000 BC	Byrd 1997
10728A	Unit 3, Dep. 5, 70–93 cm	92914	*Chione* shells	7365 ± 85	5980–5655 BC	Byrd 1997
10728A	Unit 5, Dep. 1, 0–10 cm	92915	*D.gouldii* shells	1060 ± 70 BP	AD 1230–1435	Byrd 1997
10728A	Unit 5, Dep. 1, 40–50 cm	92917	*D.gouldii* shells	1020 ± 70 BP	AD 1265–1455	Byrd 1997
10728A	Unit 5, Dep. 1, 40–50 cm	92916	*Chione* shells	6350 ± 90	5055–4665 BC	Byrd 1997
10728B	Unit 1, Dep. 1, 20–30 cm	91245	*D.gouldii* shells	780 ± 70 BP	AD 1435–1675	Byrd 1997
10728B	Unit 2, Dep. 1, 20–30 cm	91246	*D.gouldii* shells	870 ± 70 BP	AD 1375–1600	Byrd 1997
14,494	Unit 1, 40–50 cm	106340	*D. gouldii* shell	1590 ± 60 BP	AD 905–1200	Reddy 1999b
14,494	Unit 1, 70–80 cm	106341	*D. gouldii* shell	1660 ± 60 BP	AD 820–1105	Reddy 1999b
14,495	Unit 1, 20–30 cm	106342	*D. gouldii* shell	770 ± 60 BP	AD 1645–1950	Reddy 1999b
14,495	Unit 1, 50–60 cm	106343	*D. gouldii* shell	730 ± 50 BP	AD 1680–1950	Reddy 1999b
14,497	Unit 1, 10–20 cm	106344	*D. gouldii* shell	890 ± 60 BP	AD 1500– 1815	Reddy 1999b
14,497	Unit 1, 30–40 cm	106345	*D. gouldii* shell	1000 ± 60 BP	AD 1435–1675	Reddy 1999b
14,503	Unit 1, 20–30 cm	115028	*D. gouldii* shell	800 ± 50 BP	AD 1640–1950	Reddy 1999b

continued

14,503	U1–1	136853	Shell	700 ± 70 BP	AD 1525–1675	S. Berryman
14,504	STP 4, 30–40 cm	115029	*D. gouldii* shell	1070 ± 50 BP	AD 1420–1660	Reddy 1999b
14,506	Unit 1, 10–20 cm	106337	*D. gouldii* shell	970 ± 70 BP	AD 1440–1770	Reddy 1999b
14,516	Unit 1, 40–50 cm	115030	*D. gouldii* shell	1030 ± 60 BP	AD 1420–1660	Reddy 1999b
14,516	U1–1	136854	Shell	780 ± 70 BP	AD 1465–1625	S. Berryman
14,519	Unit 1, 20–26 cm	115031	*D. gouldii* shell	790 ± 40 BP	AD 1660–1890, 1935–1950	Reddy 1999b
14,519	U1–1	136855	Shell	570 ± 80 BP	AD 1665–1845	S. Berryman
14,520	Unit 1, 20–30 cm	115032	*D. gouldii* shell	1080 ± 60 BP	AD 1390–1620	Reddy 1999b
14,520	U1–1	136856	Shell	750 ± 80 BP	AD 1480–1655	S. Berryman
14,521	Unit 1, 20–30 cm	115033	*D. gouldii* shell	1100 ± 60 BP	AD 1360–1565	Reddy 1999b
14,521	U1–1	136856	Shell	950 ± 80 BP	AD 1330–1455	S. Berryman
14,522	Unit 1, 80–90 cm	115034	*D. gouldii* shell	2760 ± 60 BP	AD 35–55	Reddy 1999b
14,522	U1–1	136858	Shell	2810 ± 90	755–415 BC	S. Berryman
14,522	U1–2	136858	Shell	3050 ± 80	940–790 BC	S. Berryman

Southern Camp Pendleton – Santa Margarita River (n=41)

4416	Unit 4, 30–40 cm	141931	*Chione*	6870 ± 70	5480–5365 BC	
4416	Unit 4, 30–40 cm	141932	*Donax*	750 ± 70 BP	AD 1485–1645	
4416	Unit 5, 50–60 cm	141933	*Chione*	4060 ± 90	2270–2010 BC	
4416	Unit 5, 50–60 cm	141934	*Donax*	810 ± 70 BP	AD 1450–1545	
4417	2010–1	136847	Shell	1910 ± 80 BP	AD 415–595	S. Berryman
4417	2010–2	136848	Shell	5170 ± 90	3650–3500 BC	S. Berryman
12,572	Unit 6, 10–20 cm	138752	*Chione*	2060 ± 60 BP	AD 490–650	Reddy and O'Neill 2000
12,572	Unit 6, 20–30 cm	141205	*Chione*	1460 ± 70 BP	AD 885–1020	Reddy and O'Neill 2000
12,572	Unit 10, 10–20 cm	138754	*Chione*	1020 ± 60 BP	AD 1455–1560	Reddy and O'Neill 2000
12,572	Unit 4, 20–30 cm	138751	*Chione*	1470 ± 60 BP	AD 1065–1240	Reddy and O'Neill 2000
12,572	Unit 8, 20–30 cm	138753	*Chione*	1230 ± 50 BP	AD 1310–1415	Reddy and O'Neill 2000
12,577	?	?	Shell	6800 ± 70		Pigniolo and Cleland 1996
12,628A	Unit 1, 20–40 cm	?	Mixed shell	2340 ± 110**	?	Pigniolo and Cleland 1996
12,628A	Unit 6, 170–180	118562	*Chione* shell	1760±90 BP	AD 585–720	York et al. 1999
12,628A	Unit 8, 110–120	118563	*Anodonta* shell	1100 ± 60 BP	AD 885–1005	York et al. 1999
12,628A	Unit 6, 0–10 cm	120276	*Chione* shell	6880 ± 70	5445–5325 BC	York et al. 1999
12,628A	Unit 10, 20–30 cm	120277	*Chione* shell	6110 ± 130	4735–440 BC	York et al. 1999
12,628A	Cut bank, stratum 11	121313	*Anodonta* shell	480 ± 70 BP	AD 1315–1345, AD 1390–1520, AD 1570–1630 ***	York et al. 1999
12,628A	Cut bank, stratum 11	121314	*Anodonta* shell	110 ± 50 BP	AD 1670–1950 ***	York et al. 1999
12,628A	Cut bank, stratum 13	121315	*Anodonta* shell	190 ± 50 BP	AD 1645–1950 ***	York et al. 1999
12,628A	Cut bank, stratum 15	121316	*Anodonta* shell	420 ± 60 BP	AD 1415–1920 ***	York et al. 1999
12,628A	Cut bank, stratum 15	121317	*Anodonta* shell	370 ± 70 BP	AD 1435–1650 ***	York et al. 1999
12,628A	U8–1	136851	Shell	6840 ± 100	5480–5310 BC	S. Berrmany
12,628A	U8–2	136852	Shell	1290 ± 80 BP	AD 1030–1215	S. Berrmany
14,060	Unit 1, 70–80 cm	?	*Chione* shell	2970 ± 90**	–	Pignolo and Cleland 1996
14,170	Unit 1	?	*D. gouldii* shell	1270 ± 70**	–	Pignolo and Cleland 1996
14,170	Unit 6, 20–30	118564	*Chione* shell	1150 ± 120 BP	AD 1160–1345	York et al. 1999
14,170	Unit 4, 20–30 cm	118565	*Chione* shell	940 ± 100 BP	AD 1335–1480	York et al. 1999
14,170	Unit 4, 60–70 cm	118566	*Donax* shell	1280 ± 80 BP	AD 1045–1230	York et al. 1999
14,170	Unit 4, 70–80 cm	118567	*Chione* shell	1290 ± 90 BP	AD 1030–1230	York et al. 1999
14,170	Unit 6, 80–90 cm	118568	*Chione* shell	1510 ± 120 BP	AD 770–1025	York et al. 1999
14,748	Unit 5, 140–150 cm	118569	*Ostrea* shell	2270 ± 70 BP	AD 250–435	York et al. 1999
14,748	Unit 5, 40–50 cm	118570	*Chione* shell	2130 ± 90 BP	AD 405–625	York et al. 1999
14,748	Unit 1, 80–90 cm	120278	*Argopecten* shell	2250 ± 80 BP	AD 25–205	York et al. 1999
14,748	Unit 3, 50–60 cm	120279	*Argopecten* shell	1420 ± 120 BP	AD 875–1105	York et al. 1999
14,749	Unit 2, 40–50 cm	118571	*Argopecten* shell	790 ± 90 BP	AD 1455–1640	York et al. 1999
14,749	Unit 2, 0–10 cm	118572	*Argopecten* shell	830 ± 100 BP	AD 1430–1600	York et al. 1999
14,749	Unit 1, 10–20	120280	*Argopecten* shell	780 ± 50 BP	AD 1485–1600	York et al. 1999
14,750	Unit 1, 30–40 cm	120281	*Chione* shell	1080 ± 50 BP	AD 1285–1345	York et al. 1999
14,751	Unit 1, 90–100 cm	120282	*Chione* shell	1090 ± 80 BP	AD 1260–1375	York et al. 1999
14,752	Unit 2, 4050 cm	120283	*Chione* shell	1080 ± 60 BP	AD 1280–1360	York et al. 1999

* Unless indicated, all dates are in ^{14}C years before present with ^{13}C/^{12}C ratio correction, adjusted for local reservoir correction, ± 1 sigma, and using Libby half life (5568 years); ** Uncertain whether this age is corrected or not; *** Only two sigma calibration available

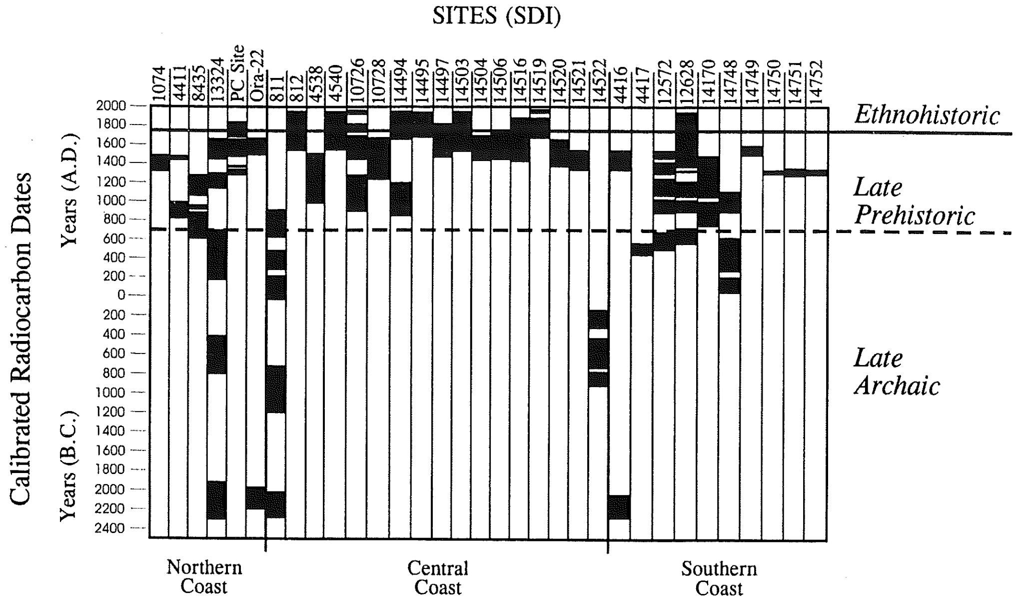


Figure 4.3 Distribution of post 2500 BC radiocarbon dates by area for the coastal area of Camp Pendleton

and fewer were occupied during the early Archaic. Archaic occupation is documented in all three areas of coastal Camp Pendleton, however, with considerable continuity of occupation from the Middle to Late Holocene.

Late Holocene shell middens also occur on each large and medium drainage along the Camp Pendleton Coast. They are typically characterized by moderate to thick (35 to 100 cm) anthropogenic sediments, occasional burials, and a diverse range of cultural material that includes substantial assemblages of shellfish, fish and terrestrial faunal remains, botanical remains, ground stone, flaked stone tools, and shell beads. These sites vary greatly in extent, ranging from 4000 m^2 to 525,000 m^2, with most classified as large sites (>20,000 m^2) and the rest as medium sites (20,000 to 2000 m^2). Available seasonality studies (based on analysis of botanical remains, fish otoliths, and seasonally available fish), have enabled researchers to document food resources procured during multiple seasons (Byrd 1996:316-328, 1997:140-142; Byrd, Pallette, and Serr 1995:169-174; Reddy, Giacomini, and Serr 1996). Late spring and summer plant resources predominate, fall resources are present at several sites, and winter resources have left only trace indications (Klug and Popper 1995; Reddy 1996a, 1997a). Fishing in summer, spring, and fall is primarily indicated by the recovery of barracuda, bonito, skipjack tuna, anchovy, and jackmackerel taxa typically captured in open waters offshore (J. Hudson 1995; J. Hudson et al. 1996; Wake 1997). These patterns suggest that virtually all the shell midden sites were major residential habitations occupied for multiple seasons and extended periods of time (Byrd 1998; Byrd and Reddy 1999).

Shell scatters are the most ubiquitous Late Holocene sites. They are typically small (less than 2000 m^2, n= 13) or medium size (n=5), with little anthropogenic sediment and a restricted range and density of cultural remains; are all virtually dominated by bean clam *(Donax gouldii)* shells. The shell scatters document a more limited range of activities and shorter lengths of occupation than the residential camps. Two functional types of these sites have been identified (Byrd and Reddy 1999; Reddy 1999b). The first types, termed limited activity locales, are interpreted as specialized shellfish processing and consumption sites. They evidence sparse shell densities, rare terrestrial faunal remains, no fish remains, and few or no artifacts. The absence of fish remains supports the specialized function of these sites and argues against them being short-term residences of family groups coming to the coast to exploit shellfish and fish during inland lean seasons as predicted in ethnohistoric reconstructions (Bean and Shipek 1978; Sparkman 1908; White 1963). These limited activity locales occur only on the coastal terraces away from water sources, and all postdate AD 1400. The second type, shell scatters with higher shell densities, several artifact types, occasional fish remains, and higher frequencies of lithics and terrestrial vertebrate remains, are generally situated along small drainages. They seem to indicate a wider range of activities and longer occupation. Termed dinner camps, they postdate 1000 BC, and all but two postdate AD 1200.

Based on emerging Late Holocene settlement patterns along the northern San Diego Coast, it is apparent that major residential bases are well documented for the last 2500 years. There is also a temporal trend toward an increase in smaller specialized activity sites. Clearly, prehistoric exploitation of the Camp Pendleton coastal zone flourished during the Late Holocene. These results suggest a diachronic trajectory beginning around AD 700 that became more highly developed after AD 1200. Characteristics of this later period include increased site density, less distance between major residential sites, and greater numbers and more varied types of specialized short-term occupation sites. This pattern can be interpreted as representing the emergence of more complex settlement patterns, with major residential bases along key drainages and more specialized sites clustered around them in a radiating organizational strategy (Binford 1980). These trends also suggest greater settlement permanence at major residential sites, a decline in the territorial range of these sites, and more thorough exploitation of the littoral zone within foraging ranges.

Currently, the coastal record at Camp Pendleton is not as robust prior to AD 700. Does this indicate a major hiatus in prehistoric coastal occupation or simply a gap in the current archaeological data? We suggest that this pattern is at least partly the result of site visibility, because valley floor sites predating 2000 years ago will be buried by alluvium (see also Warren at al. 1961:25). Geomorphic studies of Las Flores and San Mateo Creeks have demonstrated that the valley floor alluvium dates back into the Middle Holocene (Waters, Byrd, and Reddy 1999), and several sites have been documented as buried in this alluvium. During deep trenching at SDI-811, for example, a terminal Middle Holocene deposit was discovered (Rasmussen and Woodman 1998), and undated sites with Venus clams (*Chione*) are exposed in erosional cuts farther upstream along Las Flores Creek. Two phases of occupation at SDI-8435 are also buried in alluvium along San Mateo Creek (Byrd, Pallette, and Serr 1995; Reddy, Giacomini, and Serr 1996). Testing of buried sites along the Santa Margarita River has revealed a range of Late Holocene occupations focused on the exploitation of sandy beach and estuary resources (Pignolo and Cleland 1996; York et al. 1999). Given that valley floors were an important setting for major residential camps after AD 700, the lack of site visibility may severely limit our learning of the temporal extent of Late Holocene settlement. We predict that this settlement pattern was well established once valley floors became more alluviated in the Late Holocene.

Comparisons of the Northern Coast with the Central and Southern San Diego Coasts

Comparisons of the northern San Diego Coast with Late Holocene coastal occupation in southern San Diego County are inhibited by the lack of consistent reporting of radiocarbon dates. Consequently, all dates in this section are referred to in RYBP rather than calendar years. Our discussion proceeds from north to south, beginning with the San Luis Rey River area.

The San Luis Rey drainage is best known for its extensive inland Late Prehistoric settlements (True 1966, 1970). The regional study conducted by Vanderpot et al. (1993:177-187) revealed 68 prehistoric sites in the lower San Luis Rey River, of which 57% were Late Prehistoric based on geomorphic context or the presence of ceramics, bedrock mortars, pictographs, or arrow points. Based on the assumption that estuaries declined after 4000 years ago, an additional 13% (all shell middens dominated by *Chione* and *Argopecten*) were classified as Archaic. Some of these may date to the Late Holocene, however, as recently demonstrated by the dating of a specialized *Chione* locus at nearby SDI-10,841 (Byrd et al. 1997) and similar sites along the Santa Margarita River (Reddy and O'Neill 2000; York et al. 1999). Excavations at six coastal sites along the San Luis Rey River revealed Early, Middle, and Late Holocene occupations (figure 4.4) (Byrd, Victorino, and Pallette 1997; Laylander and Saunders 1993; Moratto et al. 1994; Vanderpot, Altschul, and Grenda 1993). Late Holocene occupations date after about 1500 years ago and include four sites dominated by Bean clam *(Donax gouldii)* and a small *Chione* shell scatter (table 4.3).

Limited information from dated sites near Buena Vista and Agua Hedionda lagoons revealed the presence of two major Late Holocene sites and a small shellfish collection and consumption site. Both dated sites near Buena Vista Lagoon are dominated by *Chione* shell, indicating the lagoon was open and economically viable during much of the last 3000 years (Cook 1996; Robbins-Wade 1986). The Rising Glen site (SDI-5213) was part of an extensive Late Holocene complex, with a midden up to 190 cm thick with dense quantities of shell (ca. 11 kg per m^2) dominated by *Chione*, *Argopecten*, and *Donax* (Cardenas and Robbins-Wade 1985; Robbins Wade 1986). The site is well dated between 2990 and 450 RYBP. Similarly, on the valley floor directly upstream from Agua Hedionda, Koerper, Schroth, and Langenwalter (1992) documented a residential site dating from 1730 to 1070 RYBP, dominated by *Donax*, with *Chione* and other lagoonal species represented. Research at these sites provides strong evidence of open lagoons and littoral adaptations during the Late Holocene.

Archaeological sites near Batiquitos Lagoon provide the most extensive data set in support of the closure of San Diego area lagoons between 3500 and 1500 RYBP, with a subsequent reopening (Gallegos 1985, 1987; Masters and Gallegos 1997). More than 20 sites in this area have been dated to the Late Holocene, but only four (SDI-604, SDI-946, SDI-4402, and SDI-4867) have produced dates between 3500 and 1500 RYBP (Gallegos 1985, 1991; chapter 3 this volume). Late Holocene sites in the Batiquitos area are generally dominated by *Chione* and/or *Argopecten*, occasionally contain thick midden deposits, but are more typically characterized as special function or limited use processing and consumption localities (Bull 1978; Cheever 1991; Cheever and Eighmey 1991; Gallegos 1986). These sites demonstrate that the lagoon supported economically

Table 4.3. Radiocarbon dates for Late Holocene sites south of Camp Pendleton organized by drainage from north to south

DRAINAGE / LAGOON	CA-SDI-	RADIOCARBON DATES (RYBP)*	COMMENTS	REFERENCE(S)
San Luis Rey River	5130B**	670 ± 60	*Donax* dominated	Moratto et al. 1994
	5445***	840 ± 60, 850 ± 60, 980 ± 60, 1230 ± 60, 1230 ± 60, 1650 ± 60	*Donax* dominated	Laylander and Saunders 1993
	6014**	470 ± 60, 480 ± 60	*Donax* dominated	Moratto et al. 1994
	10,841B***	625 ± 80, 395 ± 70	*Donax* dominated	Byrd et al. 1996
	10,841J***	1055 ± 70	*Chione* dominated	Byrd et al. 1996
Buena Vista Lagoon	5213†	440 ± 70, 450 ± 70, 730 ± 70, 910 ± 100, 1140 ± 70, 1360 ± 90, 1390 ± 70, 2190 ± 90, 2830 ± 70	Major residential site with thick midden dominated by *Chione*	Robbins-Wade 1986
	14,259†	1015 ± 70	Small special function *Chione* site	Cook 1996
Agua Hedionda Lagoon	5133***	1070 ± 70, 1450 ± 70, 1730 ± 60	Residential site *Donax*, then *Chione* dominated shellfish	Koerper et al. 1992
Batiquitos Lagoon	213†	3400 ± 240, 6320 ± 250		Bull 1978:174
	600 †	900 ± 70	Specialized shell midden with *Donax*, *Chione* and *Argopecten*	Cheever 1991: 26
	601†	1100 ± 70	Specialized site dominated by *Argopecten* followed by *Chione*	Cheever 1991: 39
	603†	1270 ± 70, 3900 ± 200, 6250 ± 150, 7300 ± 200	Major residential site	Crabtree et al. 1963
	604†	3500 ± 200		Hubbs et al. 1960: 209
	693†	825 ± 200, 1075 ± 150, 1220 ± 60, 1260 ± 70	Specialized shell midden dominated by *Argopecten*, *Chione*	Cheever 1991: 135
	763†	1210 ± 180, 3640 ± 60, 3620 ± 60, 4370 ± 250, 5250 ± 50		Gallegos 1985: Table 1
	946†	1160 ± 50, 1430 ± 60, 1460 ± 60, 1580 ± 70	Well buried and deep with *Chione* dominated shell lenses	Bull 1978
	2739†	830 ± 70		Gallegos 1985: Table 1
	4392†	710 ± 40, 6900 ± 280, 8010 ± 80, 8030 ± 80, 8040 ± 80, 8060 ± 50, 8110 ± 80		Gallegos 1985: Table 1
	4394†	550 ± 150		Gallegos 1985: Table 1
	4399†	920 ± 60		Gallegos 1985: Table 1
	4402†	1500 ± 150		Gallegos 1985: Table 1
	4845-1†	828 ± 80, 850 ± 90, 930 ± 70	Temporary camp with shellfish dominated by *Chione*	Gallegos 1986
	4851**	1090 ± 70, 1140 ± 80	Specialized site dominated by *Chione* shellfish	Gallegos and Huey 1991
	4863†	3640 ± 60	Minimal subsurface material	Bull 1978
	4867†	2640 ± 60		Bull 1978
	5415†	1395 ± 55		Gallegos 1985: Table 1

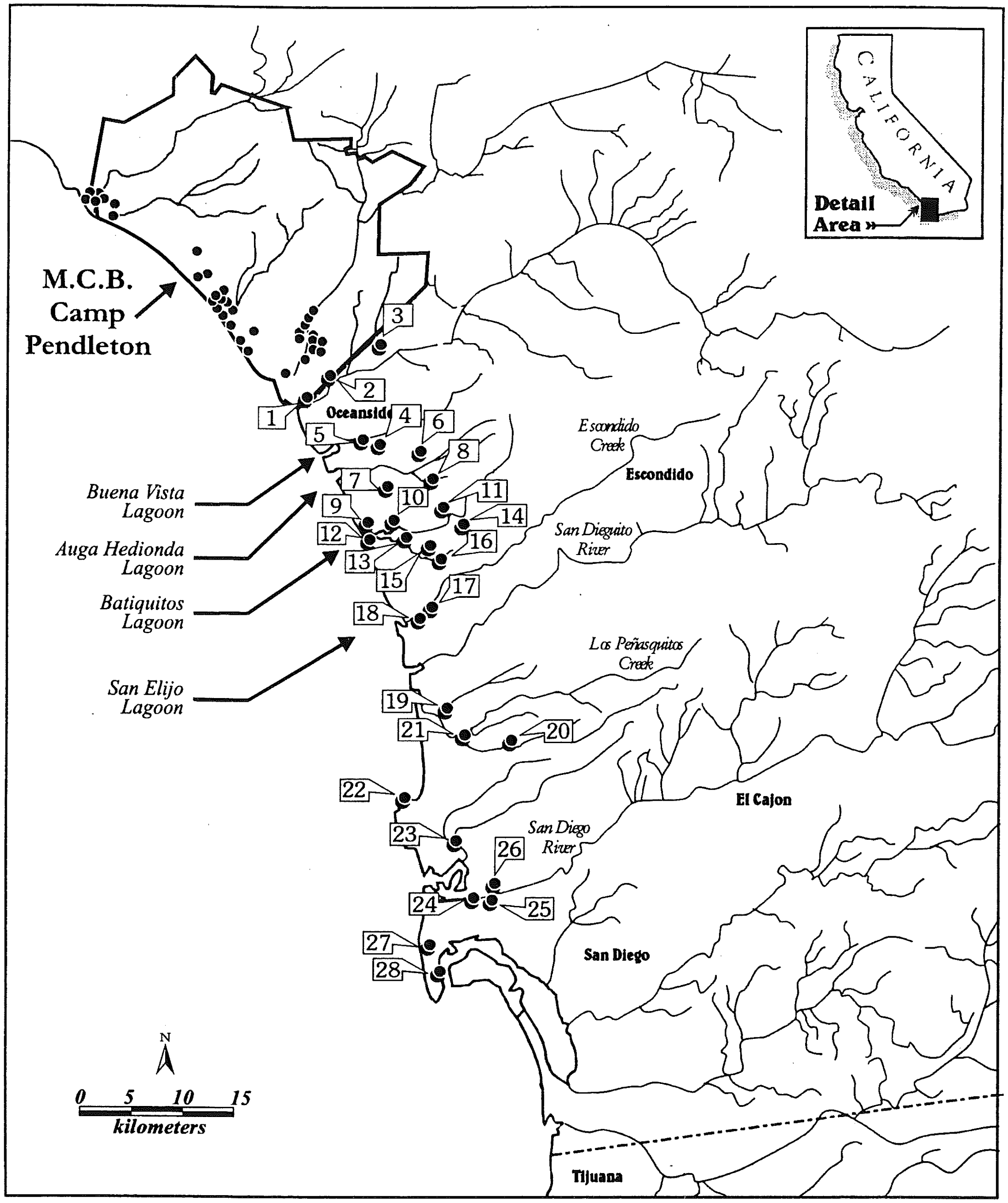
DRAINAGE / LAGOON	CA-SDI-	RADIOCARBON DATES (RYBP)*	COMMENTS	REFERENCE(S)
Batiquitos Lagoon (*continued*)	5955 †	835 ± 75		Gallegos 1985: Table 1
	6142†	900 ± 65, 920 ± 60		Gallegos 1985: Table 1
	6144†	505 ± 80, 625 ± 85, 775 ± 60, 1100 ± 70, 1310 ± 90		Gallegos 1985: Table 1
	6147†	580 ± 65		Gallegos 1985: Table 1
	6827**	3880 ± 70		Cheever 1991: 201
San Elijo Lagoon	6928**	2665 ± 40, 6230 ± 65	Specialized site, from unit 4 level 8 - middle of occupation	TEK 1984
	6933**	2445 ± 50, 2795 ± 60, 2865 ± 60, 3615 ± 60, 3930 ± 60, 4935 ± 65, 5040 ± 65, 5100 ± 65, 5200 ± 65, 5205 ± 65, 5985 ± 75, 6035 ± 75, 7900 ± 105		TEK 1984
Peñasquitos Lagoon	6829†	2355 ± 90, 3055 ± 140, 3300 ± 100, 3350 ± 100, 3400 ± 60, 3840 ± 65, 3930 ± 100, 3930 ± 60, 3985 ± 80, 4005 ± 70, 4095 ± 70, 4100 ± 95, 4155 ± 95, 4290 ± 65, 4460 ± 80, 4520 ± 115, 4675 ± 70, 4720 ± 100, 4770 ± 100, 4880 ± 90, 4955 ± 75, 4960 ± 90, 5070 ± 70, 5205 ± 90, 5430 ± 105, 5435 ± 70, 7140 ± 145	Major residential base	Smith and Moriarty 1985: 581
	4513 / 4609 / 5443†	<220?, 260 ± 70, 300 ± 60, 390 ± 60, 425 ± 145, 430 ± 50, 530 ± 50, 540?, 655 ± 80, 730 ± 70, 785 ± 105, 870?, 900 ± 75, 1080?, 1085 ± 65, 1085 ± 110, 1210 ± 60, 1240?, 1400 ± 70, 1500 ± 80, 1525 ± 60, 1620 ± 110, 1730 ± 75, 1870 ± 50, 2049 ± 60, 2064 ± 150, 2110 ± 90, 2215 ± 80, 2370 ± 70, 2475 ± 75, 2398 ± 65, 2525 ± 70, 2890 ± 90, 2925 ± 70, 2820 ± 00, 3755 ± 75, 4730 ± 100, 5040 ± 80	Ystagua complex residential base of	Gallegos et al 1989: Table 5-5; Smith and Moriarty 1983
San Diego and Mission Bays	Heron - 14,152***	340 ± 60, 1360 ± 40, 1380 ± 50, 1460 ± 70, 1510 ± 40, 1510 ± 60	Buried under 3 m of alluvium	Schaefer 1997
	La Rinconada de Jamo - 5017***	650 ± 75, 980 ± 95, 1140 ± 75, 2580 ± 105		Winterrwood and Cardenas 1987
	12,126†	860 ± 70, 990 ± 60	Thick midden (upper 1.4 m) dominated by *Chione*, *Pecten*	Kyle and Gallegos 1995; Schaefer 1997: 25
	11,767***	1915 ± 70, 2310 ± 60, 2500 ± 60, 2690 ± 70	Shell midden	Cooley and Mitchell 1996
	10,45†	2010 ± 70, 2300 ± 75, 2380 ± 70, 2400 ± 80, 2440 ± 70, 2680 ± 70	Point Loma	Pigniolo et al. 1991
	Ballast Point - 48†	680 ± 50, 1390 ± 70, 1550 ± 80, 1550 ± 90, 1800 ± 90, 1840 ± 120, 1940 ± 70, 2360 ± 80, 2570 ± 70, 2690 ± 80, 2990 ± 100, 3510 ± 90, 4940 ± 100, 6000 ± 100	Point Loma, thick midden with two loci	Gallegos and Kyle 1998

* Because of variability in reporting of the dates in the referenced reports (that is, measured age or conventional age, $^{13}C/^{12}C$ adjusted or reservoir effect included or not) the dates have not been calibrated

** No $^{13}C/^{12}C$ adjustment

*** $^{13}C/^{12}C$ adjusted

† Unknown or varied



Map Key

Site numbers (all CA-SDI- unless indicated)

1 10,841
2. 5445
3. 5130, 6014
4. 5213 (Rising Glen)
5. 14,259
6. 5133
7 6753, 6819
8 946, 4860, 4863
9 600, 601
10 693, 6827
11 213
12 603, 604
13 763, 4851
14 4402
15 4399, 4845
16 4394, 4392, 5955, 6142, 6144
17 6928
18 6933
19 6829
20 4513
21 4609 (Ystagua)
22 39
23 5017 (La Ronconada de Jamo)
24 11,767
25 14,152 (Heron)
26 12,126
27 10,945
28 48 (Ballast Point)

Figure 4.4 Map of San Diego County showing the location of dated Late Holocene coastal sites referred to in the text.

viable shellfish populations, even at times between 3500 and 1500 RYBP.

From San Elijo Lagoon south, the Late Holocene record is represented by fewer well-documented examples. Several major residential sites are known, however, and new evidence of buried sites has revealed the impact of Late Holocene alluviation on settlement pattern reconstructions (Carrico 1998; Gross and Wade 1998; Kyle and Gallegos 1995; Schaefer 1997). More than 50 prehistoric sites, including a series of major shell middens, are situated around San Elijo Lagoon (Loughlin and Bull 1974; Fink and Hightower 1976). Limited excavations have documented a rich and diverse archaeological record, and 20 dates from five sites are distributed from almost 8000 to 2500 RYBP (for example, Gallegos 1992:209; Miller 1966; B. Smith and Associates 1974; Smith 1982, 1995; TEK Corporation 1984). Shellfish exploitation patterns included the continued intensive exploitation of *Chione* and *Argopecten* throughout the sequence (TEK Corporation 1984). San Elijo Lagoon was a fully tidal estuary until recently, and Late Holocene indicators such as ceramics and *Donax* occur at other sites. Further field investigations should document additional Late Holocene occupation.

In the Los Peñasquitos Lagoon-Sorrento Valley area, a long sequence of coastal occupation spans the Late Holocene. At SDI-6829, a major shell midden is located on the north side of the lagoon (Smith and Moriarty 1985), a sequence of 27 dates bracket occupation from 7140 to 2355 RYBP, and extensive evidence suggest lagoonal resources remained important from 3500 to 2355 RYBP. Farther up the Sorrento Valley, a slightly later coastal occupation sequence occurs at Ystagua, a site complex (SDI-4513, SDI-4609, and SDI-5443) set within valley floor alluvium (see Gallegos, chapter 3, this volume). Extensive investigations at this multicomponent site complex have produced 38 dates, 35 of which range from around 3000 years ago into the Post-Contact period (Carrico and Gallegos 1989; Gallegos et al. 1989; Hector and Wade 1986; Smith and Moriarty 1983). Notably, littoral resources, including lagoonal species, were important early in the occupation.

A Late Holocene littoral adaptation was also present farther south (Gallegos 1992; Masters and Gallegos 1987). Adjacent to Mission Bay, Rinconada de Jamo (SDI-5017) contained a rich, thick (up to 1.4 m) midden dominated by *Chione* and *Argopecten*, with dates ranging from 2570 to 650 RYBP (Winterrowd and Cardenas 1987). Along the lower San Diego River, a series of sites were also dated to the Late Holocene (Gallegos 1995; Smith 1986). Late Holocene occupation at SDI-11,767 (2690 to 1915 RYBP) included a rich artifact assemblage, a range of shellfish mostly associated with bays, and fish resources (Cooley and Mitchell 1996). The adjacent Heron site (SDI-14,152), buried under 2 m of alluvium, is dated to near 1500 RYBP, with *Chione* dominated shellfish exploitation (Schaefer 1997). Nearby SDI-12,126 is a thick shell midden dated around 900 RYBP (Kyle and Gallegos 1995). On Point Loma overlooking San Diego Bay, investigations at Ballast Point (SDI-48) and SDI-10,945 further document thriving Late Holocene littoral adaptations and a strong marine resource orientation (Gallegos and Kyle 1988; Smith 1988; Pigniolo et al. 1991). Masters' (1998) paleoenvironmental reconstruction also indicates a flourishing and evolving littoral setting.

Overall, these results show that Mission Bay and San Diego Bay were productive areas for littoral hunter-gatherers throughout the Late Holocene. As we have shown in fact, coastal occupation and marine or estuarine resource exploitation continued during the Late Holocene throughout the San Diego coastal area.

Subsistence Trends

Our summary of Late Holocene subsistence patterns focuses on the northern San Diego Coast followed by brief comparisons with earlier patterns in this area and other patterns along the larger San Diego Coast.

Shellfish Remains

Shellfish exploitation was an integral part of Late Holocene adaptations on the northern San Diego Coast. The species exploited shifted over time, local patterns focused on the most abundant nearby resources, and smaller and more labor-intensive shellfish (*Tegula* and *Donax gouldii*) became key elements of this subsistence strategy (Byrd 1996; Reddy 1996b). The most distinctive aspect of this trend was the almost exclusive exploitation of the small, sandy beach *Donax* clams at all shell middens and specialized sites during the last 2000 years on the central Camp Pendleton Coast. The relative frequency of *Donax* ranged from 93 to nearly 100% at all shell middens and shell scatters in the area. This clam lives for just 2 to 3 years and reaches a maximum size of only 15 to 20 mm (Reddy 1996c).

Large quantities of shellfish were recovered from Late Holocene shell middens, with a mean of 12.7 kg /m^2 (range of 1.5 to 41.2 kg) for eight sites and a mean for maximum shell weight per 10 cm level of 3.9 kg (range of 0.3 to 14.8 kg) (Byrd 1998). These sites were situated primarily in aggrading alluvial settings (75%), and the quantity of shellfish varied significantly between drainages. Four shell middens in the northern San Onofre and San Mateo drainages had lower shellfish densities (mean 3.7 kg /m^2 and maximum shell weight per 10 cm level of 1.2 kg) than four shell middens in the central area (mean 21.7 kg /m^2 and maximum shell weight per 10 cm level of 6.8 kg). These differences may be owing to several factors, including varied alluvial sedimentation rates, differential exploitation emphasis, variance in occupation duration, and differences in the number of people involved.

Elsewhere at Camp Pendleton, shellfish exploitation varied between drainage systems owing largely to divergent ecological histories. In northern Camp Pendleton, *Donax gouldii* was much less abundant, while *Protothaca* (primarily from sheltered sand and gravel habitats and rocky points) and *Tegula* (black turban snail [maximum diameter of approximately 30 mm] from intertidal rocky shorelines) were the prevalent species. Rock-clinging mussels (*Mytilus* sp.) are also well represented. Along the Santa Margarita River, continued exploitation of *Argopecten* and *Chione* (with *Donax)* suggests the presence of a local estuary in the Late Holocene. Some sites are dominated by *Argopecten* and oyster (*Ostrea)*, indicating optimal estuary conditions (York et al. 1999).

VERTEBRATE REMAINS

Vertebrate exploitation along the Camp Pendleton Coast during the Late Holocene was dominated by small land mammals and nearshore fish, with much lower frequencies of elasmobranch fish, birds, marine mammals, and large land mammals (Hudson 1995; Hudson et al. 1996; Wake 1997, 1999a, 1999b). The major exception to this pattern was a greater exploitation of seals and sea otters (*Enhydra lutris*) and deeper water fish (such as tuna and Pacific mackerel) at SDI-13,325 near the mouth of San Mateo Creek (J. Hudson 1995). The highest frequencies and widest range of taxa dominated by waterfowl, primarily ducks, are also from this site.

In general, offshore fish, such as tunas and mackerel (Scombridae), were more prominent earlier in time (that is, SDI-811 and SDI-13,325). Elasmobranchs (such as bat ray, shovelnose guitarfish, and smooth hound), California halibut, croakers and labrids, and other bony fishes were also exploited, but over time elasmobranchs and flatfishes virtually disappeared. At sites postdating AD 1200 topfish (sardines, anchovies, and smelts), croakers, and wrasses predominated, and these fish were primarily associated with nearshore environments. This association suggests that fishing emphasis shifted to open coast and schooling sandy beach species, and reflected a change in procurement strategies from fishing with hooks and lines to using nets to capture surf and schooling fish.

Throughout the Late Holocene, small land mammals (rodents and rabbits) were the most common and diverse taxa. Large mammal remains, primarily deer, were infrequent. Most Late Holocene sites had low frequencies of bird remains. Where bird remains were present, they were generally terrestrial taxa (California quail, doves, and passerines) and rarely waterfowl. After about AD 1200 most sites have moderate densities of vertebrate remains dominated by small mammals, especially rabbits and rodents. Aquatic bird and flat fish taxa are absent, and fish diversity is low. Overall, species diversity appears to have decreased during the Late Holocene.

CARBONIZED PLANT REMAINS

Paleoethnobotanical investigations at 14 Late Holocene coastal sites provide preliminary insights into plant utilization along the northern San Diego Coast (Klug and Popper 1995; Martin and Popper 1998; Reddy 1996a, 1997a, 1999a, 2000b, 2000c). Although sample sizes and recovery rates vary, they provide sufficient data to make preliminary inferences about plant exploitation. Trends during the first half of the Late Holocene are less clear since smaller sample sizes affect patterning, particularly with respect to genera diversity. Sites postdating AD 1200 provide much larger sample sizes and more reliable reconstructions of plant exploitation patterns.

Seed density and taxonomic diversity vary considerably in the sampled Late Holocene coastal sites (table 4.4). Higher seed densities and diversity characterize major residential bases (for example, SDI-811, SDI-4411, SDI-1074, and SDI-10,728A). Note that high seed densities at SDI-12,628, SDI-14,748 and SDI-14,749 are based on relatively small and nonsystematic sampling and may not accurately represent plant use. Lower seed densities and taxonomic richness are typical at specialized sites focused on shellfish procurement. Plant use at coastal sites was focused on local habitats, particularly on the collection of grasses, and on spring and summer resources. Overall, plant remains representing 20 families and 48 genera have been documented, with grasses occurring in the highest frequencies. Of the 48 genera, 15 belong to the grass family (Poaceae), and these include only one introduced genus (*Digitaria* sp.). Grass seeds belonging to *Bromus/Stipa* spp., *Hordeum* sp. *Phalaris* sp., and *Sporobulus* sp. occur in the highest frequencies. "Fire followers," which include genera indicative of fire (fire followers and plants that thrive in open areas created by prescribed burns), are represented to varying degrees at Late Holocene coast sites. These include *Callandria*, *Lotus*, *Marah*, corms and bulbs from wild flowers, *Hordeum*, *Trifolium*, *Chenopodium*, and Poaceae. The presence of these plants suggests that prescribed burning was practiced to varying degrees along the coast. Evidence of acorn exploitation is minimal, a trend also noted at more inland Late Holocene sites (Reddy 1997b). In general, seed densities at Late Holocene outer coast sites are significantly lower than at Late Holocene sites in upland settings at Camp Pendleton (Reddy 1999a).

Contrasts of Late Holocene with Early and Middle Holocene Sites Along Las Flores Creek

On the central Camp Pendleton Coast, several differences are evident in resource trends at Late Holocene sites versus the two well-documented Early to Middle Holocene sites, SDI-10,726B and SDI-10,728A. First, shellfish exploitation

Table 4.4. Summary of carbonized plant remains from Late Holocene to Camp Pendleton

CA-SDI-	REF.	SV (L)	CS (N)	SD (N/L)	G (N)	GR (%)	SR	FF (N*)
811	Reddy 1996a; Martin and Popper 1998	127.5	137	1.35	12	21	Spring, summer, poss. fall	48
1074	Klug and Popper 1995	63.4	136	2.1	13	17	Spring, summer, early fall/winter	36
4411	Klug and Popper 1995	28	140	5	9	5	Summer, fall	22
4538	Reddy 1996a	61	95	1.36	13	44	Spring, summer	61
10726A	Reddy 1996a, 2000b	806.3	224	0.28	10	15	Spring, summer, fall	53
10,726B (15,254)	Reddy 1996a, 2000b	691	293	0.42	14	33	Spring, summer, fall	167
10,728(A)	Reddy 1997a	242	379	1.57	33	30	Spring, summer, fall	164
10,728(B)	Reddy 1997a	71	33	0.46	6	33	Spring, summer, poss. fall	42
12,572	Reddy 2000c	190.35	72	0.38	6	10	Spring, summer	14
12,628	Popper and Martin 1999	1.8	8	4.44	0	0	Unknown	0
13,325	Klug and Popper 1995	24.7	14	0.6	4	7	Spring, summer	29
14,170	Popper and Martin 1999; York et al. 1999	**	192	2.22	4	22	Spring, summer	41
14,748	Popper and Martin 1999	4.5	20	4.44	1	0	Unknown	0
14,749	Popper and Martin 1999	2.2	12	5.45	1	0	Unknown	0
TOTAL		2317.35	1563	0.67	48	17***		

SV = Sample Volume; CS= Carbonized Seeds; SD= Seed Density; G=Genera; Gr=Grasses; SR=Seasons Represented;FF=Fire Followers; N= Number L= Liters
*Genera indicative of fire (fire followers and plants that thrive on burns) include *Callandria, Lotus, Marah*, corms/bulbs from wild flowers, *Hordeum, Trifolium, Chenopodium*, and Poaceae.
**3.6 liters of known volume, but remaining volume unreported
***Mean value

shifted over time, due partly to changes in habitat. Earlier sites have a more diverse range of species (over 20 documented per site), with the taxa dominated by *Chione* and *Argopecten; Ostrea lurida* is most frequent in the initial occupation levels (Byrd 1996). Shellfish density was only slightly higher (mean shell weights of 17.2 and 11.6 kg/m^2 and maximum shell weight per 10 cm level of 7.2 and 4.4 kg, respectively) than on average for Late Holocene sites. Persistence of rocky shore and estuary habitats into the early Late Holocene is indicated by rocky shore shellfish in the earliest levels at SDI-811 (Rasmussen and Woodman 1998) and observations of buried sites with a preponderance of *Chione* (Waters, Byrd, and Reddy 1999).

Differences in vertebrate subsistence practices also exist between Early and Middle Holocene sites and Late Holocene sites. Earlier sites generally have higher taxonomic diversity and greater densities of vertebrate faunal remains. Vertebrate subsistence focused on two primary habitat mosaics: estuaries and their contact zones with the ocean and the surrounding terrestrial habitats. The major difference was greater numbers and diversity of fish species, including elasmobranchs, California halibut (*Paralichthys californicus*), and other flatfishes (Bothidae and Pleuronectidae) in the earlier sites. Anchovies (Engraulidae) and smelts (Atherinidae) were also well represented. Most of these species were associated with bays and estuaries (Eschmeyer, Herald, and Hammann 1983; Salls 1988). Ducks and other waterfowl were more frequent, indicating the presence of relatively productive estuarine systems. For plant resources, the patterns were more complex and will require additional investigation to fully explore. A diverse diet appears to have characterized subsistence strategies at early settlements, however, and grasses are well represented throughout the sequence.

In summary, subsistence trends entailed intensification in the exploitation of littoral resources, both of terrestrial and marine origin. From the Middle to Late Holocene, diet breadth increased with greater reliance on smaller, lower-ranked resources in virtually all subsistence categories: shellfish, fish, birds, terrestrial fauna, and possibly plants. Shellfish remained important, but harvesting strategies shifted to smaller species such as *Donax gouldii*. The dietary importance of large mammals and birds declined during the Middle and Late Holocene, while small land mammals increasingly dominated the terrestrial meat diet. Fish resources, primarily lower-ranked nearshore species, decreased in diversity and possibly in relative dietary importance over time, although shellfish and fish may have eclipsed terrestrial protein resources during the Late Holocene. Collection of plant resources during the Late Holocene also appears to have increasingly focused on those species requiring higher handling costs, particularly grasses.

SAN DIEGO REGIONAL PATTERNS

Through the Holocene, changes in sea level and shoreline significantly affected the range and abundance of coastal resources, particularly shellfish, as rocky shores and bays gave way to lagoons and extensive sandy beaches (Inman 1983). The broad temporal trend across the Holocene in the procurement of shellfish entailed a shift from rocky bottom and rocky intertidal habitats (such as *Mytilus*) to lagoons (*Argopecten* and *Chione)* to sandy beaches (*Donax* and *Tivela)* (Bull 1978; Gallegos 1985; Masters and Gallegos 1997; Warren 1964; Warren and Pavesic 1963). Lagoon siltation and the spread of sandy beaches affected what resources were available and presumably their relative density. Yet it is clear from Late Holocene shellfish procurement trends that the timing and nature of shifts in shellfish availability, inferred from their presence within dated archaeological sites, was highly situational. Where sufficient data are available, each drainage and shoreline stretch appears to have its own distinct history. Shellfish gathering, often of very different species, clearly persisted, however, as a viable economic strategy at numerous Late Holocene coastal sites.

The exploitation of lagoonal shellfish, especially *Chione* and *Argopecten*, is well documented at many Late Holocene sites near major lagoons, particularly major residential bases. These two species typically dominate shellfish assemblages, and the temporal span of their use varied greatly. Archaeological investigations along Mission Bay reveal the presence of bay and lagoon species from around 2500 years ago into the modern era (Winterrowd and Cardenas 1987). At Buena Vista and Peñasquitos lagoons, this trend persisted throughout much of the Late Holocene, and it was also evident after 1500 years ago at Batiquitos Lagoon. At San Elijo Lagoon both *Argopecten* and *Chione* were exploited to at least 2500 years ago (TEK Corporation 1984). In much of the northern portion of the San Diego area, particularly the central coast of Camp Pendleton and along the San Luis Rey River, *Donax* was the predominant shellfish resource after 2000 years ago (Byrd 1998; Laylander and Saunders 1993). At Agua Hedionda, *Donax* dominates after 2000 years ago, but lagoon species are also well represented (Robbins-Wade 1986). In addition, a shift to a greater use of rocky shore species was documented at Ballast Point along San Diego Bay (Cerreto 1988). Thus, although there is considerable diversity in the types of littoral habitats and shellfish exploited along the San Diego Coast in the Late Holocene, lagoonal resources were widely exploited when available.

A related trend during the Late Holocene was the prevalence of small shell scatters, and these sites are interpreted as specialized processing and consumption localities. Such sites are well documented at Batiquitos Lagoon and along the Camp Pendleton Coast. At Batiquitos Lagoon these post-1500 RYBP sites are generally dominated either by *Argopecten* or *Chione* (and occasionally *Donax*). The presence of specialized *Argopecten* sites during this period was not predicted by prior perceptions regarding temporal changes in shellfish species (for example, Gallegos 1985). The evidence suggests that expedient and intensive exploitation of locally available shellfish was an important aspect of Late Holocene adaptations along the San Diego Coast.

Regarding the exploitation of marine vertebrates, fish were well represented at a series of Late Holocene sites, and the available data reveal varied emphasis on different local habitats (see also Noah 1998). This variability includes emphases on lagoon and open water fish at SDI-5213 along Buena Vista Lagoon (Robbins-Wade 1986), nearshore fish at SDI-5133 near Agua Hedionda Lagoon (Koerper et al. 1992) and at various sites on Camp Pendleton (Wake 1999b), nearshore kelp beds and open ocean beyond the surf zone at SDI-5017 near Mission Bay (Winterrowd and Cardenas 1987), and rocky and soft substrates at SDI-48 along San Diego Bay (Gallegos and Kyle 1998). Fish remains were also noted at many other Late Holocene sites, but varied recovery techniques preclude easy comparisons. Finally, a more maritime emphasis, with significant exploitation of marine mammals and deep water fish, was uncommon but is documented at SDI-48 and SDI-10,945 near San Diego Bay and at SDI-13,325 along San Mateo Creek (Byrd, Pallette, and Serr 1995; Gallegos and Kyle 1998; Pigniolo et al. 1991). Throughout the San Diego outer coast area, terrestrial resources were also important, and vertebrate remains were dominated by small species. Currently, our knowledge of plant resource use is largely limited to the Camp Pendleton area where grasses and legumes dominate macrobotanical assemblages (Reddy 1999a); elsewhere, systematic recovery of carbonized plant remains is infrequent.

LATE HOLOCENE TECHNOLOGIES

The most discussed technological developments during the Late Holocene are generally linked to the onset of the Late Prehistoric period, including bow and arrow technology, ceramics, and the possible appearance of the mortar and pestle (Meighan 1954; M. Rogers 1945; True 1966; Wallace 1955; Warren 1964). In the San Diego area, spatial variation in other aspects of material culture and behavior are often considered to be indicative of different Native American linguistic groups (True 1966).

Research into the timing of technological changes during the Late Holocene has been hampered by the lack of fine-grained chronological control due to considerable bioturbation, particularly at multicomponent sites (see Erlandson 1984; McDonald and Eighmey 1998). In addition, most of the sites that form the basis of these patterns are situated in the mountains or inland foothills. Syntheses of technological trends for coastal sites are lacking. The available evidence, albeit nonquantitative, indicates lower frequencies of arrow points, ceramics, and imported obsidian at coastal rather than inland sites, and possibly the later introduction (or widespread use) of ceramics. Non-perishable specialized marine resource procurement gear, such as fishhooks and gorges, are rare or absent at most Late Holocene littoral sites in the San Diego area (Noah 1998: Table 4). Important exceptions to this trend include the presence of shellfish hooks at SDI-13,325 and SDI-1074 along

San Mateo and San Onofre creeks, and bone gorges and composite fish hooks at SDI-48 and SDI-10,945 along San Diego Bay (Byrd, Pallette, and Serr 1995; Chace 1975; Gallegos and Kyle 1998; Pigniolo et al. 1991).

Evidence for increasing elaboration in material culture (either in terms of the range of utilitarian tools being used for the procurement and processing of food stuffs or tools for other tasks), in the greater use of decorative motifs on utilitarian goods, or increased production of nonutilitarian items such as beads, is lacking in the outer coast region. Craft specialization, large-scale trade of nonperishable items, and strongly linked regional economic systems such as characterized the Chumash region at Spanish contact are also not well documented in the San Diego area. These topics, along with the cultural context and overall impact of new technologies, have not been the subject of detailed investigations but represent an important and potentially productive direction for future research. Overall, existing patterns (or lack thereof) suggest either conservatism in the adoption of new technologies or, more likely, the fundamental importance of perishable gear and equipment, as noted in the ethnohistoric record.

SUMMARY

Unlike many characterizations of the San Diego Coast during the Late Holocene (for example, Christenson 1992; Gallegos 1992; Masters and Gallegos 1997; Warren 1964; Warren, Siegler, and Dittner 1998), we have demonstrated that littoral occupation was well represented. Well-dated major Late Holocene residential sites (shell middens) occur along San Diego Bay, Mission Bay, Los Penasquitos Lagoon and the Sorrento Valley, Agua Hedionda Lagoon, and Buena Vista Lagoon, and from Las Flores Creek to San Mateo Creek at Camp Pendleton. Many of these sites probably represent coastal villages noted by Portolá in AD 1769 (Carrico 1998). Given the richness of cultural remains and the considerable time depth documented at many of these larger sites, they probably represent relatively stable and sedentary coastal settlements. The San Luis Rey River area also probably had considerable Late Holocene occupation, based on Vanderpot, Altschul, and Grenda's (1993) regional study. More limited evidence of Late Holocene occupation is available for the lower Santa Margarita River, Batiquitos Lagoon, San Elijo Lagoon, and San Dieguito Lagoon areas. Of these four areas, only Batiquitos Lagoon has had sufficient archaeological research, so that the dearth of occupational evidence between 3500 and 1500 years ago seems relatively secure. Overall, the available data from the San Diego Coast document essentially continuous occupation associated with highly situational Late Holocene littoral adaptations, which included exploitation of terrestrial plants and animals, shellfish, fish, and on occasion marine mammals. They also confirm that ethnohistoric accounts of remnant local Native American populations are of limited utility for understanding precontact coastal subsistence systems.

Why does our interpretation differ from some prominent earlier reconstructions? In large part, prior interpretations relied heavily on the analysis of limited paleoecological data from a single core and archaeological sites from a single estuarine basin, Batiquitos Lagoon. This interpretation was perfectly reasonable at the time, but new data clearly demonstrate that the patterns of environmental changes and cultural responses along the San Diego Coast were quite different and much more diverse than previously suspected.

Ongoing research at Camp Pendleton is also demonstrating the fundamental role that alluvial and colluvial deposition has played in obscuring the Late Holocene archaeological record. A recent review by Gross and Robbins-Wade (1998) of the southern San Diego Coast also demonstrates the effects of alluviation and colluviation in burying coastal sites. Moreover, Carrico (1998) recently argued that historic sedimentation has probably buried several Post-Contact coastal sites, such as along the San Dieguito and Tijuana Rivers. Given the prevalence of valley floor occupation during the Late Holocene, it is not surprising that it is taking longer to gain a better understanding of this phase of the region's coastal occupation. With the accumulation of data over the last 35 years, it is clear that a diverse range of environments was available and exploited, and Late Holocene adaptations were richer and more complex than initially recognized (see Moss and Erlandson 1995). It is also clear that littoral productivity is more varied on a diachronic scale than are terrestrial settings owing to the extremely dynamic nature of coastlines. Hence, coastal settings remain some of the most difficult to model for hunter-gatherer subsistence practices.

Unfortunately, chronological issues continue to inhibit insights into Late Holocene cultural and environmental changes in the San Diego area. First, the proposed chronological gap from 3500 to 1500 RYBP has been exacerbated by classification procedures. In the past, if lagoonal shellfish remains dominated a shell midden, for instance, the site was often assumed to be an Archaic period site, probably older than 3500 years. Many excavations (often done in the context of CEQA CRM projects) at sites with lagoon shellfish have not obtained absolute dates, perpetuating prior hypotheses instead of critically evaluating them. Second, regional studies that assess chronology and cultural developments often rely on highly variable and imprecise data; much of the available dating evidence is not directly comparable, the full range of occupation at individual sites is not established, and ^{14}C dates on different materials have not been standardized to calendar years (see Erlandson 1994). This is not surprising since these dates were assayed over a 40-year period on a range of samples of varying integrity, yet it makes detailed temporal comparisons between sites and areas very difficult. With better comparative data and the widespread use of calibration to change radiocarbon years to calendar year estimates, our perceptions of the peaks and valleys in coastal occupation will almost certainly change significantly.

Recent research at Camp Pendleton along the northern San Diego Coast provides the most detailed picture of diachronic trends in Late Holocene adaptations. In this area, settlement pattern shifts took place by around AD 700 and become more pronounced after AD 1200. These trends included greater overall site density, closer spacing in the distribution of major residential settlements, and an increase in the number and types of specialized short-term occupation sites. We have interpreted these patterns as representing the emergence of a more complex, logistical settlement system. Associated data also indicate considerable settlement permanence at major residential sites, a decline in the territorial range of these sites, and more thorough exploitation of the littoral zone within the foraging range of each residential site. At the same time, this intensive harvesting involved increased reliance on smaller, less "optimal" resources (such as nearshore schooling fish and small shellfish) that typically entailed a greater investment in time to collect, process, and store. This situation suggests a loss of foraging efficiency and resource intensification at littoral communities similar to other regions of coastal California (Basgall 1987; Broughton 1994a, 1994b, 1997; Glassow 1996c, 1997a; Porcasi 1995; Raab 1992, 1996; Raab and Yatsko 1992).

In this area, trans-Holocene trends in average site size and the overall number of sites suggest lower population densities in the Early to Middle Holocene and less need for specialized sites within the daily foraging range of major residential bases. In contrast, the Late Holocene appears to have been a period when coastal populations coped with smaller foraging ranges by intensifying the use of specific resources and creating a greater range of site types. Although the causes for these changes remain unresolved, we hypothesize that the end of the Holocene witnessed increased population pressure (either as a result of larger populations, a more restricted subsistence base, or both). These trends appear to be correlated with increased territoriality, greater settlement permanence, resource stress, and shifts in subsistence strategies. These settlement and subsistence patterns may also reflect potentially profound changes in the social structure of these hunter-gatherer communities that are much more difficult to address archaeologically. They may have been important determinants of cultural patterns evident in the Luiseño ethnohistoric record, including tightly spaced villages, strong territoriality, and aspects of ownership, residential patterns, and community-level decision making. A key objective of future research should be to examine the interrelationships among environmental change, population density, population movement, territorial circumscription, and the pace of culture change. It is clear, however, that Late Holocene occupation in the San Diego area was dynamic and locally innovative, and it did not entail coastal abandonment.

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Complexity, Demography, and Change in Late Holocene Orange County

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Recent studies of Southern California coastal prehistory, particularly those focused on the Chumash area of the Santa Barbara Channel, have emphasized the apparent social consequences of climatic downturns (for example, Arnold 1990b, 1991a, 1992a, 1995a, 1997; Arnold, Colten, and Pletka 1997; Raab and Larson 1997). Focused on such phenomena as recurrent droughts as catalysts for resource intensification, and the evolution of sociopolitical formations as defensive units, these studies envision cultural changes as reflections of punctuated equilibrium rather than gradual responses to slow, low-intensity demographic and/or environmental flux. These studies also beg reassessment of Late Holocene culture change along the Orange County Coast.

In this chapter, we combine high-resolution rainfall, sea surface temperature (SST), and wetland salinity data with other information relating to succession within prehistoric plant and shellfish communities to help understand Late Holocene cultural changes in coastal Orange County. Shifts in climate and hydrologic conditions, anthropogenically or environmentally caused resource depletions, and new production technologies all link demographic dynamics to subsistence intensification, territoriality, violent behavior, trade, and the further elaboration of status hierarchies during the Late Holocene in Orange County. Important hydrologic events include the meandering channels of major drainage systems, such as the Los Angeles River, the San Gabriel River, and especially the Santa Ana River. Droughts during the Medieval Climatic Anomaly (MCA) and the Little Ice Age (LIA) are viewed as catalysts precipitating social changes in Late Prehistoric times. Based on the evidence for these sudden and/or dramatic environmental events and concomitant cultural responses, we argue that a model of punctuated equilibrium provides a better explanation for the Late Holocene prehistory of coastal Orange County than does a model of gradualism.

The spatial and temporal patterning of Orange County ^{14}C dates indicates that dramatic demographic shifts occurred within the Late Holocene. Whether reflecting depopulation or changing settlement arrangements, fewer ^{14}C dates for the Newport Bay area fall between 4000 and 3000 years ago during the transition from the Milling Stone period to the early Intermediate period than are assigned to the previous millennium. Based on ^{14}C data, the population focus appears to have been at Bolsa Chica Bay at this time rather than at Newport Bay. For the early Late Prehistoric period, an upsurge in the number of ^{14}C dates at and near Newport Bay signals an increase in local population, while depopulation characterizes Bolsa Chica Mesa. The upsurge in ^{14}C dates in the San Joaquin Hills at this time perhaps signals settlement reconfiguration toward a dispersed residential pattern. In addition, it is possible that some families moved from the Bolsa Chica area to the Newport Bay region in response to siltation of Bolsa Chica Bay and reduction in shellfish availability. In the Newport Bay and San Joaquin Hills region, the upsurge in ^{14}C dates coincides with an increase in the numbers of sites, many of which have high densities of tools and subsistence remains, indicating they were residential bases.

Departing from traditional regional chronologies, we employ the earlier demographic shift at Newport Bay, along with adoption of the circular fishhook, to mark the beginning of the Intermediate period. The second demographic shift, in conjunction with adoption of the bow and arrow, provides a chronological boundary for the transition between the Intermediate and Late Prehistoric periods. Speculatively, the beginning of bow and arrow use may coincide with the coastal arrival of Takic migrants from the Great Basin. As another temporal convenience, we take the onset of certain population shifts, apparently attendant with MCA drought episodes, as a point intermediate between the early Late Prehistoric and the late Late Prehistoric subperiods.

NATIVE GROUPS AT CONTACT

At the time of Spanish contact, Orange County was occupied by native groups later known as Gabrielino (Tongva) and Juaneño (Ajachemem). As tribal designations, Gabrielino and Juaneño are working fictions, indicating only two groupings of people, one sharing Gabrielino-Fernandeño speech and many customs and the other sharing Luiseño-Juaneño speech and many customs. Both languages are of the Cupan group of the Takic family of the Uto-Aztecan stock (Shipley 1978; see also Bright 1975). The Fernandeño are usually subsumed under the Gabrielino (Bean and Smith 1978:538). The Juaneño are considered by some to be a segment of the Luiseño (see R. White 1963:91).

The Gabrielino and Juaneño subsisted by hunting and gathering. The most important food sources were several species of oak, which provided acorns, and grasses and sage bushes, which provided seeds. Rabbits and deer may have contributed the most important animal protein sources inland, but at or near the coast, fish, shellfish, and terrestrial and marine mammals all contributed to the diet (Boscana 1978; Heizer 1968; Johnston 1962; McCawley 1996).

The coastal Gabrielino and Juaneño were distributed in a series of rancherias or politically autonomous clan-based groups that occupied coastal Southern California when the Spanish arrived in the late eighteenth century (D. Earle and O'Neil 1994). Each rancheria was a discrete bounded territory and had a principal village where the clan chief resided. The principal village was a permanent year-round residential center with ceremonial enclosures and a cemetery.

D. Earle and O'Neil (1994) identified a series of rancherias whose principal villages were located along the Santa Ana River. Genga, located on Newport Mesa overlooking the Santa Ana River, was closest to the ocean, while Pajbenga, Totpavit, and Hutuknga were farther upriver (figure 5.1). Hutuknga was the largest of these villages with an estimated population of 150 to 250. The next largest was Genga with between 100 and 150 residents (see Koerper et al. 1996). Newport Bay was within Genga territory, as indicated by the bay's original Spanish name, *Bolsa de Gengar*. Late Prehistoric sites around Newport Bay are presumed by D. Earle and O'Neil (1994) to have been dependencies of Genga. It is probable that the northern San Joaquin Hills were also within the Genga territory. People from Genga were baptized at both San Gabriel and San Juan Capistrano missions. As discussed by D. Earle and O'Neil (1994), Genga was linked by marriage ties to rancherias upriver, such as Hutuknga; to rancherias in Los Angeles County, such as Puvunga in east Long Beach; and to rancherias to the south around San Juan Capistrano. Although the lower Santa Ana River area is usually considered to have been Gabrielino, it was probably a multiethnic and multilingual community, as indicated by Genga marriage ties to both Gabrielino and Juaneño rancherias. The Santa Ana River political units appear to have been conduits of contact and exchange between the Gabrielino and Juaneño cultural areas and between the coast and the interior (D. Earle and O'Neil 1994).

In what is now southern Orange County, Juaneño villages were located on San Juan Creek and its tributaries, and along Aliso Creek and San Mateo Creek. Located on San Mateo Creek, Pange was the largest Juaneño village, with an estimated population of 250 (D. Earle and O'Neil 1994:77).

ENVIRONMENT

Throughout the Holocene, major prehistoric population concentrations along the Orange County Coast occurred between the Newport Beach and Seal Beach areas. They were located on high ground (8 to 40 m) above embayments and wetlands that were at times fed directly by the Santa Ana River (figure 5.1). Demographic shifts occurring from one mesa or hill to another were undoubtedly influenced by the shifting fortunes of the river.

During the Holocene, the Santa Ana River meandered approximately 28 km along the coastline, spilling periodically into or near Newport Bay and into the Santa Ana Marsh, which lies between Huntington Beach Mesa to the north and west and Newport Mesa to the south and east. At other times, the river took a straight southwesterly course across the county to Bolsa Chica Bay, bounded north and south by Bolsa Chica Mesa and Huntington Beach Mesa, respectively. The river waters could also run to either side of Landing Hill, feeding Anaheim Bay or Alamitos Bay. The Los Angeles and San Gabriel Rivers at times also flowed into Anaheim and Alamitos Bays.

Even in the 1900s, the Santa Ana River was dynamic. Until the outbreak of World War I, the river ran parallel to the coast and behind a sand bar, exiting into lower Newport Bay (Macdonald 1991:54). In 1938 during a major flood, the river flowed east to west across the northern end of Anaheim on a westerly trek to Los Alamitos Bay (Troxell et al. 1942). It is unlikely that the river has discharged through upper Newport Bay for several hundred or even thousands of years (Macdonald 1991:5). Indeed, O. Davis's (1996:23) recent lower Newport Bay pollen study suggests that the "long dry period" at San Joaquin Marsh, which he

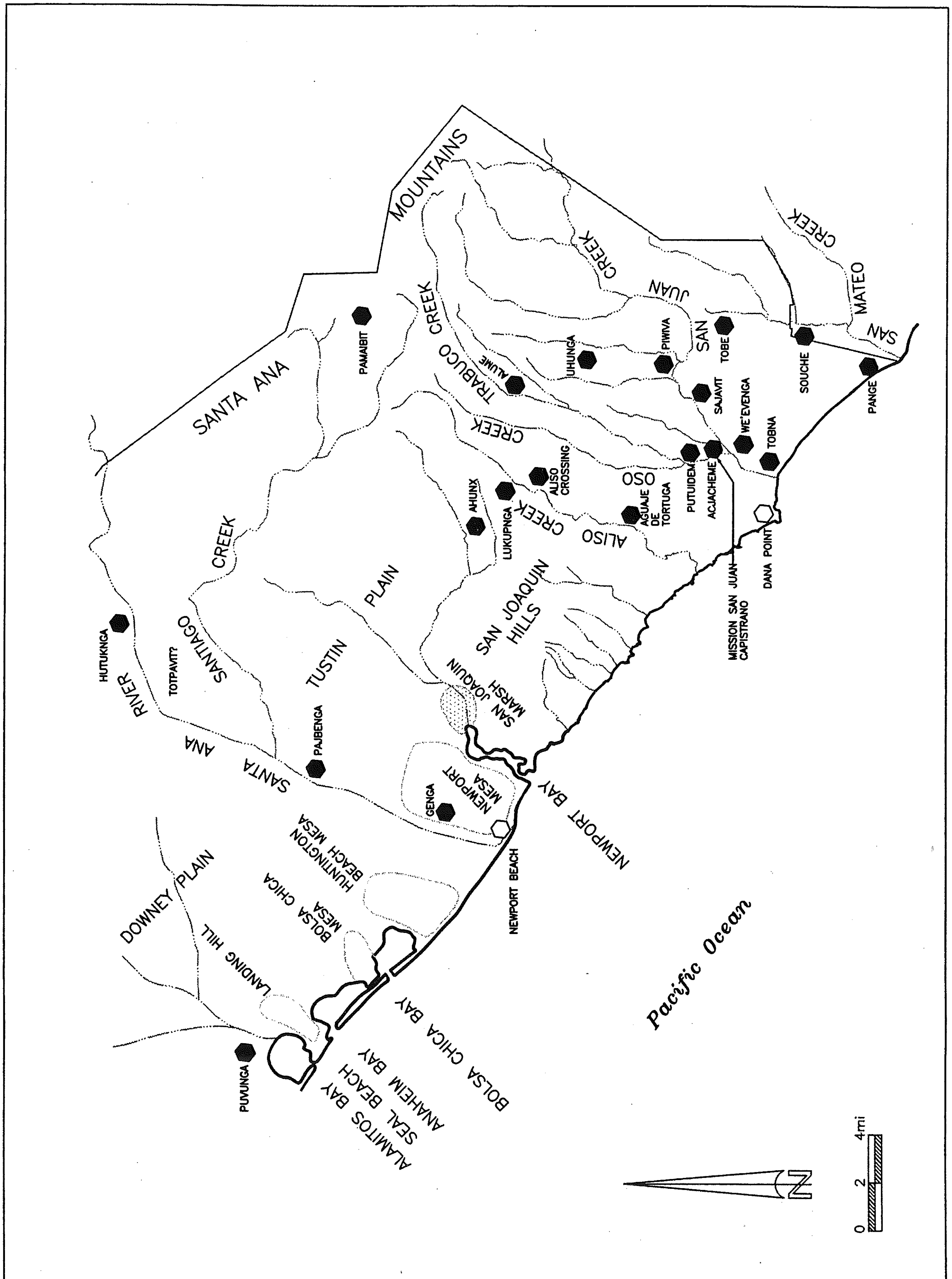

Figure 5.1 Locations of Mission period villages with topographic and hydrographic features of Orange County. *Map by Richard Houck* (after D. Earle and O'Neill 1994).

previously documented (O. Davis 1992), may have begun as a consequence of the river being diverted from the head of the bay.

A number of plant associations were available to coastal inhabitants of the mesas and other high ground. These included coastal sage scrub, grassland-herbland, riparian woodland, saltmarsh estuary and bay, and freshwater marsh communities, all of which offered economically important flora and fauna (see Koerper 1981). Interfaces of estuary and freshwater marsh microenvironments are particularly productive, creating ecotones with concentrations of many organisms of each association, as well as life forms not characteristic of either the saltmarshes or freshwater marshes ("edge species").

The beach, coastal strand, and marine zones held an array of shellfish, sea mammals, and fish. Low-elevation chaparral and oak woodland resources (Koerper 1981) were available to coastal dwellers who followed the Santa Ana River inland or who had access to the San Joaquin Hills. These hills also supported grasslands and sage scrub growth.

Inland from that part of the coast that extended from the Newport Bay area to the Los Alamitos Bay area, a vast artesian basin was made possible by underlying impervious clayey layers. Water escaping through breaks in the clay produced widespread swampland and artesian springs (Works Progress Administration 1936:144). The vast marshy vegetation and peat lands of over 3200 ha might extend as far inland as 12 km from the coast within the boundary of the 15 m contour (Talbert 1952:23). Food sources on and around the mesas were generally sufficient, precluding any necessity to forage very far amid the dense growth of this swampy territory. Consequently, for populations concentrated on high ground close to the coast, the several catchment zones would not have extended any significant distances across relatively impenetrable lands. With regard to basic subsistence, territory beyond the 15 m contour that bordered the swamps would have held limited allure for most area residents who lived near the ocean.

There were, however, residential bases at inland locations opposite the coastal population concentrations. Inhabitants would have foraged through the basin area that lay behind the artesian zone, and likely made limited incursions into swamp lands. It is clear from ethnohistoric and archaeological records that villages and residential bases were situated along reliable watercourses. For instance, the ethnohistorically known villages of Genga, Pajbenga, and Hutuknga were located beside the present channel of the Santa Ana River (D. Earle and O'Neil 1994; Koerper et al. 1996). The river was also the route Mohave traders followed when transporting goods (such as textiles from the Southwest) during the late Late Prehistoric period (Koerper 1996; Koerper and Hedges 1996).

Other settlements would have been positioned along alternate routes of the Santa Ana drainage. To either side of any Santa Ana channel, at least as far coastward as the 15 m contour, some villages, residential bases, and locations would have existed within this less densely populated subregion. We know less about the adaptive strategies of these more inland people, particularly those of the Downey and Tustin plains, areas highly disturbed by modern development.

Moving to the south county area, historically recorded Juaneño communities were located along creeks whose waters drained to the ocean. The major creeks, Aliso, Trabuco, San Juan, and San Mateo, flowed perennially, and there were springs along Aliso Creek. People from various villages located along these drainages probably exploited the marine zone by following the drainages downslope. There were no large bays or estuaries in the south county, although some coastal marshlands were available at the mouths of some drainages. All other previously mentioned microenvironments were available for exploitation.

Resources in the catchments of Santa Ana foothill settlements were not as diverse as those at or near the coast. Although foods were not obtainable in freshwater and saltwater marshes and at the beach, coastal strand, and marine zones, low elevation chaparral communities and foothill woodland associations offered some compensation. While fish, shellfish, and terrestrial and marine mammals all contributed animal protein for coastal people, rabbits and deer were proportionally more important inland.

During the Late Holocene, lowland and cismontane communities (herbs, shrubs, and oak) were subsiding, continuing a trend that began around 3700 BC. There was a corresponding increase in coastal sage scrub and chaparral, particularly in the last 2200 years (Heusser 1978). Fires, often deliberately set, encouraged plant succession in the direction of increased chaparral (see Hanes 1970; Lewis 1973) and coastal sage scrub, thereby increasing seed crops. Scrub oaks (*Quercus dumosa*), for instance, sprout vigorously after a fire, and their leaves and acorns are important food sources for deer (Lewis 1973:27-28). People also used scrub oak acorns when there were shortages of other acorn types. Repeated burning eventually converts sage scrub to grasslands, and fire enhances seed-rich grassland productivity (Koerper 1981:99). Brush stands usually grow intermittently in grassy habitats. The extensive grasslands the Portolá Expedition encountered in Orange County (Bolton 1971:132, 137, 143) may be ascribed to repeated fires.

No less important to understanding Late Prehistoric demographics are environmental factors, such as siltation, that affect shellfish productivity in bay and lagoon environments (Koerper 1981:50-58). The consequences of postglacial sea level rise for most San Diego County estuaries were recognized decades ago (Shumway, Hubbs, and Moriarty 1961;

Warren and Pavesic 1963; Warren, True, and Eudy 1961). Chace (1966) applied Warren's (1968; Warren and Pavesic 1963) ecological model to Newport Bay, but Koerper (1981) argued that the bay continued to contain productive shellfish beds through the Late Prehistoric period. Evidence from the Newport Coast Archaeological Project (NCAP) demonstrated that rich shellfish beds persisted in Newport Bay throughout the Late Holocene (Mason and Peterson 1994). Only sporadic use of Bolsa Chica Mesa and Huntington Beach Mesa is recorded during most of the Late Prehistoric period, owing partly to poor shellfish yields, a circumstance that also characterized Anaheim Bay, although Alamitos Bay remained productive (Whitney-Desautels 1997:17).

While pollen from the Santa Barbara Basin (Heusser 1978) and observations of archaeologically recovered shellfish provide broad scenarios of environmental change, high-resolution climatic data are required to more directly address current hypotheses of cultural development. Happily, data to more precisely connect climate and culture change have recently been generated through studies of geochemistry, sedimentology, and dendrochronology.

Stable isotope analyses of marine shells are providing records of local SSTs, for instance. In Late Holocene Orange County, lower ^{18}O values on ORA-855 mussel shells suggest that local waters during the LIA (AD 1400 to 1850) were about 3°C cooler than today (Koerper, Killingley, and Taylor 1985). Other $^{18}O/^{16}O$ ratio analyses necessitate a reconsideration of Pisias' (1978) paleotemperature reconstructions based on radiolarian work (D. Kennett 1998; D. Kennett and Kennett 2000; J. Kennett, Kennett, and Ingram 1997). Some isotopic studies also provide seasonality estimations, and so far shellfishing appears to be more intensive during warmer months for much of the Holocene (Dunbar et al. 1998; Ericson 1993; Koerper and Killingley 1998). Additionally, otolith analysis covering much of the Holocene indicates reduced nearshore coastal fishing through the cold months (Koerper 1995; R. Mason, Koerper, and Langenwalter 1997; R. Mason and Peterson 1994). These parallels may suggest that shellfishing was an adjunct of fishing or fowling, both of which are less productive in winter.

Reduced LIA SSTs (Koerper, Killingley, and Taylor 1985) correspond to circa post AD 1390 freshwater conditions at San Joaquin Marsh, at the upper end of Newport Bay (O. Davis 1992). Around 3800, 2800, and 2300 years ago, three other freshwater episodes punctuated the predominant saltmarsh regime that developed after 4500 years ago.

Further, the lowest moisture levels indicated by Davis's (1992) San Joaquin Marsh pollen analysis occurred between AD 1100 and 1300 when dendroclimatic data identify a prolonged and particularly harsh drought period. This dendroclimatic information comes from submerged tree stumps in the central Sierra Nevada (M. Hughes and Graumlich 1996; Stine 1994), subalpine conifers in the southern Sierra Nevada (Graumlich 1993), big cone spruce in the Transverse Ranges (Larson and Michaelsen 1994), and Bristlecone pine timberline shifts (LaMarche 1974). Further, geomorphological and microfossil studies in the Bouton Creek catchment in the eastern Long Beach area indicate protracted droughts between about AD 900 and 1300 (Boxt et al. 1999), a period referred to as the Medieval Climatic Anomaly or Medieval Climatic Optimum. These extreme conditions had profound consequences for the people of Orange County. Indeed, north of Gabrielino territory in the Santa Barbara Channel region, such drought conditions likely contributed to the transformation of an egalitarian society into a ranked society (D. Kennett and Kennett 2000).

CHRONOLOGY

Two schemes, those of Wallace (1955) and Warren (1968), have dominated discussions of chronology building in Orange County (Koerper 1981:118-179; Koerper and Drover 1983, 1984; Warren 1984). C. King's scheme (1981, 1990) for the Santa Barbara Channel area is occasionally referenced in the local literature, particularly when time-sensitive beads are discussed (Gibson 1992; Gibson and King 1994). Here, we retain some of Wallace's nomenclature (Milling Stone, Intermediate, Late Prehistoric), substitute the generic and neutral designation "period" in place of either "horizon" or "tradition," and set archaeological cultures within the Holocene divisions formulated by Erlandson (1988b; Erlandson and Colten 1991b). Thus, we divide the Late Holocene in Orange County into the Intermediate and Late Prehistoric periods, and the Milling Stone period spans all of the Middle Holocene and part of the Early Holocene.

Nearly 1300 calibrated dates for Orange County are available to aid in our chronology building (figure 5.2). A frequency distribution of these dates helps define periods and subperiods and reflects changes in settlement and population. Peterson calibrated all dates using the CALIB program (Rev. 3.0.3A) (Stuiver and Reimer 1993). In calibrating dates for marine shell, a locally derived correction for marine upwelling was used (Prior, Peterson, and Southon 1996).

Erlandson and Colten (1991b:1-2) emphasized that the transition from Middle to Late Holocene (ca. 1000 to 1500 BC) is less than arbitrary, citing C. King (1981) whose Early and Middle periods in the Santa Barbara Channel area break at around 1400 BC, a recognition of increased diversification in subsistence, technology, and adornment. Between around 2000 and 1000 BC, for whatever reasons, the number of ^{14}C dates diminishes for Newport Bay and for Orange County generally, although not for Bolsa Chica Bay. Milling Stone residential bases on the marine terraces of the

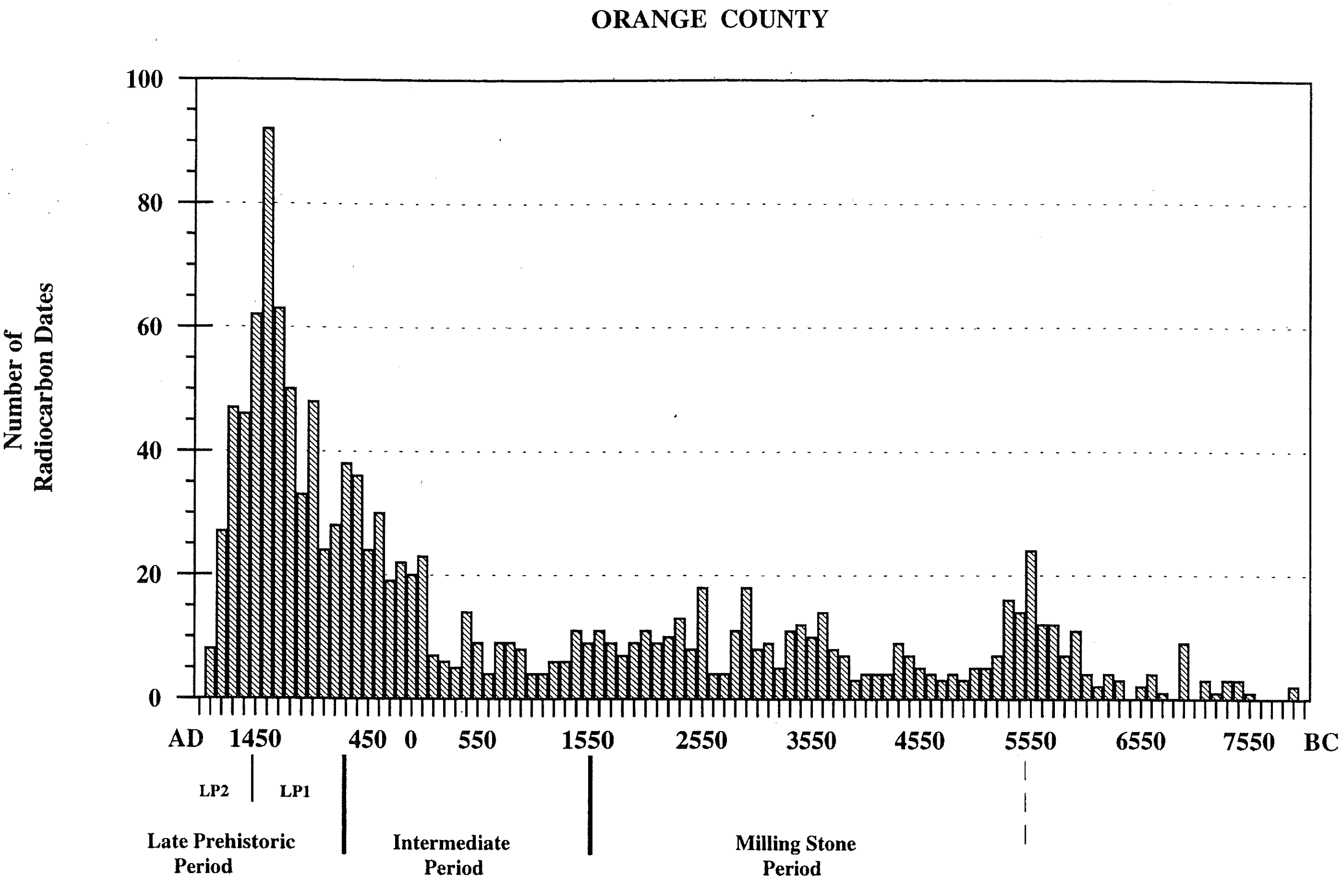

Figure 5.2 Frequency distribution of radiocarbon dates. *Graph by Patricia Peterson*

Newport Coast (R. Mason, Koerper, and Langenwalter 1997) were no longer occupied after about 2000 BC. The number of ^{14}C dates, however, for the Bolsa Chica Bay area indicates continued occupation at this time.

We place the beginning of the Intermediate period within a 1000 year span (2000 to 1000 BC) represented by fewer ^{14}C dates for the Newport Bay area and Newport Coast, and further believe that the date of approximately 1400 BC marks the transition point between the late Milling Stone and early Intermediate periods, a time coinciding with the Middle to Late Holocene interface. Following the onset of the Intermediate Period, there is a nearly continuous increase in the number of ^{14}C dates through the middle of the Late Prehistoric period.

The beginning of the Late Prehistoric period at about AD 600 coincides with the beginning of the expansion of residential settlement into the San Joaquin Hills southeast of Newport Bay. The Late Prehistoric period was originally divided into two subperiods, LP1 and LP2, based on further expansion of major residential settlement into the San Joaquin Hills (R. Mason and Peterson 1994). Now that calibrated dates are available for the entire county, it can be seen that LP2, beginning approximately AD 1300, shows the beginning of a decrease in dates that culminates with Spanish colonization in the late 1700s. This decline may reflect a decrease in human population related to droughts during the MCA. Further, it was during LP2 that some Gabrielino peoples migrated from places somewhere between southern Los Angeles County and the Santa Ana River to the San Juan Capistrano Valley area. Such population shifts were probably too late to be related to environmental events of the MCA, but instead may have occurred during a dry cold episode of the LIA (Koerper and Mason 2000).

Following traditional practice, we also identify artifacts associated with each temporal division. Single-piece circular fishhooks first appeared in the county towards the beginning of the Intermediate period (Koerper et al. 1988), signaling diminished use of fish gorges. Three hooks have been AMS dated, all falling within the Intermediate period (Koerper et al. 1995). First use of circular hooks on San Clemente Island may have begun about 1350 BC (Raab 1996, 1997; Raab et al. 1995; Raab et al., chapter 2).

Time sensitivity is undocumented with regard to the atlatl and dart points unearthed from Intermediate period components in Orange County. Indeed, such sensitivity could not even be demonstrated in a large sample of Middle Holocene projectiles (Koerper, Schroth, and Mason 1994). Certain rare artifacts, such as discoidals and lunate crescents, may have survived from Milling Stone into Intermediate times (Koerper and Drover 1983:20).

While mortars and pestles first appeared in the Milling Stone period (Erlandson and Colten 1991b:1; Glassow 1997c:152; Wallace 1955:220), they were increasingly employed during the Intermediate period and after (Koerper 1979:75, Table 2). If the primary function of these tools was to prepare acorn meal, the importance of acorns may have increased gradually over time. It has been suggested, however, that the mortars and pestles were first used to pulverize root foods (Glassow 1997c:154). Thus acorn exploitation may yet turn out to be a time-sensitive trait, although not one easily detected archaeologically. Any definitive statement could follow only from accurate speciation of plant residues from a large diachronic sample of processing equipment.

In contrast to the comparatively gradual ascendancy of mortar and pestle over mano and metate, arrow projectile points rather suddenly replaced atlatl dart projectiles between AD 400 and 600. We earlier suggested that the replacement of atlatl and dart by bow and arrow marked the end of the Intermediate period on the Orange County Coast and the beginning of the Late Prehistoric period (Koerper et al. 1996:277-288). About this time, an upsurge in ^{14}C dates began for the San Joaquin Hills, possibly indicating population pressure in the area surrounding Newport Bay. These events may be related. Population increase may have resulted in adjustments in social structure. Rapid adoption of the bow and arrow may have been a consequence of increased fighting by groups competing for resources (Blitz 1988).

No single arrow point type is identified as the earliest. The first arrow points may have been downsized from dart points of similar forms. The earliest notable quantities of points were of the Cottonwood series. Leaf-shaped forms probably preceded the triangular styles, and the ratio of Cottonwood leaf-shaped to Cottonwood triangular types decreased through time (Koerper et al. 1996). The degree of basal notching on triangular points (Waugh 1988) seems not to be time sensitive (Koerper et al. 1996). Locally manufactured Sonoran arrow points appear almost exclusively during the second half of the Late Prehistoric period, after about AD 1300 (LP2) (Koerper et al. 1996).

Bead chronologies are particularly useful for defining archaeological cultures locally. Gibson and King's (1994) study of beads from the NCAP employed 300 NCAP ^{14}C dates to test C. King's (1981, 1990; see also Gibson 1992) and Bennyhoff and Hughes' (1987) chronologies. This effort generally supported application of the Santa Barbara Channel sequence to Orange County prehistory. Further research adds corroboration (Gibson 1996, 1997a, b, c, d). A recent study breaks new ground, having employed AMS technology to directly ^{14}C date nine shell beads and two shell ornaments from ORA-378, a predominantly Intermediate period site in Irvine (Gibson and Koerper 2000; Koerper 1995), to further refine the Chumash bead sequence for application in Orange County.

Bead types definitely associated with the Intermediate period include small obliquely or diagonally spire-ground *Olivella* shells (A2a), large (8 to 9 mm in diameter) *Olivella* wall disks with large hole diameters (2.5 to 3.0 mm), and teardrop/oval *Megathura* (limpet) rings (ca. AD 0 to 500) (Gibson 1992). Characteristic of the early Late Prehistoric period, (LP1) are tiny (2 to 3 mm in diameter) *Olivella* wall disk beads (AD 700 to 900) (Gibson 1992). Present in both LP1 and LP2 are *Olivella* cup beads (AD 1100 to 1780), as well as mussel (*Mytilus*) disk beads (AD 900 to 1800) (Gibson 1992). *Olivella* split-punched beads (AD 900 to 1000 in the Santa Barbara Channel region) are, so far, absent in Orange County. Beads characteristic of LP2 include *Olivella* thin-lipped types (after AD 1500), as well as very large cup beads that employ all of the callus and part of the wall of an *Olivella*. These *Olivella* full-lipped types are restricted in time of occurrence (AD 1650 to 1780) (Gibson 1992).

The LP2 period provides the first certain evidence of trade connections to the Lower Colorado River. Mohave people transported Hohokam *Glycymeris* shell bracelets, baked clay anthropomorphs, Sonoran-type projectiles, and textiles into Orange County in exchange for shell and shell beads, indirectly infusing Hohokam culture elements onto the Pacific Coast (Koerper 1996; Koerper and Hedges 1996).

Of the little Obsidian Butte volcanic glass that passed into Orange County, the great majority arrived during LP2 (Ericson et al. 1989; Koerper et al. 1986). Nearly all obsidian arriving during the Intermediate and Milling Stone periods was quarried from northern sources, mostly the Coso volcanic field.

Trade in culinary ware fashioned from Santa Catalina Island soapstone offers another hallmark of the Late Prehistoric period. Micaceous steatite provided the material for bowls and comals. This same material, as well as higher grades of talc schist from the island, was used to manufacture distinctive effigies that served as dimorphic sexual symbols in ritual contexts. So-called "birdstones," "pelican stones," and "hookstones" comprise a genre (Kroeber 1925:630) that may have been employed throughout the Late Holocene (Koerper et al. 1995) and into historic times (Koerper and Labbé 1987, 1989), but those sculptures made of soapstone were a Late Prehistoric phenomenon.

Fired clay pipes traded from San Diego County are a feature of LP2. Tizon Brown culinary ware was manufactured in terminal LP2 or protohistoric times (Hurd, Miller, and Koerper 1990; Koerper et al. 1978).

SETTLEMENT, DEMOGRAPHICS, AND ENVIRONMENT

Two basic causal models to account for Chumash social change between AD 1150 and 1300 are related to various threats to well-being and inherited status and wealth. Raab and his colleagues (Raab and Bradford 1997; Raab, Bradford, and Yatsko 1994; Raab and Larson 1997) suggest recurrent droughts as catalysts for resource intensification and competition, causing sociopolitical entities to evolve as defensive units organized territorially. In this climate of crisis and political intensification, movers and shakers brokered intersettlement alliances and marriages, their reward being elite status, including the inherited role of chief with its unprecedented prerogatives.

In her political economy model, Arnold (1990b, 1991a, 1992a, 1995a, 1997; Arnold, Colten, and Pletka 1997) posits that population/resource imbalances provided opportunities for chiefs to control bead production and for boat (*tomol*) owners to become labor controlling entrepreneurs in bead-for-food exchanges. The major environmental factor prompting this social change developed out of the supposed detrimental effects (for example, depressed kelp forest growth) of elevated SSTs, but drought is acknowledged some role in causing difficult times (Arnold 1992a:336; Larson, Michaelsen, and Walker 1989). While warmer ocean waters translate into comparatively less resource availability for marine-dependent coastal and island dwellers (Dorman and Palmer 1981; Tegner and Dayton 1987; see Glynn 1988), no direct faunal evidence from archaeological sites indicates a disastrous downturn in marine resource productivity (Colten 1993; Erlandson 1993a; Raab and Bradford 1997:341; Raab et al. 1995). Based on their oxygen isometry research, D. Kennett and Kennett (2000) characterize the AD 450 to 1300 climatic interval as one of the coldest and most unstable marine weather regimes of the Holocene. The interval is also described as one of greater marine productivity, but with a dry, cool terrestrial environment. According to D. Kennett and Kennett (2000), dry conditions may have resulted in increased competition for fresh water and other resources.

These new paradigms, embracing punctuated climatic and cultural events, provide evidence that belies a general model of gradualism to account for local cultural evolution. Guided in part by the Chumash dialogue, we sought to explore for Orange County how episodic climatic fluctuations, population and resources imbalances, and subsistence intensification might have precipitated such phenomena as shifts in settlement and changes in political organization.

DEMOGRAPHIC AND SOCIAL DYNAMICS IN ORANGE COUNTY

The frequency distribution of 1282 ^{14}C dates in 100-year intervals (figure 5.2) can be taken as a rough indicator of population change (see Glassow 1999). The temporal distribution of ^{14}C dates varies positively with numbers of sites by locale. We have considered site artifactual and ecofactual densities and other factors to support our assumption that the patterning of ^{14}C dates provides a key to population change. These dates suggest that, during the Milling Stone period, population was stable at a relatively low level for thousands of years. The fourth millennium BP (ca. 2000 to 1000 BC) is represented by relatively few dates at Newport Bay and the Newport Coast and appears to have been a time of extremely low population in the Newport Bay region. Yet there are 28 dates from Bolsa Chica Bay that fall between 4000 and 3000 years ago (about two-thirds of the dates for this millennium). In the Newport Bay region, the beginning of the third millennium BP (ca. 1000 BC) marks the start of an increasing trend in the number of dates per 100 year period, suggesting population growth in many areas beginning at this time and culminating at the end of LP1 about AD 1300. The decrease in the number of ^{14}C dates during LP2 may not necessarily indicate a decreasing population. The population may have been more concentrated in villages such as Genga. Unfortunately, only two ^{14}C dates from the Late Prehistoric period are available from Genga (ORA-58), because it was investigated primarily during the 1930s prior to the advent of ^{14}C dating. On the other hand, fewer LP2 dates from the Newport Mesa-Newport Bay region may result from movement of some people to the southern Orange County area. It is also possible that the introduction of European diseases reduced population numbers during this period (see Erlandson and Bartoy 1995; Preston 1996).

SUBSISTENCE INTENSIFICATION AND DIET RECONSTRUCTION

Raab (1996) suggested that expanded diet was accompanied by downturns in foraging efficiency. He noted two trends consistent with intensification: (1) the procurement of increasingly marginal consumables (often smaller plant and animal food species), and (2) technological innovation to exploit new foods that are more difficult to harvest and process. Such diet breadth expansion and intensification of food resource use is a result of stress related to imbalances between population numbers and food supply. Raab (1996:66) continues, "Stress of this kind may have arisen from a number of circumstances, including population growth, overexploitation of food resources and environmental change."

The ethnographic record for Gabrielino and Luiseño indicates resource intensification. For instance, the great variety of food from smaller fauna exploited locally include insects (Harrington 1942:8; Heizer 1968:22; Sparkman 1908:199-200), reptiles (Engelhardt 1927:30; Heizer 1968:22,33), a variety of small land and water birds and bird eggs (Harrington 1942:7; Heizer 1968:22; Engelhardt 1927:30), and smaller mammals, even mice (Heizer 1968:22); such marginal species require greater energy investments. Archaeologically, in Luiseño territory, highly labor-intensive activities associated with fishing and shellfish exploitation in very late periods is indicated at such sites as SDI-5353 at Agua Hedionda Lagoon, a settlement recorded by the Portolá expedition in 1769. There, a tremendous profusion of bean clams (*Donax gouldii*) and sardines characterized the faunal assemblage (Koerper, Schroth, and Langenwalter 1992). The sardines equaled several times the biomass of the other fish combined. *Donax* collectors residing at this lagoon site trekked to the open coast where the animals mass on the beach. It is unlikely that the recovered shells were shucks, but rather the shell with its meat went together into the cooking pot or basket. Interestingly, at SDI-10,728 on Las Flores Creek in Camp Pendleton, bean clams and much fish appeared at the end of the Late Prehistoric period (Byrd 1997; Byrd and Reddy, chapter 4).

It is difficult to know when acorns were first used in prehistoric Orange County. The presence of mortar and pestle does not automatically signal exploitation of this crop which is common to oak woodland and parkland settings and which was exploited largely in the fall. Interior live oak (*Quercus wislizenii*) provided only a fall crop, but some summer exploitation was possible for canyon or maul oak (*Q. chrysolepis*), coast live oak (*Q. agrifolia*) and Engelman oak (*Q. engelmanii*). If intensive acorn use signals a strategy for replacing depleted, more cost-effective resources, as some have suggested (Basgall 1987; Wohlgemuth 1996), ethnographic references attesting to the oaks' value provide yet another indication of stress.

The technology of acorn processing is too well known to need repeating here, but it clearly speaks to the issue of cost efficiency and increased investments to deal with a new food category. What is frequently overlooked, however, is an additional cost stemming from the effect of this food on human digestion. An acorn diet may cause constipation, which requires the consumption of such plants as the berry and bark of toyon (Christmas Berry, *Heteromelea arbutifolia*) that have laxative properties. The berries, available in the fall, were steeped in water for this purpose, or the bark was powdered to provide relief (Koerper 1981). On a final note, inland peoples may have traded acorns to coastal dwellers in return for dried fish and other goods (Kroeber 1925:630).

Archaeological data from the NCAP and San Joaquin Hills Transportation Corridor provide evidence of increasing use of smaller species of fish from kelp bed habitats and smaller shellfish taxa from rocky shore habitats. There is also some evidence for the potential semidomestication of native barley (a grass seed).

Sheephead (*Semicossyphus pulcher*), a large fish from the kelp bed zone, constitutes most of the identified fish remains recovered from NCAP Milling Stone period sites. During the Late Prehistoric period, however, two smaller schooling fish from in and around the kelp bed habitat, blacksmith (*Chromis punctipinnis*) and señorita (*Oxyjulis californica*), comprise most of the fish remains from NCAP sites, although sheephead is still represented (R. Mason and Peterson 1994). During the Milling Stone period, sheephead made up 97% of the identified fish specimens from the kelp bed habitat, and blacksmith and señorita comprised 3%. During the Late Prehistoric period, sheephead comprised only 17% of kelp bed specimens, while blacksmith and señorita made up 83%. The decline in sheephead specimens was likely a result of increased predation by a larger human population, necessitating a shift to smaller, more numerous species, such as the blacksmith and señorita. Because they are schooling fish that likely can be found just outside the kelp, blacksmith and señorita may have been caught with nets. Added labor is required to make nets. Some types of net fishing require more coordinated labor, and larger boats are needed to hold multiple fishermen and their net technology.

Shellfish procurement from rocky shore habitats shows a similar trend from larger to smaller taxa based on data from NCAP sites (R. Mason and Peterson 1994). During the Milling Stone period, mussels (*Mytilus* sp.) made up 86% of the rocky shore shellfish minimum number of individuals (MNI). During the Late Prehistoric period, the rocky shore habitat was less important than bay habitats, but among taxa collected from rocky shores, small gastropods such as *Crepidula* sp., *Crucibulum* sp., and *Crepipatella* sp. comprised 62% of the rocky shores MNI, while mussels made up only 23%. Data from ORA-225 (M. Peterson 1997) in Bonita Canyon indicate that the shift to increasing use of small gastropods began during the middle and late Intermediate period. During the middle Intermediate period (350 BC to AD 250), mussels comprised 55% of the rocky shores MNI, and small gastropods made up 37%. During the late Intermediate period (AD 250 to 600), the proportions were roughly equal. Increasing use of small gastropods implies that people were putting stress on mussel populations and had to switch to smaller shellfish. Use of smaller shellfish implies greater collecting time to obtain similar amounts of meat.

Increased labor is also implied, beginning about AD 600, by the transport of large quantities of shellfish uphill over 6 km from Newport Bay to the Late Prehistoric French Flat and Pelican Hill (CA-ORA-662) residential bases. Massive quantities of scallops, oysters, and cockles were carried in the shell from the bay up into the hills. This protein source supported residence in the hills while people were procuring other resources such as hard seeds. Expansion of residential settlement more than 3 km away from Newport

Bay at this time may represent the beginning of territoriality and the form of political organization seen when the Spanish arrived.

Hard seed procurement may have been the principal reason for expansion of residential settlement into the hills with their large stands of coastal sage. One of the sage taxa, chia, is high in both calories and protein (Gilliland 1985). The archaeological record shows, however, that native barley (*Hordeum pusillum*), maygrass (*Phalaris* sp.), and goosefoot (*Chenopodium* sp.) were the most important hard seeds gathered in the hills. Seeds from native barley, maygrass, the grass family, goosefoot and the goosefoot-amaranth family, and wild cucumber were found in 67 to 75% of the hearth feature samples from 13 San Joaquin Hills and Bonita Creek sites (Klug and Popper 1998). Nutritional analyses of maygrass and goosefoot carried out in other parts of North America indicate that these seeds yield large amounts of calories and protein. Goosefoot seeds provide 416 kilocalories and 15.5 g of protein per 100 g of seeds (Seeman and Wilson 1984), while maygrass provides 370 kilocalories and 23.7 g of protein per 100 g (Crites and Terry 1984). The protein yield of maygrass is actually higher than most shellfish and fish and is comparable to rabbit and deer (R. Mason 1991: Table 21). Native barley and maygrass seeds were available in the late spring, and goosefoot was available in the summer. These plants are "weedy," meaning they grow best in areas disturbed by the clearing of vegetation for settlements or by burning.

The native barley seeds from the San Joaquin Hills and Bonita Creek sites vary greatly in size. This variation may represent a natural range of seed sizes, the presence of two species of *Hordeum* (one larger and one smaller), or different stages in the manipulation of native barley being grown as a semidomesticate (Klug and Popper 1998). Miksicek (1994) suggested that California native barley seeds became larger as the result of selection. Studies of barley in the Midwest, however, have focused on morphological changes, rather than size variation, as an indicator of domestication (Asch and Asch 1985). There is some evidence for morphological change in some of the *Hordeum* seeds from the San Joaquin Hills sites (Lisa Klug, personal communication, 1998). Thus, variation in the size and morphology of native barley seeds is suggestive of manipulation to increase yields.

Intensification of hard seed procurement may also have occurred through managed or prescribed burning. Managed burning, as discussed by Klug and Koerper (1991), consists of intentional burning to promote sprouting and is effective in increasing seed yields in coastal sage scrub, chaparral, and grassland. In the San Joaquin Hills, where coastal sage scrub is the predominant plant community today, managed burning may have been used to convert sage scrub to grassland, creating an environment where barley and maygrass could grow. Evidence for fire management in Southern California is seen in elevated counts of seeds of "fire-follower" plants and plants that prefer burned locations (Timbrook, Johnson, and Earle 1982). Fire-followers include deerweed, wild cucumber, bulbs, and corms. Deerweed is ubiquitous in the Late Prehistoric San Joaquin Hills sites, and wild cucumber is usually present (Klug and Popper 1998). Bulbs and corms are not abundant, however, perhaps as a result of preservation factors. According to Klug and Popper (1998), the evidence for managed burning is suggestive but not conclusive because not all fire-follower plants are ubiquitous, and those that do show elevated counts could occur as a result of clearing for settlements without managed burning.

The move into the San Joaquin Hills at the beginning of the Late Prehistoric period may have been made to procure sage seeds, but these seeds are not well represented in macrobotanical samples. However, clearing for settlements and managed burning may, however, have created grassland areas where maygrass and native barley seeds were collected. Since native barley is an annual grass, it must grow from seeds each year, and the species does not have a root system that survives burning like the perennial bunchgrasses (Miksicek 1994). Barley seeds may have survived annual burning owing to their tough coat or by being collected and scattered after areas were burned the next year. The latter would be another example of semidomestication and intensification of barley use. Thus, intensification of barley seed use may have led to selection for larger seeds or certain morphological characteristics, managed burning, and collection and storage of seeds for scattering in burned areas the next year. All of these possibilities require further investigation.

SETTLEMENT CHANGE

During the Middle Holocene, settlement consisted of residential bases that were part of a settlement system emphasizing foraging or moving people to resources (R. Mason, Koerper, and Langenwalter 1997). Residential bases on the marine terraces at the coast south of Newport Bay were occupied during the summer for sheephead fishing and gathering mussels and other shellfish. Other residential bases were located around Newport Bay and probably in the foothills of the Santa Ana Mountains.

The period from 2000 to 1000 BC was once considered the "black box" of Orange County prehistory. There are comparatively few known sites in most parts of the county and very few ^{14}C dates for this span of time. Two-thirds of the dates from this millennium (figure 5.2) are from two sites at Bolsa Chica Bay. Twenty-eight ^{14}C dates from ORA-83 and ORA-85 fall between 1000 and 2000 BC, indicating continued settlement in this area, while the Newport Bay and Newport Coast region experienced a marked decline in settlement activity.

After 1000 BC, a settlement shift occurred in the Newport Bay region. There were fewer sites compared to before 2000 BC, but settlement was more concentrated in a few residential bases in favored locations near permanent water sources. Also, residential bases on the marine terraces along the ocean coast were no longer occupied. Intermediate period residential bases for exploiting the Newport Bay region were located within 3 km of the bay (a source of fish and shellfish) and near springs or watercourses fed by springs, such as Bonita Creek. Examples of Intermediate period residential bases are ORA-119A (Koerper 1981) on the east side of San Joaquin Marsh at the upper end of Newport Bay, ORA-287 (Clevenger 1986) on the west side of the San Joaquin Marsh, ORA-378 (Koerper 1995) located 3 km east of San Joaquin Marsh on a bluff above a spring, ORA-225 (R. Mason 1997) located 3 km east of upper Newport Bay on Bonita Creek, and a complex of sites (ORA-106, ORA-134, ORA-220, and ORA-223) (R. Mason 1996; Rosenthal 1992) on Bonita Mesa near a spring. Data from ORA-225 indicate that sites farthest from Newport Bay may have first been used as field camps or minor residential bases and later became major residential bases as population expanded. ORA-225 became a residential base about 350 BC (R. Mason 1997).

The locations and contents of Intermediate period settlements indicate that collecting parties were sent to the bay and ocean to bring fish and shellfish back to the residential bases, rather than moving the residential base to the ocean for part of the year. This pattern contrasts with the latter part of the Milling Stone period when a single group may have occupied the area, moving seasonally from residential bases on the outer coast to Newport Bay to the foothills. During the Intermediate period, several groups may have occupied the area, each tethered to a residential base near a water source from which collecting parties were sent to various habitats at the coast and bay to bring fish and shellfish back to the residential base. During the Intermediate period, however, bay shellfish in the shell were not transported more than 3 km inland. The San Joaquin Hills and the Newport Coast were not occupied during the Intermediate period because of a lack of permanent water sources and an apparent unwillingness to transport shellfish more than 3 km from Newport Bay. The nearest Intermediate period occupation south of Newport Bay was in Moro Canyon about 10 km from Newport Bay. Small test excavations provided samples that yielded Intermediate period dates from ORA-327 and ORA-331 in the Crystal Cove State Park area on the outer coast between Newport Bay and Moro Canyon (Barter 1991).

At the beginning of the Late Prehistoric period (AD 600), settlement expanded into the San Joaquin Hills (R. Mason and Peterson 1994). For the first time, bay shellfish in the shell were transported more than 3 km from Newport Bay. Three types of sites appear to have been occupied during the Late Prehistoric period in the San Joaquin Hills. Based on multivariate analysis of the distribution of the proportions of artifact types among the NCAP Late Prehistoric components, the three site types were defined as major residential bases, minor residential bases, and specialized activity loci (R. Mason and Peterson 1994).

Major residential bases, occupied for one or more seasons, were settlements for which resources were collected in the hills (seeds and land animals), at the ocean (fish and shellfish), and from Newport Bay (fish and shellfish) for processing and consumption. Major residential bases have a full complement of tools used by men and women. Projectile points, gorges, fishhooks, cores, flakers, and biface preforms were used primarily in activities performed by men; ground stone tools and awls were used primarily in activities performed by women (Willoughby 1963). The bases also contain beads and have high densities of subsistence remains (shell, animal bone, and hard seeds). Although many of the San Joaquin Hills sites are small (less than 800 m^2) and are in or associated with rock shelters, the density of shell and animal bone, the diversity of tool types, and the presence of beads suggest that these sites were major residential bases (R. Mason and Peterson 1994).

Minor residential bases were occupied for shorter periods of time, possibly by people who spent more of their time around Newport Bay and made occasional trips to the hills where they stayed overnight for a few days at a time. Such bases also had tools used by males and females, but many tool types found in major residential bases were not represented, and awls and beads were rare or absent. Densities of subsistence remains were several orders of magnitude lower than in major residential bases. Minor residential bases are similar to field camps used by both sexes as defined by Thomas (1983), but they occurred in close proximity to major residential bases, although field camps would be expected to be more than 10 km away. They were likely used at the same time of year as the major residential bases, but for shorter periods and a more restricted range of activities.

The specialized activity loci appear to have been primarily single-gender activity areas. Most were male-oriented work areas where projectile points, biface preforms, and cores dominate the assemblages. Two sites were work areas used primarily by women; they contain ground stone tools and the angular hammers and abraders used to maintain them. Projectile points, biface preforms, and cores are entirely absent. Densities of subsistence remains are similar to or lower than those at minor residential bases.

The three levels of site complexity in the San Joaquin Hills during the Late Prehistoric period represent a structured approach to intensive use of resources in the northern San Joaquin Hills. This three-tiered structure of site types did not appear all at once throughout the northern San Joaquin Hills at the beginning of the Late Prehistoric period. Between AD 600 and 1300 (LP1) most sites were minor residential bases or specialized activity loci. Major residential bases were confined to upper Coyote Canyon and the ridges on both sides of the canyon in an area located about 6 km from upper Newport Bay via Bonita and Coyote Canyons. These sites include ORA-236 (Coyote Cave) (Mitchell 1991) and ORA-231 (French Cave) in Coyote Canyon, ORA-270 on a ridge north of Coyote Canyon (de Barros and Koerper 1990), and a group of sites in the French Flat area on the ridge south of Coyote Canyon that include ORA-232, ORA-274, ORA-671, ORA-672, ORA-674, and ORA-676 (R. Mason et al. 1992, 1994). Most of these sites are in or adjacent to rock shelters. After AD 1300 (LP2), all of these sites continued to be occupied as major residential bases, but major residential settlement also expanded to Pelican Hill (ORA-662), which had been only a minor residential base during LP1. Pelican Hill is located about 8 km from upper Newport Bay via Bonita and Coyote Canyons. Pelican Hill was a large open site with over 100 discrete hearth features (R. Mason et al. 1993), but only parts of the hilltop were occupied at any one time. One likely reason for the delay in using Pelican Hill as a major residential base was the difficulty in obtaining water. Water would have been transported up Pelican Hill to the site from Coyote Canyon or lower Buck Gully in watertight baskets, another increase in energy expenditure.

As with the San Joaquin Hills rock shelter sites, many Late Prehistoric site components around upper Newport Bay and San Joaquin Marsh appear to have been major residential bases, but were small, ranging from 200 to 1600 m^2. These sites contrast with earlier Intermediate period residential bases that were 5000 m^2 or more in area. There are larger Late Prehistoric residential bases, such as ORA-57, ORA-106, ORA-225, and ORA-662. The distribution of discrete hearth features of various temporal affiliations within the Late Prehistoric period suggests, however, that these sites could have resulted from the shifting occupation of family groups within the site areas throughout the period.

In addition to their small size, Late Prehistoric period sites in the Newport Bay area and San Joaquin Hills are notable for their paucity of burials. A large number of small residential sites with few or no burials throughout the Newport Bay area and San Joaquin Hills is part of a pattern of exploitation of resources by small, dispersed family groups within a territory controlled by a village outside this area. At the beginning of the Spanish Mission period, the Newport Bay area and San Joaquin Hills were probably part of the territory controlled by Genga, a village on the lower Santa Ana River (Koerper et al. 1996). Archaeologically, the village of Genga is represented by ORA-58 and other nearby sites along the east bank of the lower Santa Ana River in Costa Mesa. ORA-58 has an area of about 75,000 m^2, and its investigation in the 1920s and 1930s by Strandt and Winterbourne yielded 200 to 300 burials (Koerper et al. 1996:9), as well as elaborate nonutilitarian artifacts not found in any Newport Bay area and San Joaquin Hills sites.

Given that the northern San Joaquin Hills and Newport Bay were within the territory of Genga and that the maximum population of this territory is estimated to have been 150 people (D. Earle and O'Neil 1994:176), there appear to be too many sites for the population, if they were all occupied year-round. This suggests that the major residential bases defined archaeologically from the San Joaquin Hills were satellite habitation areas within the territory of Genga. These and similar sites around Newport Bay may represent small habitation sites occupied by family groups that dispersed throughout the rancheria territory during spring, summer, and early fall to procure resources. The most important resources found in the hills appear to have been hard seeds, including grass seeds (native barley and maygrass) harvested in late spring and goosefoot seeds harvested during the summer. It is likely that the winter usually was spent in the principal village at Genga or at other habitation sites along the Santa Ana River or Newport Bay. Winter subsistence was probably based on foods stored in the village, such as acorns and hard seeds. The lack of a substantial burial population in the Late Prehistoric period San Joaquin Hills major residential bases and Newport Bay sites also argues for a return to a central village with a cemetery at some point during the year.

Less information on settlement systems is available from other parts of the county. As previously noted, the Bolsa Chica area on the northern coast had an Intermediate period occupation, but no residential sites have been attributed to the Late Prehistoric period (Whitney-Desautels, personal communication, 1997). Siltation of Bolsa Chica Bay would have greatly reduced the local availability of bay and estuary shellfish.

South of Newport Bay, Aliso Creek is the next major drainage and water source. Information on settlement in the lower Aliso Creek area was compiled by de Barros (1996), who applied the NCAP site types to the Aliso Creek sites. Because samples of tools and subsistence remains from the Aliso Creek sites are small and not comparable to each other or to the NCAP sites, site types were often based on a "best guess" using the available information. Milling Stone period residential bases were located near the ocean and in the inland part of the study area (figure 5.3), suggesting a seasonal round between these two areas. In the inland area, residential bases and locations were situated both along the creek and in the hills, suggesting a foraging strategy of moving the residential base to the resources. During the Intermediate period, the number of sites was greatly reduced and consisted of a series of major residential bases along Aliso Creek (figure 5.4), the primary water source. This situation suggests a shift in settlement and subsistence to a collecting strategy in which people went to the hills and coast to obtain food and other resources and then transported them back to residential bases. During the Late Prehistoric period, the full range of site types seen in the Newport Bay-San Joaquin Hills area was also present in the Aliso Creek area (figure 5.5). There appears to have been a village on Aliso Creek midway between the ocean and the inland limit of the study area, and major residential bases, minor residential bases, and field camps were distributed both in the hills and along the creek. This distribution of site types suggests intensive exploitation of many resources that were collected and brought back to the major residential bases and the village for processing and consumption. The data suggest that the settlement trajectory in the lower Aliso Creek drainage was similar to the San Joaquin Hills-Newport Bay area but on a smaller scale.

TERRITORIALITY AND TRADE

Food stress and labor intensification invite a number of possible responses, including territoriality, warfare, trade, or increasing social stratification. Again, ethnographic sources provide valuable insights. Inland Luiseño rancherias are reported as territorial, and within a rancheria territory there was differential access to some resources. Inland rancheria territory might typically extend from the valley lands around the main village through the uplands and into the mountainous areas where acorn-gathering camps were located (True 1966:51). The rancheria owned some areas as a whole. The most important inland rancheria areas were collectively held and used to exploit oak groves (Beals and Hester 1974:115). Inland group members could exploit animals anywhere within the rancheria's boundaries. Special resource areas might be owned by families or individuals and were jealousy guarded just as rancheria territory as a whole might be guarded by force of arms or witchcraft. Valuable food product areas were subdivided among a rancheria's various families (Sparkman 1908:190). These "gardens" included clusters of cactus, medicinal plants, or tobacco (R. White 1963:124). Some small plots (individual trees or a small berry patch) might even be controlled individually.

Most quarrels between Luiseño rancherias arose from trespass on others' lands in pursuit of food (Sparkman 1908:190). Clear distinctions were drawn between coastal and mountain people (DuBois 1908:148-150; Sparkman 1908:198). In 1771 Padre Cambron wrote:

> We awoke to find plumes of smoke signals along the entire horizon. We investigated and learned that this was a general pow-wow of all the surrounding rancherias, convoked to make peace between those of the Sierra [San Gabriel Mountains] and those from the coast, mortal enemies up to this time. (Temple 1958:159-160)

Just as violent behavior was a salient feature of Chumash existence (J. Johnson 1988:116-117; C. King 1982; Landberg 1965:88-89), so warfare seems to have occurred often in Gabrielino and Luiseño territory, although the kind of supporting forensic evidence found in the Chumash area (Lambert 1993; Lambert and Walker 1991; Walker and Lambert 1989) is generally absent for Orange and San Diego counties, where burial data are limited.

Ethnographic reports include various hallmarks of intense conflict. Boscana (1978:69-70) described Juaneño fighting as deadly, with no quarter given to warriors. There might be decapitation, and scalping provided war trophies for display from high poles near the *wamkish* (the ground within a small ceremonial enclosure). Tac's (1958) description of ceaseless war includes the remorseless dispatching of noncombatants, even children and other helpless persons, in bloody night raids against sleeping villages.

Juaneño women and children were sometimes placed in harm's way during combat. Women might be sent, even while carrying infants, to retrieve the spent arrows of the enemy to distribute to their own menfolk (Boscana 1978:70). Such treatment of noncombatants provides one index to the rising costs versus benefits of an expanding population. Other practices that regulated population include the destroying of the "perverse child" (Boscana 1978:45) and subjecting male puberty rite initiates to ingestion of toloache (*Datura* sp.), a potentially lethal drug. The Juaneño practice of designating a boy baby at birth to be raised as a berdache (Boscana 1978:54) also contributed to suppression of fertility, as did the acceptance of nonreproductive sex, such as homosexuality.

Increasing warfare was undoubtedly a path to elevating certain persons to elite status. During war, a chief's orders were strictly obeyed. A Juaneño chief made war or peace and scheduled economic and religious activities (Boscana 1978:43). Unwarranted disrespect toward the chief might be punishable by death by shooting with arrows (Boscana 1978:42-43).

Hoffman (1885:7) described the chiefly line as one inherited "from father to son, and from brother to brother." If the correct line of descent ended, "they elected one of the

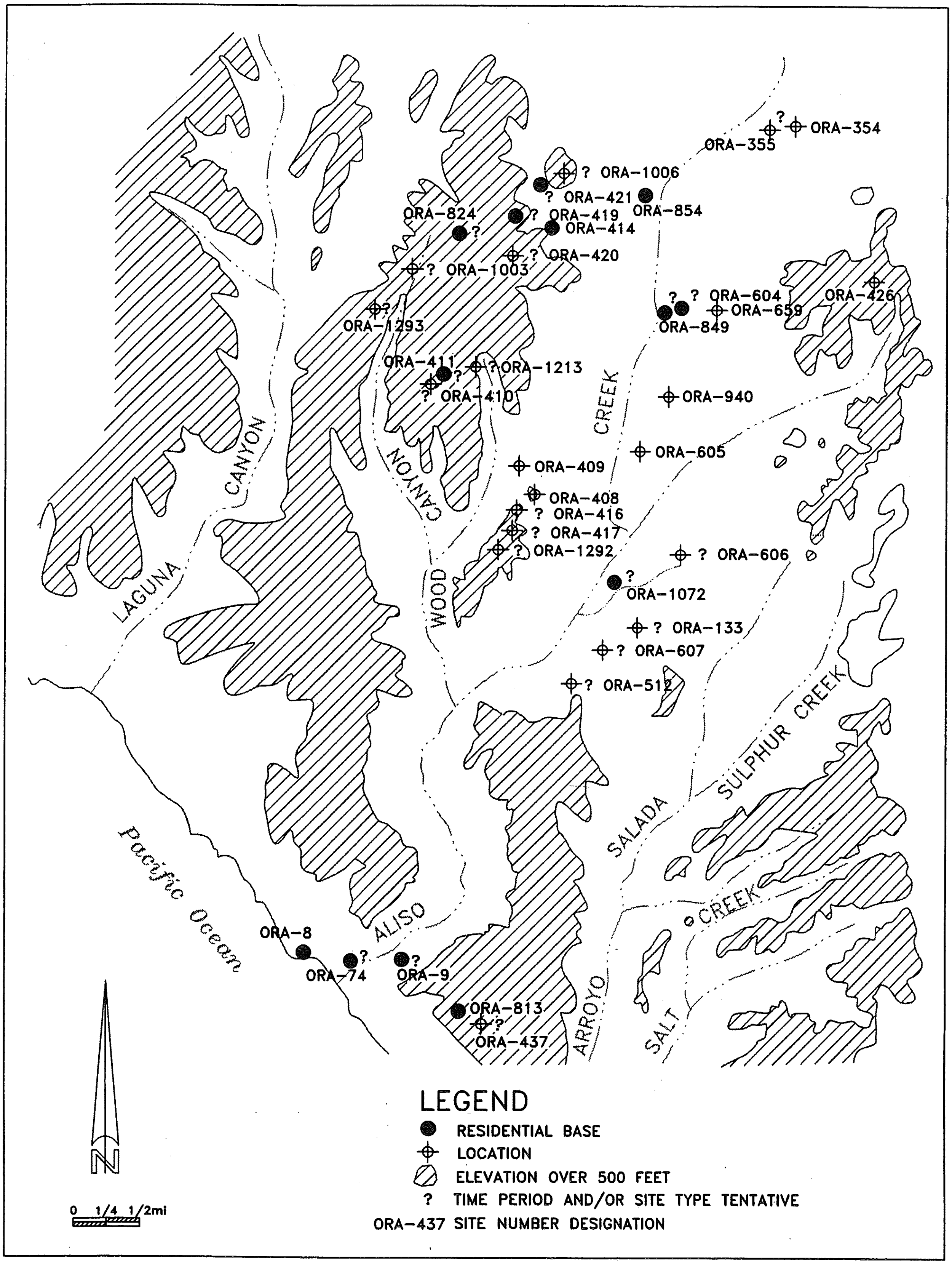

Figure 5.3 Milling Stone sites in the lower Aliso Creek area. *Map by Richard Houck.*

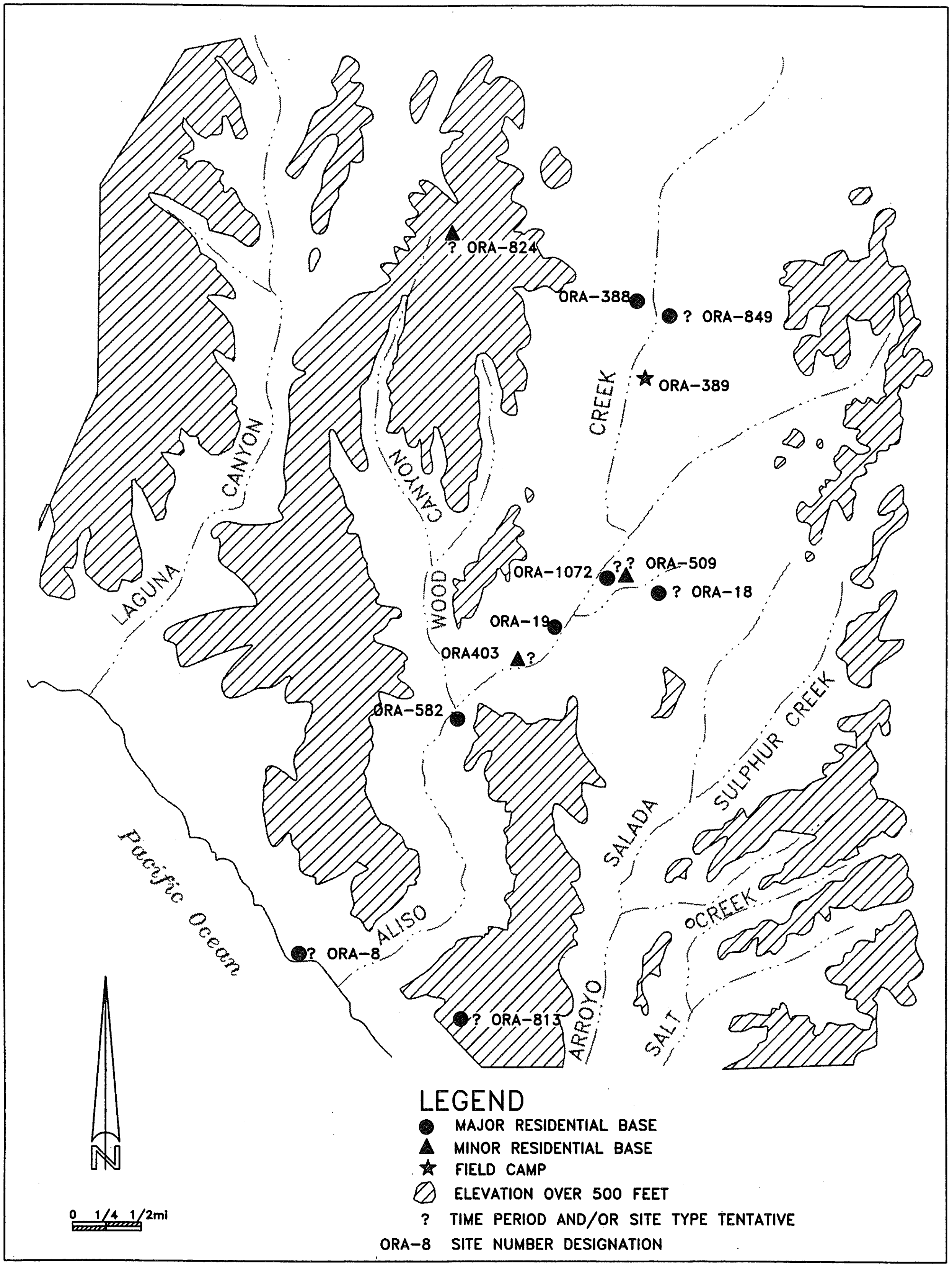

Figure 5.4 Intermediate sites in the lower Aliso Creek area. *Map by Richard Houck.*

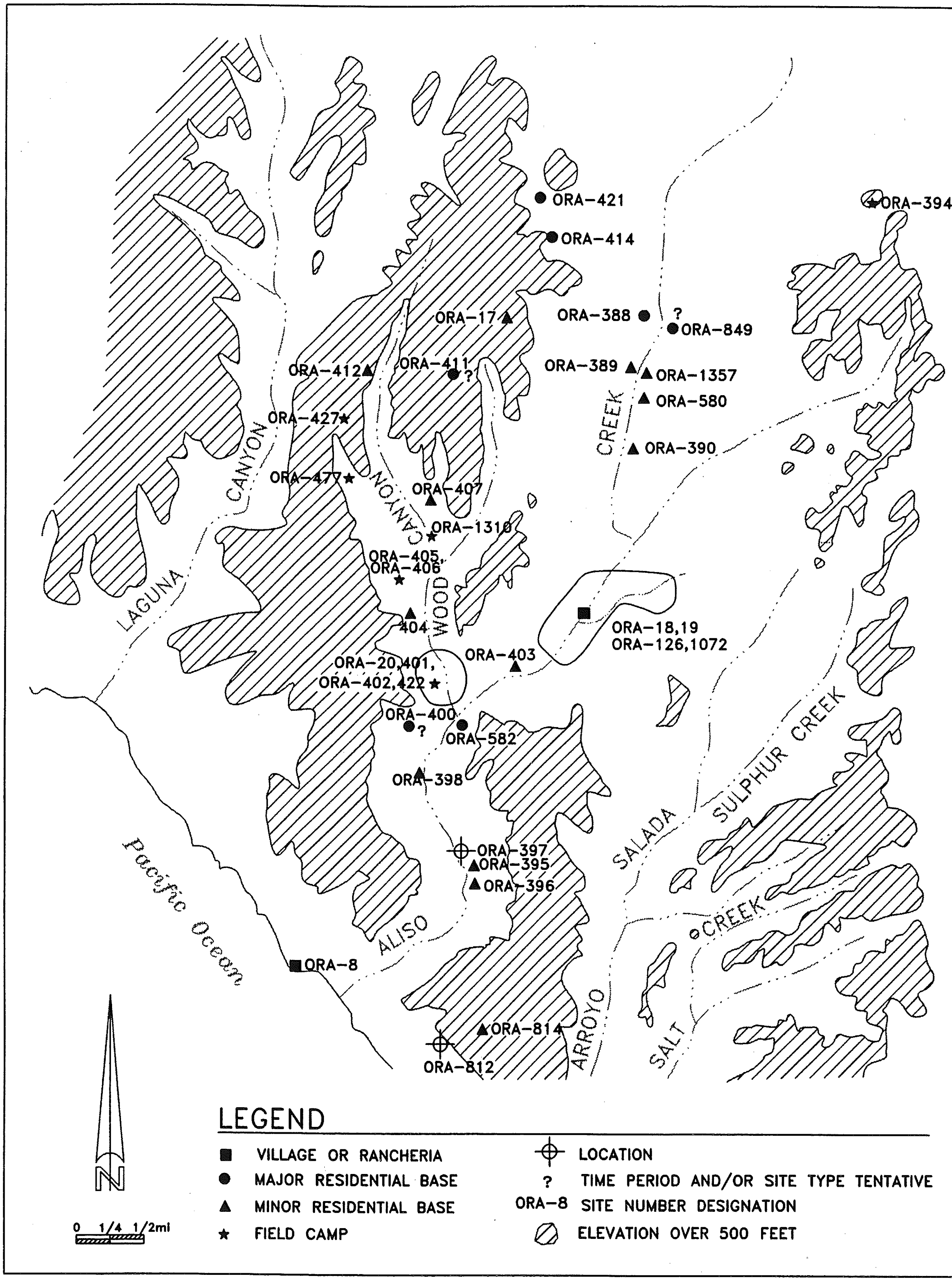

Figure 5.5 Late Prehistoric sites in the lower Aliso Creek area. *Map by Richard Houck.*

same kin, nearest in blood." Among the Juaneño, if there was no male heir for the chiefly title, a child of the chief's daughter would become chief. The nearest male relation to the chief assumed the leadership role until the child chief was old enough to assume his duties (Boscana 1978:42).

The hereditary nature of chieftainship is writ large with the information that the newborn of a chief would be washed with water by the old women who would drink his bathwater "with great gusto." These women then danced around the chief, chanting the future renown of the newborn (Heizer 1968:30).

Juaneño chiefs directed the days on which hunting and gathering activities occurred, designated feast days, and adjudicated issues between their and others' rancherias (Boscana 1978:42-43). Gabrielino chiefs maintained social control, acting as judges between disputants in a village. A chief's authority was legitimized by his possession of the sacred bundle (Bean and Smith 1978:544).

Although warfare to defend access to resources was one result of territoriality, trade and exchange among territories mediated by chiefs was probably more common. In addition, chiefs could give permission for other groups to collect resources in their territory. Both of these methods of obtaining resources were organized by the rancheria chiefs and were dependent on the maintenance of intervillage ties promoted through marriages between different rancherias and by sodalities such as the Chinigichnich religious cult.

Marriage ties linked Genga to upriver rancherias such as Hutuknga, to rancherias in Los Angeles County such as Puvunga in east Long Beach, and to rancherias to the south around San Juan Capistrano (D. Earle and O'Neil 1994). Genga was probably multiethnic and multilingual, as indicated by its marriage ties to both Gabrielino and Juaneño rancherias. The Santa Ana River political units appear to have been conduits of contact and exchange between the Gabrielino and Juaneño cultural areas and between the coast and the interior (D. Earle and O'Neil 1994).

The coast-interior ties may have been economically important to Genga, which had little or no access to acorns within its territory. There are small groves of coast live oak at the head of Coyote and Bommer Canyons in the San Joaquin Hills, but these were unlikely to have provided large, reliable acorn yields. Marriage ties with Hutuknga, itself tied to rancherias on the inland side of the Santa Ana Mountains, may have allowed the residents of Genga access to acorns from the Santa Ana Mountains through trade for dried marine resources such as shellfish and fish. Such barter exchange may have been facilitated by the use of shell beads. Acorns obtained through either exchange or collecting expeditions organized by a Genga chief were probably stored at the village to provide winter sustenance for people who had spent other parts of the year in the hills or elsewhere in the territory.

Certain ethnohistorical and archaeological evidence bearing on "directional commercial trade" reflects increasing social status differentiation after AD 1300. With directional trade, commodities are transported from the source to preferentially favored locations (Renfrew 1972:470). Mohave Indians were transporting Southwestern textiles westward to barter for Pacific shells and beads, and possibly baskets. Gabrielino did not travel great distances to trade; rather they met foreign traders at trade centers within Gabrielino territory (Harrington 1920–1930). Certain exotic status goods, such as *Glycymeris* bracelets, Sacaton pottery, and fired clay anthropomorphs accompanied the Mohave entrepreneurs who may have exchanged them through reciprocity with coastal trade partners (their protectors) in a social ritual preliminary to the more overtly economic activity of barter market exchange (Koerper 1996; Koerper and Hedges 1996). Playing the prestigious role of trade partner, a man (possibly a chief) would accrue status, a validation of his right to control the flow of bartered goods.

In summary, trade and warfare, organized by chiefs, were the results of territoriality. Territoriality is a form of political circumscription (Carneiro 1970) that, based on archaeological evidence, resulted in intensification of resource use (increased labor or time expenditure to procure resources) within the territory of each rancheria. Coastal territories were both smaller and had higher populations compared to inland rancherias (D. Earle and O'Neil 1994). This situation meant that all resources within the coastal territory had to be exploited more intensively because access to resources in other larger territories was denied or had to be politically arranged.

FINAL OBSERVATIONS AND CONCLUDING REMARKS

Climate change was an important factor related to demographic shifts and subsistence-settlement adjustments within Late Holocene Orange County. Anthropogenic phenomena are not discounted, however. During the Middle Holocene, the adaptive strategy interpreted for the larger Newport Bay region embraced a foraging pattern where people moved their residential bases to resources in a seasonal round. At the end of this period, a precipitous decline in ^{14}C dates from the Newport Bay region occurred between about 2000 and 1000 BC. Middle Holocene summer fishing and shellfishing residential bases along the Newport Coast were abandoned after 2000 BC. Very dry conditions beginning about 2000 BC, indicated by pollen studies, may have contributed to these settlement changes. Apparently, the Bolsa Chica area remained supplied with water, perhaps by nearby artesian springs or drainage from the lowlands inland of Bolsa Chica and the Huntington Beach mesas. Shortly after 1000 BC, fewer but more concentrated settlements appeared in favored locations near permanent water sources in the Newport Bay region. A collecting strategy provided the foundation for increased sedentism here and along Aliso Creek. Some resource intensification is apparent in the mid- and late-Intermediate as probable overexploitation of mussels caused people working rocky shore habitats to rely more heavily on small gastropods.

Even greater intensification started at the beginning of the Late Prehistoric period and can be gauged by the distance Newport Bay shellfish were transported. During the Intermediate period, bay species were not brought more than 3 km inland, but as the Late Prehistoric began, mollusks were carried as much as 6 km into the San Joaquin Hills. This change reflects increased subsistence efforts coinciding with apparent population increases and concomitant development of major residential bases and possibly regional territoriality, all beginning about AD 600. Late Prehistoric sites around Newport Bay and in the San Joaquin Hills were smaller than Intermediate sites, an indication of dispersed collector family groups within the orbit of a major village, possibly Genga or some other large settlement at Newport Mesa, on the easterly bluffs overlooking the Santa Ana River channel. This settlement shift is an additional reflection of resource intensification. Other indicators include the greater percentage of blacksmith and señorita taken over sheephead, a reversal of an earlier pattern, and continued emphasis in the rocky shores zone on small gastropods over pelecypods.

We interpret the upsurge in ^{14}C dates in the San Joaquin Hills area as an artifact of reconfiguration of settlement toward a dispersed residential pattern within a territory driven by rising population. Population increase in the Newport Bay and environs, which began about AD 600 and peaked around AD 1300, may reflect in situ growth and/or migration by Bolsa Chica families seeking to overcome the demise of shellfishing owing to siltation of their wetlands. With the introduction of the bow and arrow in Orange County around AD 600, it is tempting to speculate that some Takic migrants may have been arriving from the desert, the presumed, but by no means certain, origin of the weapon.

Population pressure likely followed recurrent droughts of the AD 1100s and 1200s. Recalling Liebig's Law of the Minimum (Hardesty 1977:196; M. Harris 1991:74), one necessary resource, such as water or hard seeds, limited growth within certain low elevation coastal catchments, and families sought a major river or hilly areas with springs and access to seeds in grasslands and scrublands. After AD 1300, Pelican Hill with its seed resources evolved into a large residential base whose location necessitated that water be hauled some distance uphill.

The LP1-LP2 transition and beyond offers additional challenge. Judging from radiocarbon evidence, population began a steady decline in the Newport Bay region. This decline preceded any likely introduction of European disease.

It is unlikely carrying capacity was ever exceeded, but we suggest that food yields failed to increase in proportion to the additional investments of energy expended in subsistence labor. One response to this process of diminishing returns is to limit production, a solution that works if controls are sufficient to alleviate population pressure. If, however, an area is absorbing significant numbers of new arrivals, intensification will predictably continue until resource depletions threaten economic collapse. Whether the proximate causes of migration were witchcraft, violence, rational assessments of economic realities, or any combination of such factors, some families, guided perhaps by a chief, would have chosen a path of least resistance leading to new territory.

Emigration (see Halstead and O'Shea 1989; Hayden 1990), a course reluctantly undertaken when there are significant food shortfalls, represents a quantum shift compared with dispersals through increased mobility. Remarkably, there is supporting evidence in the Juaneño oral tradition for imbalances between population and resources that drove people to leave old catchment zones and move to new ones.

In the story of the founding of Putuidem, Father Boscana relates that Oyaison brought many families from Sejat, a place described in the original text as seven or eight leagues away from Mission San Juan Capistrano, to Putuidem, about one-half league to the north of the mission. Colonization was "in consequence of the rapid increase of population, the annual production of seeds ... insufficient to maintain so great a number ..." (Boscana 1978:83). Shortly after the establishment of Putuidem, "scarcity of grain" prompted some families to relocate throughout the Valley of San Juan (Boscana 1978:84). The location of Putuidem is ORA-855 (Koerper and Mason 2000; O'Neil and Evans 1980). All 22 of the site's calibrated ^{14}C dates (from nonartifactual marine shell samples) fall within LP2. This temporal evidence suggests that the migration to ORA-855 occurred during the LIA, perhaps resulting from cold, dry conditions. While it has been conventional to see these migrations to San Juan Capistrano Valley as deriving from southern Los Angeles County, it is far more likely that migrants came from the lower Santa Ana River area, which is 7 or 8 leagues from the mission (Koerper and Mason 2000).

Drought conditions and/or expanding population more sharply drew territorial rights, one precondition to eventual intergroup conflict. Conflict, lying at the root of sociopolitical complexity (see Carniero 1970; Haas 1982), in turn selected for strong leadership. In Orange County some chiefs did assume elite status, notably some of whom may have doubled as trade partners of Mohave long-distance entrepreneurs who supplied luxury and prestige items such as *Glycymeris* shell bracelets, fired clay anthropomorphs, and Sonoran funerary projectiles. While ethnographic records document that hereditary chiefs exercised considerable influence over the affairs of their Gabrielino and Juaneño societies, chiefdom-level sociopolitical integration never developed in Orange County. Views to the contrary may reflect a "bias for complexity" in native California studies, a counterpoint to the earlier vulgar portrayal of "Digger Indians" as overly simple and despised folk (see Oetting 1985). Undue complexity may also rest on descriptions of the Gabrielino as possessing social "ranks" (see Koerper 1989), but social differentiation and true political centralization are not necessarily linked (Hoopes 1988).

Finally, recent archaeological reconstructions in coastal Southern California resist packaging Late Holocene culture change as mainly the result of gradualism. Rather, settlement pattern and political organization developed by fits and starts in a manner analogous to biology's punctuated equilibrium. In Orange County archaeology, episodic climatic fluctuations, population versus resource imbalances, and subsistence intensification help account for diachronic variability in adaptive strategies. These new perspectives are born of an interdisciplinary approach that embraces large suites of ^{14}C dates, large samples of tools and subsistence remains, high-resolution environmental data, and new assessments of ethnographic and ethnohistoric descriptions.

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Complexity and the Late Holocene Archaeology of San Nicolas Island

RENÉ L. VELLANOWETH, PATRICIA MARTZ, AND STEVEN J. SCHWARTZ

San Nicolas Island is an enigmatic piece in the puzzle of California's past. Although the island made for a colorful setting in Scott O'Dell's award-winning book, *The Island of the Blue Dolphins* (1960), little is known about its native inhabitants. By the time early ethnographers and linguists began working in the area, few Nicoleños survived. Other than four words left to us by Juana Maria, the fabled "Lone Woman" of San Nicolas, we have virtually no account of native islander life. The dearth of early historic and anthropological accounts on the island has created a black hole in Southern California ethnography, leaving the archaeological record as the sole testimony to this island's rich cultural past. Without the aid of documentary evidence and only sporadic archaeological contributions, the stories of Southern California's past have been written with the small, wind-swept island of San Nicolas all but silent.

At the time of European contact, indigenous peoples of the Southern California Coast were described as having a level of sociopolitical organization and economic complexity unusual for hunter-gatherers. Archaeologists in the region have long sought to understand the mechanisms behind this complexity. They have searched for archaeological manifestations of culture change and have used early ethnographic and historic accounts to flesh out the archaeological record of the region. The coastal Chumash and Tongva, in particular, have been the focus of much scholarly interest over the past few decades. Some archaeologists have found what they believe to be signs of increased cultural complexity beginning sometime in the Late Holocene. They suggest that native Southern Californians lived in densely populated areas in large villages, towns, and markets; had a sophisticated maritime-based economy with craft specialization, artistic elaboration, extensive trade networks, and shell bead money; and produced a rich, spiritually grounded oral tradition with strong religious foundations (for example, Arnold 1992a; Colten 1993; Grenda and Altschul 1994; Kennett 1998; Lambert 1994; McCawley 1996; Raab and Larson 1997). How could societies without agriculture attain such a high level of complexity? What fueled the transformation from small-scale egalitarian life styles to wealth accumulation, craft specialization, and ascribed status? Were there regional differences or did everybody participate in the larger system? What role did the people of San Nicolas Island play in this broader socioeconomic process?

Although the specific role people of San Nicolas Island played in the regional economy is not well understood, evidence does suggest that they produced a variety of shell beads and other ornaments and tools in exchange for mainland and island goods. For example, Santa Catalina Island steatite is quite common in San Nicolas Island sites, especially in Late Holocene components. Exotic obsidians and cherts are also found at San Nicolas Island sites, suggesting they were traded to the Nicoleños in exchange for local goods. Bowls and pestles were made from high-quality San Nicolas Island sandstone, and a variety of stone, bone, and shell effigies and other ritual icons were also manufactured on the island. Artists Mound, a site located on the northwest coast of the island, is well known for the finely made artifacts that have eroded out of its soils and been collected over the years (Bryan 1970). Diverse collections of artifacts from San Nicolas Island are housed in museums around the world and attest to the magnitude and intensity of island craft production. Many of the artifacts Hudson and Blackburn (1983, 1985, 1986, 1987) used as examples of Chumash material culture were, in fact, actually found on San Nicolas Island. These goods were probably produced on the island for trade with mainlanders and other islanders.

It can be said that the study of emergent complexity has been as influential in the development of archaeology in California as any other subject matter. As some recent studies suggest, however, native groups may have taken different paths to achieve similar levels of complexity (Arnold, Colten, and Pletka 1997; Grenda and Altschul 1994; Raab and Larson 1997). These cultures were undoubtedly influenced by similar circumstances, but local variations in resource availability, territorial circumscription, population density, and cultural attitudes certainly resulted in many differences as well. While San Nicolas Island has not figured into many discussions of cultural complexity, its history represents an important link in connecting the various coastal societies that formed the crux of complex social formation in the region.

As some archaeological studies in coastal California suggest, the Late Holocene witnessed general increases in population density (Glassow, Wilcoxon, and Erlandson 1988), decreases in human foraging efficiency (Raab et al., chapter 2, this volume; Raab 1996; Broughton 1994a, 1994b), and environmental perturbations (Arnold 1991b, 1992a, 1995b; Raab and Larson 1997) that may have paved the way for changes in demography, social complexity, and material culture elaboration. Because of its small size, relative isolation, and dearth of terrestrial resources, San Nicolas Island makes an ideal case study for examining the development of maritime adaptations. Over 500 sites are known, from virtually all areas of the island. They contain numerous shell middens of all sizes, in which faunal remains are generally very well preserved; and because virtually no burrowing animals live on the island, these sites often provide excellent stratigraphic resolution (Schwartz and Martz 1992). In short, the archaeological record of San Nicolas Island can provide critical new data for examining the development of cultural complexity in Southern California.

In this chapter, we use data generated from cultural resource management projects, archaeological field schools, and Master's theses to outline general cultural developments on San Nicolas Island during the Late Holocene, between about 1500 BC and AD 1800. We summarize what is known about Late Holocene chronology, technological developments, settlement patterns, and subsistence practices, and examine how these data bear on the issue of cultural complexity. Dietary reconstructions summarize subsistence data recovered from recent excavations on the island's west end and contribute to our understanding of the regional subsistence economy. More descriptive than theoretical, this chapter aims to contribute basic data to Southern California archaeology and expand our outlook of regional prehistory. As these data become more widely available, the native people of San Nicolas will be heard again, if only from the mute fragments they left behind.

SAN NICOLAS ISLAND

Environmental Setting

San Nicolas Island is the outermost and most isolated of the California Channel Islands. It is situated about 120 km (74.6 miles) southwest of Los Angeles and approximately 98 km (60.9 miles) from the nearest point on the mainland (figure 6.1). The island lies about equidistant from the tightly clustered northern Channel Islands and the more widely dispersed southern Channel Islands. Santa Barbara Island, lying approximately 46 km (28.6 miles) to the northeast, may have been a stopping point for voyages between San Nicolas and the other islands or the mainland (Erlandson et al. 1992; Rick and Erlandson 2000a).

San Nicolas Island is only about 5.6 km (3.5 miles) wide and 13 km (8.1 miles) long but has 35.4 km (22 miles) of coastline. The island is composed primarily of uplifted Eocene sandstones and shales that have been modified by marine erosion, forming several impressive Pleistocene terraces visible on the island's north and west shores (Meighan and Eberhart 1953; Vedder and Norris 1963). Topographically, San Nicolas is dominated by a wind-swept plateau surrounded by escarpment slopes, sandy and rocky beaches, and narrow coastal plains. Constant eolian activity shapes the sand dunes that cover much of the island. The island receives only about 16.5 cm (6.5 inches) of rainfall during an average year, but thick fog frequently blankets the island, adding to the precipitation total.

Fresh water exists mainly in the form of twelve perennial springs and seeps located chiefly within the northwest portion of the island. Except for a few areas on the plateau and southern slopes where fresh water accumulates after heavy rainfall, all potable water comes from groundwater reservoirs. Ground water originates from precipitation absorbed by dune sand and transmitted to underlying bedrock and marine terrace water bearing deposits (Burnham et al. 1963). In dry years, water tends to be less abundant, although somewhat brackish water is available on the surface even during extended drought conditions. For example, during the drought of the mid to late 1980s, the US Navy, owners of the island today, pumped all of its fresh water from local aquifers.

The vegetation is sparse and plant diversity is relatively low, with very few edible endemic species (Junak and Vanderwier 1988). Only 50% of the floral taxa are considered native; of these, rattlesnake weed (*Daucus pusillus*), silver beach weed (*Ambrosia chamissonis*), coyote brush (*Baccharis pilularis*), and giant coreopsis (*Coreopsis gigantea*) are the most common (Martz 1994a:10). Only six land animals are native to San Nicolas: the white-footed deer mouse (*Peromyscus maniculatus*), the island fox (*Urocyon littoralis*), the island night lizard (*Xantusia stansburiana*), the southern alligator lizard (*Elgaria multicarinata*), the side-blotched lizard (*Uta

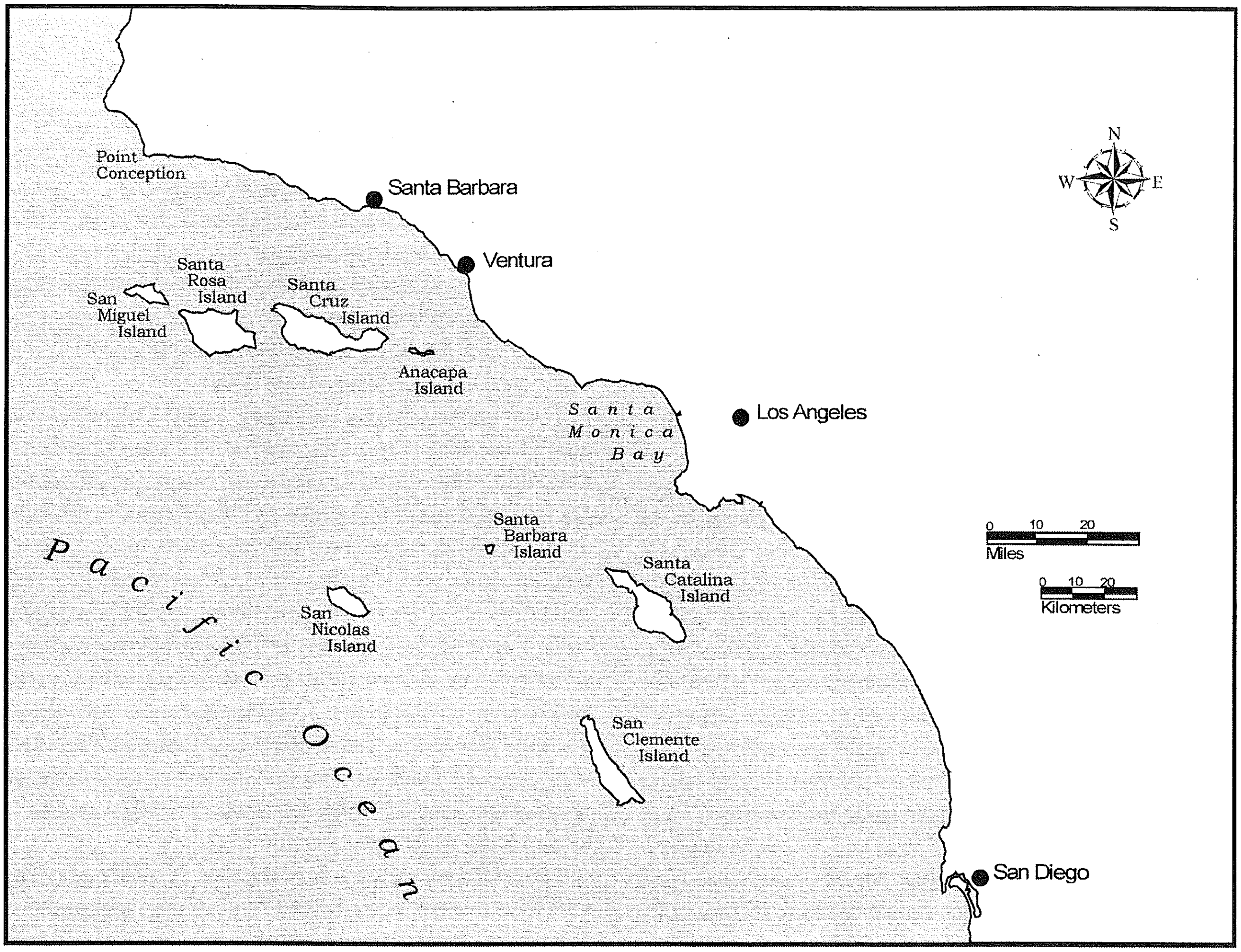

Figure 6.1. The Southern California Bight, showing the location of San Nicolas Island

stansburiana), and the land snail (*Micrarionta* sp.) (Vellanoweth 1998).

While terrestrial resources are relatively impoverished, marine habitats offer an abundant variety of important plants and animals. For example, six species of pinnipeds inhabit the island, including California sea lions (*Zalophus californianus*), northern elephant seals (*Mirounga angustirostris*), and Pacific harbor seals (*Phoca vitulina*), all of which breed here today. Archaeological and historical evidence indicates that sea otters (*Enhydra lutris*) were present in large numbers prior to their decimation by fur hunters in the nineteenth century (Meighan and Eberhart 1953; Martz 1994). Brandt's cormorants (*Phalacrocorax penicillatus*) and Western gulls (*Larus occidentalis*) also breed on the island, and many other seabirds feed on the rich marine life around the island.

Postglacial sea level transgression began to slow about 5000 years ago, leaving in its wake drowned wave-cut platforms and coastal canyons that created fertile substrate for the rocky and sandy bottom intertidal and inshore-subtidal habitats important to native islander life (Barnes and Hughes 1988; Inman 1983; Morrison 1976). A broad shelf, which extends up to 4 km (2.5 miles) offshore and has an average depth of 107 m (350 ft), provides ideal conditions for lush kelp forests (Vedder and Norris 1963). These kelp beds afford habitat for a rich array of species, including fish, sea mammals, and shellfish. Closer to shore, rocky intertidal zones are home to a variety of shellfish, including red abalone (*Haliotis rufescens*), black abalone (*H. cracherodii*), and California mussel (*Mytilus californianus*), as well as smaller species such as turbans (*Tegula* spp.) and top snails (*Astraea undosa*), limpets (*Lottia gigantea, Megathura crenulata, Fissurella volcano*), and chitons (*Mopalia ciliata, Cryptochiton stelleri*).

Analysis of shell midden constituents from island sites suggests that these rock-perching taxa, as well as sandy bottom species like the purple olive (*Olivella biplicata*), provided excellent sources of food and raw materials. There is also evidence that islanders especially used kelp beds during the Late Holocene. We see an increase in the relative abundance of kelp forest marine birds (cormorants, and so forth) and mammals (that is, sea otters), for instance, in Late Holocene deposits (Bleitz 1987, 1993). Even today, the island is ringed by kelp forests that commercial seaweed distributors regularly harvest.

Cultural and Archaeological Background

When Europeans first explored the waters around San Nicolas Island (ca. AD 1542–1800), they found it inhabited by a people sometimes referred to as the Nicoleño. These people were most likely Uto-Aztecan speakers related to the Gabrielino (Tongva or Kumivit) Indians of the Los Angeles basin area (Bean and Smith 1978; Johnston 1962). Except for Juana Maria, the Nicoleño were removed from the island in 1835. For 18 years Juana Maria remained alone on the island, until 1853 when a sea captain took her to the mainland. She died only a few weeks later. A recent analysis of the few Nicoleño words recorded suggests that the language may have been closely related to Cupeño (Munro 1994), but no definitive conclusion can be reached from such a small sample. According to Bean and Smith (1978:539-540), San Nicolas Island was called Sonygna by the Gabrielino, and the island population may have ranged between about 600 and 1200 people during the centuries prior to Spanish conquest.

The cultural affiliation of the Nicoleño, like Indian groups of Southern California in general, has been a subject of debate for decades (see Bean and Smith 1978; Drover and Spain 1972; Howard and Raab 1993; Jenkins and Erlandson 1996; Kerr and Hawley 1999; Koerper 1979; Kroeber 1925; Raab and Howard 2000; Rozaire 1957, 1959; Titus 1987; Vellanoweth 1995, 2000; and others). Most scholars agree that Uto-Aztecan speakers from the Great Basin migrated coastward into Southern California and displaced Hokan speakers, creating the often mentioned "Shoshonean Wedge." What is not agreed upon is the nature and timing of these events. Linguists generally refer to a period between 3000 and 4000 years ago as the time Uto-Aztecans first entered coastal Southern California (Hopkins 1965:57). Various archaeologists support estimates that include a more recent incursion between 1000 and 1300 years ago, the period between 2500 and 3000 years ago, and an early entry sometime around 6000 years ago (Drover and Spain 1972; Koerper 1979:70; Moratto 1984:164-165; Wallace 1962; Warren 1968; also see Martz 1994a:133-146). Archaeological data from San Nicolas Island has figured prominently in this dilemma. Numerous artifacts and artifact styles have been linked to a Uto-Aztecan cultural interaction sphere, including the presence on the island of s-twist cordage and coiled basketry (Bleitz 1991; Lauter 1982:87; Rozaire 1967), cremation practices (Kowta 1969:42), and rare bead types (Vellanoweth 1995, 2001).

The exact timing of the initial spread of Uto-Aztecans into Southern California will probably remain an issue of contention for some time, one that certainly generates many lines of inquiry worthy of further examination. The fact, however, that arid-lands adapted people arrived and flourished on the coast, including the outer islands, presents numerous complications in examining shifts in maritime adaptations throughout the region. These people would have brought with them different technologies, artifact styles, and cultural attitudes toward interaction with the local environment and other ethnic groups. These differences probably left a signature in the archaeological record. We would expect to see differences in marine resource use and perhaps innovations in technology, art, and religion.

Although antiquarians undertook casual explorations of the island as early as the late 1800s, serious archaeological research began only in the last 35 years (Schwartz and Martz 1992). During the 1950s, Meighan and Eberhart (1953) completed a brief survey of San Nicolas that set the stage for more sophisticated investigations carried out by archaeologists from California State University, Los Angeles (CSULA) and other institutions. A number of archaeologists have conducted specialized research on the island: Reinman and Townsend (1960) on native burials, Lauter (1982) on cultural chronologies, Clevenger (1982) on lithics, and Bleitz (1987) and Salls (1988) on faunal remains.

In the 1990s, CSULA archaeologists sampled various large and small middens from different environmental zones to establish a cross section of the island's archaeological resources (Martz and Rosenthal 2001; Vellanoweth 1996). Among their efforts, they again recorded sites, this time using global positioning systems and geographic information systems software (Martz 2002, 1998). In addition, recent work by archaeologists from Petra Resources and Statistical Research has generated a wealth of archaeological data, including descriptive and specialized analyses of food refuse, artifacts, and features. This research has shown that the largest and richest sites occur along the island's northwest coast, where fresh water is most available and relatively easy access is afforded to rich intertidal and kelp bed resources (Vellanoweth 1996).

Early archaeological explorations focused on collecting museum pieces; but basic contextual information, such as provenience and stratigraphy, was not recorded (De Cessac 1882; Schumacher 1875a). Exquisitely made crafts, as well as tools and basic goods, reside in these collections. Decorated baskets; grass skirts; carved effigies; shell, bone, and stone tools; beads; and even pieces of a canoe plank painted with red-and-white geometric designs attest to the sophistication of the islanders. Some early investigators published brief papers describing their finds, but for the most part the artifacts reside in museums around the world with little description or analysis.

Because the sociopolitical, economic, and artistic complexity of the Nicoleños can be seen among these collections we must turn to them to completely understand the role

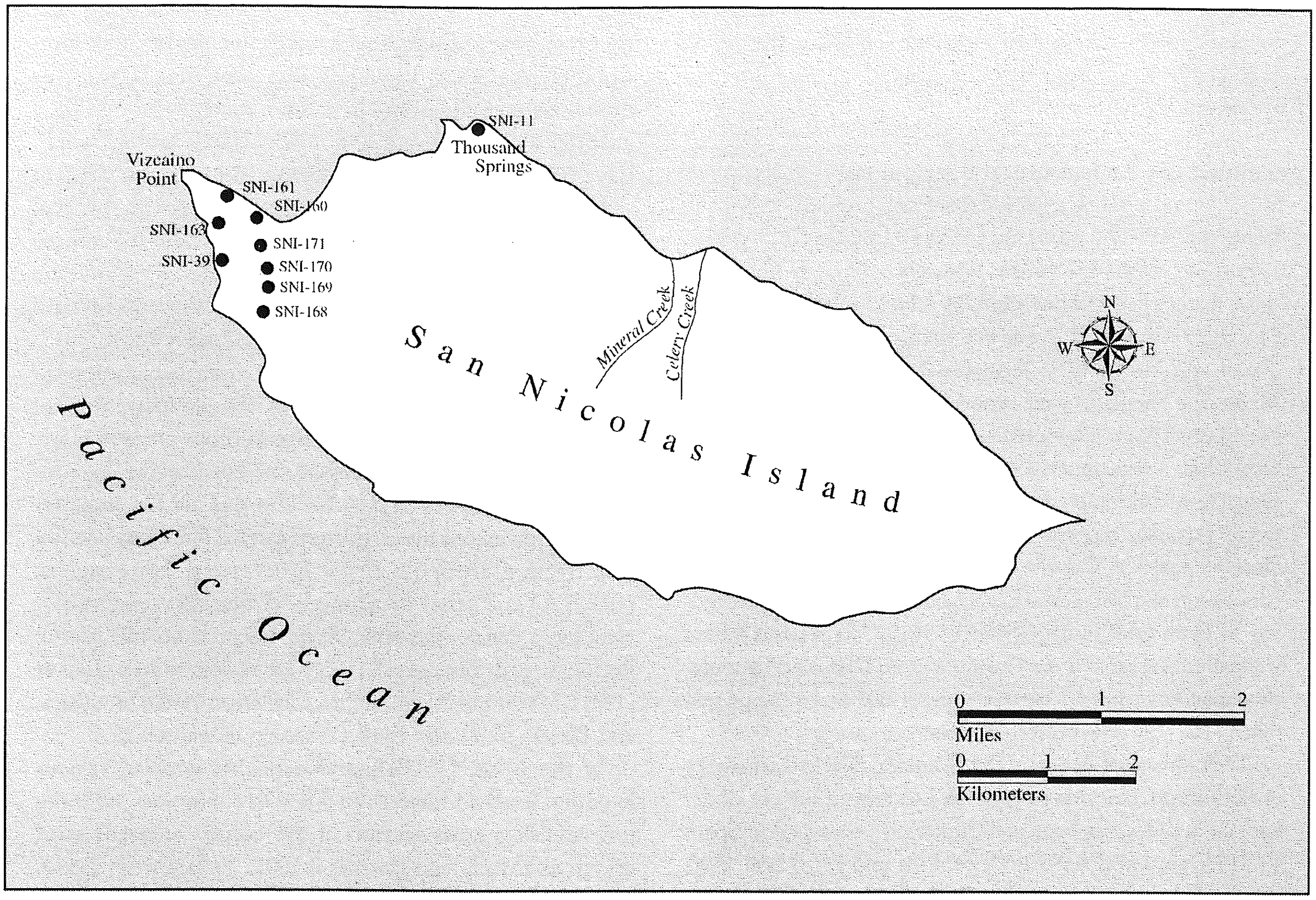

Figure 6.2. The geography of San Nicolas Island, showing the location of major Late Holocene sites discussed in the text

islanders played in regional interaction spheres. Before we address the technological and political aspects of complexity, however, we set the background by presenting archaeological data regarding Late Holocene chronology, settlement, and subsistence.

LATE HOLOCENE SETTLEMENT AND LANDSCAPE USE

The manner in which people settled the prehistoric landscape was influenced by an area's potential to sustain them. Adequate supplies of water, food, shelter, and raw materials were all important factors. At times, of course, social, political, and religious motives may have been equally influential in deciding land use patterns. Considering that San Nicolas Island lacked many critical resources, cultural-based motives may very well have figured prominently in its colonization history. The data we present here focus, however, on interactions between humans and the island environment. We aim to provide a general outline of how, when, and where people settled the island during the Late Holocene (figure 6.2).

Productive fishing grounds and intertidal zones, sea mammal haul-outs and rookeries, as well as the availability and accessibility of raw material resources such as lithic outcrops and ornamental shells, were important in determining landscape use on San Nicolas Island. A number of factors helped influence the availability of certain resources on the island. For example, environmental conditions such as coastline structure, geological substrate, and changes in sea level and water temperature combined to create different habitats that supported a variety of plant and animal communities. In addition, prevailing wind and ocean currents, upwelling, seasonal weather patterns, and behavioral characteristics of favored animals provided additional environmental parameters that helped structure landscape settlement and use.

Although the physical and biological dynamics of a particular environmental setting influenced human settlement and land use in the past, cultural practices affected these strategies. For example, the timing of social and religious activities had to be budgeted into the yearly calendar, and seasonal movements sometimes took people away from productive areas, which affected the overall land use pattern. These cultural factors probably significantly influenced the settlement of San Nicolas Island through time.

Understanding the dynamics of human settlement systems is an ongoing process that involves the accumulation of settlement data as sites are sampled, dated, and analyzed. For San Nicolas Island, we have some intriguing patterns that are testable, but we are still analyzing much of the recovered data, and only preliminary conclusions can be made at this time. Thirty-six of the sites sampled thus far contain components dated to the Late Holocene. In this section, we present Late Holocene chronology and settlement data for San Nicolas Island. We use ^{14}C dates as rough indicators of population density and examine changes in landscape use through time. Fish otoliths and animal natural history profiles provide seasonality data. These data sets are then reviewed against the background of Middle Holocene settlement patterns to reveal changes that occurred later in time. Further analysis of site constituents will undoubtedly reveal much more than we can currently describe, but the data we present here raise a number of important issues regarding the development of Nicoleño societies over the past 3500 years.

Settlement History

Postglacial sea level rise dramatically reduced the size of San Nicolas Island, perhaps limiting our potential for uncovering evidence of its earliest inhabitants. Rising seas had a particularly dramatic effect on the northwest coast, where a broad, low-lying, shallow marine terrace was inundated (D. Johnson 1983:497). Large mushroom-shaped sandstone pillars off shore attest to a vast and complex series of intertidal networks that once existed in the area when sea levels were lower. This area of the island was particularly productive, with easily accessible kelp beds, rich rocky and sandy bottom intertidal zones, and a relative abundance of fresh water in the form of seeps and springs. Clearly, the northwest coast would have been attractive to early visitors. The large densely stacked dune sites situated here also attest to the productivity of this region. In fact, nearly all of the earliest sites on the island are located on the northwest coast (Schwartz and Martz 1992; Vellanoweth 1996).

Little is known about the timing and duration of the earliest visits to San Nicolas Island. Only SNI-339, a site located on the southeast coast, has produced a ^{14}C date approaching 8000 years ago. It was an isolated find, however, lacking solid contextual information and cannot be used to confirm human occupation this early in time. Evidence from San Miguel (Erlandson et al. 1996), Santa Rosa (Orr 1968; Erlandson 1994), Santa Cruz (Erlandson 1994), and San Clemente Islands (Raab and Yatsko 1992; Salls 1991) shows that maritime peoples were present in the area during the Early Holocene. Whether these people lived on San Nicolas is not clear, but the potential for early visits cannot be ignored.

The first substantial evidence for human occupation of San Nicolas Island dates to the Middle Holocene. At least 19 sites containing up to 25 components have been dated to this time period. Most of these sites are located on the northwest coast, with only about 25% situated in the stabilized dune fields of the central and western plateau or on the southeast coast. Seasonality data from fish otoliths excavated from some of these sites suggest that settlement and fishing during the Middle Holocene were confined to the spring and fall, with sporadic visits in the summer and none documented in the heart of winter (Martz 1994; Salls 1988; Vellanoweth 1996). These data may reflect a decrease in fishing activities and not necessarily complete abandonment of these sites. Considering that strong winds buffet the island, especially during harsh winter storms, and that fuel supplies are relatively scarce, people may have concentrated their activities at more sheltered parts of the island during winter. While the seasonality data are not conclusive, it is conceivable that people from the other islands or the mainland may have visited San Nicolas on a seasonal basis during the Middle Holocene. Considering that the other islands seem to have been occupied year-round, San Nicolas probably was as well. Nonetheless, these data suggest that a seasonal pattern of island settlement existed during the Middle Holocene.

Late Holocene Settlement

Many more sites, located in a variety of areas, were formed during the Late Holocene. At least 106 ^{14}C samples from at least 45 components at 36 archaeological sites have been dated to the Late Holocene (table 6.1). Every segment of this time period is represented on the island, including the often mentioned Middle/Late Transition of the Santa Barbara Channel cultural sequence (figure 6.3). There is a general increase in the number of components dated to the Late Holocene when compared to the Middle Holocene, probably reflecting population growth and increased sedentism. Although today we know relatively little about residential structure and organization, early accounts describe numerous features associated with village organization. Early investigators described semi-subterranean whale bone pit houses, fire hearths, and large cemeteries with rich grave offerings that show considerable artistic elaboration in the manufacture of stone, bone, and shell ornaments and effigies (M. Rogers 1930a, 1930b; Heizer 1951a:11; Schumacher 1877; Woodward 1940a, 1940b). These descriptions read as if the Native peoples of San Nicolas Island were fully integrated into regional cultural systems and contributed widely to the construction and maintenance of specific ethnic ties and economic spheres. This pattern is

Table 6.1. Late Holocene Radiocarbon Chronology for San Nicolas Island*

SITE (SNI-)	LOCATION	LAB #	MATERIAL	UNCORR. ^{14}C AGE (RCBP)	CALIBR. AGE RANGE (CYBP)			BC/AD		
						INTERCEPT			INTERCEPT	
184	Northwest Coast	Beta-116359	Charcoal	100±50	270	118	0	1680	1832	1950***
43	Western Plateau	Beta-84103**	Wood	190±60	300	120	2	1650	1830	1948***
18	Northwest Coast	UCLA-164	*Haliotis* sp.	300±60	250	130	0	1700	1820	1950
25	Northwest Plateau	Beta-116352**	Charcoal	130±40	270	130	0	1680	1820	1950***
168	Northwest Coast	Beta-82210	Charcoal	260±60	430	300	150	1520	1650	1800
76	Southeast Coast	Beta-116355	Charcoal	280±50	430	310	290	1520	1640	1660
329	Northeast Coast	Beta-92083**	Charcoal	310±40	460	380	310	1490	1570	1640[c]
214	Western Plateau	Beta-96683**	Charcoal	310±60	470	380	300	1480	1570	1650[c]
76	Southeast Coast	Beta-116354	Charcoal	310±50	460	380	300	1490	1570	1650[c]
340	Southeast Coast	Beta-92078	Charcoal	380±50	510	470	320	1440	1480	1630
340	Southeast Coast	Beta-92077	Charcoal	400±50	510	480	330	1440	1470	1620
168	Northwest Coast	Beta-98894	Charcoal	550±50	620	540	520	1330	1410	1430
25	Northwest Plateau	Beta-116920**	Charcoal	550±50	620	540	520	1330	1410	1430
11	Northwest Coast	IVC-45	Charcoal	573±109	660	590	510	1290	1360	1440[c]
340	Southeast Coast	Beta-92097	Charcoal	580±60	650	590	530	1300	1360	1420[c]
79	Central Plateau	Beta-116356**	Charcoal	600±40	650	590	530	1300	1360	1420
290	Central Plateau	Beta-116362**	Charcoal	590±80	650	590	530	1300	1360	1420[c]
329	Northeast Coast	Beta-92085	Charcoal	610±40	650	600	550	1300	1350	1400[c]
346	Central Plateau	Beta-92086b	Charcoal	610± 40	650	600	550	1300	1350	1400[c]
11	Northwest Coast	IVC-81	Charcoal	650±45	660	600	560	1290	1350	1390[c]
25	Northwest Plateau	Beta-116351	Charcoal	650±90	670	600	550	1280	1350	1400[c]
328	Northeast Coast	Beta-116363**	Charcoal	660±40	660	600	560	1290	1350	1390[c]
342	Southeast Coast	Beta-92082	Charcoal	680±45	670	650	570	1280	1300	1380
329	Northeast Coast	Beta 92084**	Charcoal	710±40	670	660	550	1280	1290	1400
351	Central Plateau	UCR-2658**	Charcoal	780±70	740	690	660	1210	1260	1290
73	Southeast Coast	Beta-116353	Charcoal	940±50	930	840	790	1020	1110	1160[c]
11	Northwest Coast	IVC-82	Charcoal	960±46	930	920	790	1020	1030	1160
11	Northwest Coast	Beta-98859	Charcoal	990±70	960	930	790	990	1020	1160
6	North-central Coast	Beta-116349**	Charcoal	1030±50	970	940	930	980	1010	1020[c]
342	Southeast Coast	Beta-92081	Charcoal	960±50	970	950	930	980	1000	1020
342	Southeast Coast	Beta-92080	Charcoal	1050±40	980	950	930	970	1000	1020
160	Northwest Coast	Beta-116511	Charcoal	1060±60	1050	960	930	900	990	1020
11	Northwest Coast	Beta-98858**	Charcoal	1110±50	1060	1020	990	890	930	960[c]
11	Northwest Coast	Beta-98855	Charcoal	1130±70	1170	1030	960	780	920	990[c]
168	Northwest Coast	Beta-98893	Charcoal	1140±80	1170	1030	960	780	920	990[c]
346	Central Plateau	Beta-92088	Charcoal	1170±50	1170	1060	990	780	890	960
38	Southeast Coast	Beta-97308	Marine shell	1610±70	1160	1060	960	790	890	990
168	Northwest Coast	Beta-98898	Marine shell	1340±60	1170	1090	1010	780	860	940
11	Northwest Coast	Beta-98856	Charcoal	1200±70	1260	1130	1010	690	820	940***
162	Northwest Coast	Beta-108485	Charcoal	1270±70	1290	1210	1090	660	740	860***
160	Northwest Coast	Beta-108484	Charcoal	1295±60	1290	1220	1170	660	730	780[c]
346	Central Plateau	Beta-92087	Charcoal	1300±50	1290	1260	1180	660	690	770
351	Central Plateau	Beta-63392**	Charcoal	1320±60	1290	1270	1180	660	680	770
168	Northwest Coast	Beta-98892	Charcoal	1320±70	1290	1270	1180	660	680	770
38	Southeast Coast	Beta-97309	Marine shell	1510±70	1320	1270	1210	630	680	740
38	Southeast Coast	Beta-97306	Marine shell	1540±70	1350	1290	1230	600	660	720
11	Northwest Coast	Beta-98863	Charcoal	1360±70	1310	1290	1190	640	660	760
38	Southeast Coast	Beta-97307	Charcoal	1450±70	1410	1320	1290	540	630	660***
43	Central Plateau	Beta-92072**	Charcoal	1480±40	1410	1350	1310	540	600	640
94	Central Plateau	Beta-116357	Charcoal	1510±50	1480	1400	1330	470	550	620
11	Northwest Coast	Beta-98857**	Charcoal	1530±30	1520	1410	1350	430	540	600
11	Northwest Coast	IVC-44	Charcoal	1559±120	1560	1420	1310	390	530	640
11	Northwest Coast	Beta-98860	Charcoal	1560±70	1530	1420	1350	420	530	600
160	Northwest Coast	Beta-116512	Charcoal	1620±50	1560	1530	1420	390	420	530
160	Northwest Coast	Beta-116513	Charcoal	1710±60	1710	1630	1540	240	320	410***

continued

SITE (SNI-)	LOCATION	LAB #	MATERIAL	UNCORR. ^{14}C AGE (RCBP)	CALIBR. AGE RANGE (CYBP)			BC/AD		
						INTERCEPT			INTERCEPT	
38	Southeast Coast	Beta-97305	Charcoal	1780±60	1820	1710	1610	130	240	340
38	Southeast Coast	Beta-97304	Marine shell	1930±60	1810	1710	1620	140	240	330
162	Northwest Coast	Beta-108486	Charcoal	1880±70	1920	1820	1710	30	130	240
21	Central Plateau	W-2412	*Haliotis* sp.	2070±200	2120	1880	1630	170	70	320
168	Northwest Coast	Beta-98891	Charcoal	1950± 70	1990	1910	1820	40	40	130***
351	Central Plateau	UCR-2657	*Haliotis* sp.	2100±50	1980	1910	1850	30	40	100
171	Northwest Coast	Beta-98896	Marine shell	2220±50	2130	2060	1980	180	110	30
168	Northwest Coast	Beta-98886	Charcoal	2100±80	2290	2080	1950	340	130	0
163	Northwest Coast	Beta-109486	Charcoal	2200±60	2330	2210	2120	380	260	170***
204	Western Plateau	Beta-96689	Charcoal	2220±60	2330	2210	2170	380	260	220***
11	Northwest Coast	GaK-8204	Charcoal	2220±110	2350	2210	2070	400	260	120***
117	Central Plateau	Beta-116358	Charcoal	2220±60	2330	2210	2130	380	260	180***
102	Western Plateau	Beta-92074**	Charcoal	2260±70	2350	2250	2150	400	300	200***
51	Southeast Coast	UCLA-197	Charcoal	2440±80	2710	2400	2350	760	450	400***
51	Southeast Coast	UCR-713	Marine shell	2600±100	2710	2540	2350	760	590	400
11	Northwest Coast	UCLA-2559B	Charcoal	2460±80	2730	2590	2350	780	640	400***
106	Western Plateau	Beta-96687	Charcoal	2490±70	2740	2590	2360	790	640	410***
106	Western Plateau	Beta-96686**	Charcoal	2530±60	2750	2710	2490	800	760	540
238	Northwest Coast	Beta-116360**	Charcoal	2540±50	2750	2730	2500	800	780	550
105	Western Plateau	Beta-96684**	Charcoal	2570±60	2750	2740	2550	800	790	600
168	Northwest Coast	Beta-82204	Charcoal	2570±70	2750	2740	2510	800	790	560
168	Northwest Coast	Beta-98887	Charcoal	2580±60	2750	2740	2620	800	790	670
204	Western Plateau	Beta-96690**	Charcoal	2580±60	2750	2740	2620	800	790	670
102	Western Plateau	Beta-92075	Charcoal	2590±70	2760	2750	2620	810	800	670
204	Western Plateau	Beta-96691**	Charcoal	2630±60	2780	2750	2740	830	800	790
168	Northwest Coast	Beta-98889	Charcoal	2650±120	2860	2760	2710	910	810	760
102	Western Plateau	Beta-92076	Charcoal	2660±50	2780	2760	2750	830	810	800
43	Western Plateau	Beta-84104	*Mytilus* sp.	2800±80	2850	2760	2710	900	810	760
168	Northwest Coast	Beta-98888	Charcoal	2710±140	2950	2780	2740	1000	830	790
106	Western Plateau	Beta-96688**	Charcoal	2740±60	2920	2810	2780	970	860	830***
168	Northwest Coast	Beta-82205	Charcoal	2720±100	2920	2820	2750	970	870	800
351	Central Plateau	UCR-2660**	Charcoal	2750±60	2920	2850	2780	970	900	830
39	Northwest Coast	Beta-108476	Charcoal	2750±70	2920	2850	2780	970	900	830
351	Central Plateau	Beta-64083	*Haliotis* sp.	2930±70	3010	2910	2800	1060	960	850
169	Northwest Coast	Beta-98899	Marine shell	2940±70	3030	2920	2830	1080	970	880
351	Central Plateau	Beta-63391**	Charcoal	2850±70	3140	2950	2870	1190	1000	920
39	Northwest Coast	Beta-108477	Marine shell	2970±60	3060	2950	2860	1110	1000	910
161	Northwest Coast	Beta-787669	*Haliotis* sp.	3420±60	3080	2980	2880	1130	1030	930
161	Northwest Coast	Beta-78668**	Charcoal	2880±60	3160	2980	2890	1210	1030	940***
168	Northwest Coast	Beta-82208	Charcoal	2880±60	3160	2980	2890	1210	1030	940***
39	Northwest Coast	Beta-108478	Charcoal	2880±100	3210	2980	2870	1260	1030	920***
168	Northwest Coast	Beta-98897	Marine shell	3010±70	3140	3010	2900	1190	1060	950
168	Northwest Coast	Beta-98890	Charcoal	2900±120	3240	3040	2870	1290	1090	920***
168	Northwest Coast	Beta-82207	Charcoal	2980±90	3320	3140	3000	1370	1190	1050***
51	Southeast Coast	UCR-714	Marine shell	3170±90	3350	3240	3110	1400	1290	1160
51	Southeast Coast	UCLA-196	Marine shell	3170±90	3350	3240	3110	1400	1290	1160
351	Central Plateau	Beta-65741**	Charcoal	3080±50	3360	3290	3210	1410	1340	1260***
168	Northwest Coast	Beta-82209	Charcoal	3080±150	3470	3290	3080	1520	1340	1130***
16	Northwest Coast	UCLA-165	*Haliotis* sp.	3300±100	3480	3380	3270	1530	1430	1320
168	Northwest Coast	Beta-82206	Charcoal	3190±200	3640	3420	3170	1690	1470	1220***
11	Northwest Coast	Beta-98862**	Charcoal	3250±60	3550	3470	3390	1600	1520	1440
169	Northwest Coast	Beta-98895	Charcoal	3360±80	3690	3610	3470	1740	1660	1520***
11	Northwest Coast	GAK-8205	Charcoal	3430±130	3840	3660	1530	1890	1710	1530***

* All dates were calibrated using Calib 4.1 (Stuiver and Reimer 1993, 1999) All marine shell samples and most charcoal samples were adjusted for $^{13}C/^{12}C$ ratios to compensate for the differential uptake of carbon isotopes (isotopic fractionation). Marine shell samples were calibrated using a delta R value of -225± 35 years for the effects of the local marine reservoir effect.

** Accelerator mass spectometry date

*** Calendar dates with multiple intercepts on the calibration curve

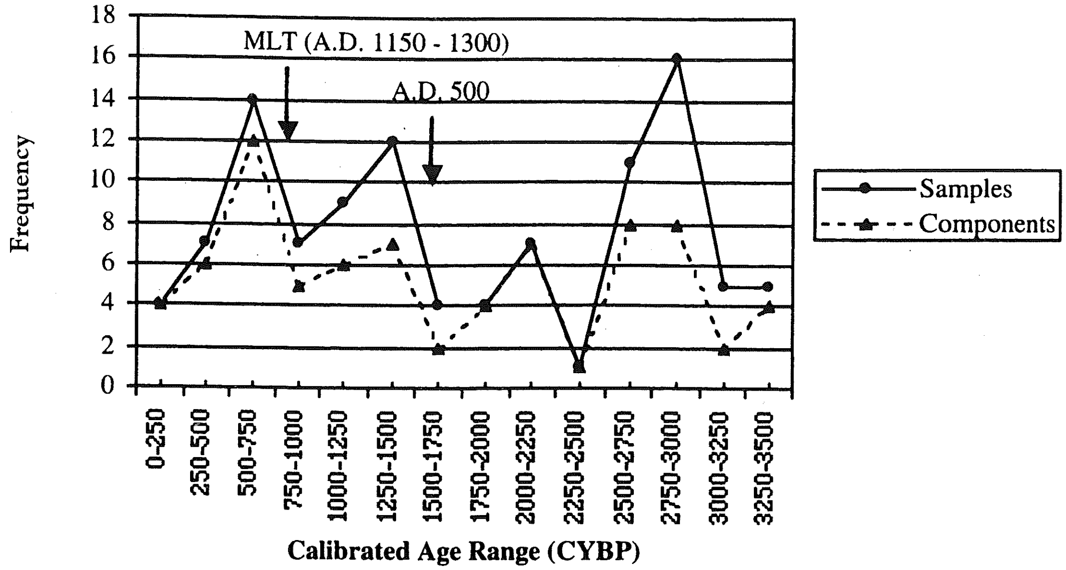

Figure 6.3. Late Holocene radiocarbon date distributions for San Nicolas Island

consistent with most archaeological data from Southern California, suggesting that the substantial population growth during the Late Holocene was accompanied by increased sedentism with a tendency toward village life.

The temporal distribution of ^{14}C dates also suggests that the intensity of island occupation pulsated over the past 3500 years. The frequency of dated sites occupied during any 250-year interval is assumed to be a rough proxy for the number of people living on the island (Glassow 1999). Decreases in occupation or population declines, based on the number of ^{14}C dated components, appear to have occurred on San Nicolas Island between 1300 and 1050 BC, 550 and 300 BC, and AD 200 and 450. Occupational peaks occurred between 1050 and 800 BC, 300 and 50 BC, AD 450 and 700, and AD 1200 and 1450. More sites date to the period between AD 1200 and 1450 than any other 250-year period of occupation on the island. The interval from 1050 to 800 BC also appears to have been a time of relatively intense occupation, with 16 dates for 8 sites represented.

Recently, considerable attention has been given to understanding the archaeology of Southern California during the Middle-to-Late Transition, between about AD 1150 and 1300 (Arnold 1992a; Kennett 1998; Raab and Larson 1997; and others). The Middle-to-Late Transition has been characterized as a period of extreme drought (Raab and Larson 1997) with elevated sea surface temperatures and depressed marine productivity (Arnold 1992a). More recently, ocean conditions during the Middle-to-Late Transition have been described as unstable, generally cold but highly productive (Kennett and Kennett 2000; Kennett and Conlee, chapter 9, this volume). Whatever the mechanism, cold or warm seas/wet or dry conditions, many archaeologists have connected environmental perturbations during the later third of the Late Holocene to the development of cultural complexity in the region. In our sample of Late Holocene sites on San Nicolas Island, there are just four ^{14}C dates from four sites that record to the Middle-to-Late Transition. This is a conservative estimate, however, based on the number of mean calibrated midpoints for dates that fall within the Transition. If all the dates within a 2 sigma calibrated age range are used instead, then the number of components dated to the Middle-to-Late Transition increases to 11, with 15 ^{14}C dates represented. Considering the inherent errors in radiocarbon dating, it is reasonable to assume that the larger figure approximates more closely the actual number of sites occupied during the Middle-to-Late Transition on San Nicolas Island. If this is the case, then this time period is well represented, but if the more conservative number is correct, the people of San Nicolas followed the general regional pattern and largely abandoned the island during this time period (see also Arnold 1992a; Erlandson, Kennett, and Walker 1997; Glassow 1999).

The worldwide climatic anomaly of the sixth century has been characterized as a time when the earth's temperature quickly fell several degrees (Kennett and Kennett 2000; Williams et al. 1993). This temperature drop had a dramatic effect on human societies around the world. The exact cause of this sudden shift is still debated, but some possibilities include changes in the earth's magnetic polarity, asteroids or comets smashing into the earth, and/or extensive volcanic activity. The decline of the Roman Empire, the spread of people across the vast Pacific, the pithouse-to-pueblo transition and the wholesale adoption of ceramics in the American Southwest, and the beginning of complex social

Table 6.2. Frequency of Late Holocene Radiocarbon Dates by Geography on San Nicolas Island.

CALIB. AGE RANGE (CYBP)	NW C		N C C		NE C		SE C		C P		W P		NW P		TOTAL	
	S	X	S	X	S	X	S	X	S	X	S	X	S	X	S	X
0–250	2	2									1	1	1	1	4	4
250–500	1	1			1	1	4	2			1	1			7	5
500–750	3	2			3	2	2	2	4	4			2	1	14	11
750–1000	3	2	1	1			3	2							7	5
1000–1250	7	4					1	1	1	1					9	6
1250–1500	5	2					3	1	4	4					12	7
1500–1750	2	1					2	1							4	2
1750–2000	2	2							2	2					4	4
2000–2250	4	4							1	1	2	2			7	7
2250–2500							1	1							1	1
2500–2750	4	3					1	1			6	4			11	8
2750–3000	10	4							3	1	3	3			16	8
3000–3250	3	1					2	1							5	2
3250–3500	4	3							1	1					5	4
Total	50	31	1	1	4	3	19	12	16	14	13	11	3	2	106	74

Notes NW C= Northwest Coast; N C C = North Central Coast; NE C= Notheast Coast; SE C = Southeast Coast; W P = Western Plateau; NW P = Northwest Plateau; S= samples; X=sites

and political formation in parts of the New World all occurred around this time. Changes in effective temperature and available light seem to have devastated plant and animal communities, in turn wreaking havoc on human subsistence resources and resulting in social upheaval and change. It is not surprising that the settlement data for San Nicolas Island suggest an appreciable decline in occupation intensity during this rather unstable time. Elsewhere in Southern California there is evidence of increased interpersonal violence during this period (Lambert 1994), although comparable data are not available for San Nicolas Island.

Late Holocene components are found in virtually all geographic zones on the island (table 6.2). The relatively even distribution of Late Holocene sites contrasts sharply with settlement patterns during the Middle Holocene when land use was focused on the northwest coast and smaller, more mobile groups used the richest parts of the island seasonally. Population density on San Nicolas Island during the Middle Holocene was also probably considerably lower. Lower population density allowed people to occupy discrete areas that contained desirable resources packed into a relatively small part of the island. The concentration of Middle Holocene sites on the northwest coast probably reflects this pattern. Most Late Holocene components (42%) are also found in the northwest coast region, but through time other parts of the island began to be used more extensively. All coastal areas, except the south-central, have components dating to the last 3500 years. The south-central coast is a relatively remote and inaccessible part of the island, however, and little archaeological work has been done there. Future research in this area will undoubtedly reveal Late Holocene components as well.

While 64% of the dated Late Holocene sites are found on the island's coastal regions, as much as 36% are situated on the upper plateau, with over half of these on the central plateau. This pattern contrasts with the archaeological record for the Middle Holocene, where plateau sites make up less than 15% of all sites dated to this time period. The increase in plateau sites during the Late Holocene probably reflects a general increase in population densities, with settlement shifting into less optimal areas. Northwest coast sites represent about 45% of all sites sampled, although this pattern may be influenced by sampling bias because more investigations have been conducted there than any other part of San Nicolas Island. The function of sites on this part of the island may have changed as increased populations demanded a restructuring of settlement and land use patterns. Overall, people throughout the Late Holocene seemed to have used the entire island more extensively through time, especially when compared to Middle Holocene settlement patterns.

Although the Late Holocene settlement pattern for San Nicolas Island apparently oscillated through time, there seems to have been a general increase in population, culminating with a peak sometime around AD 1300. This fluctuation in occupation intensity probably represents cyclical adjustments as population decline, for whatever reason, was followed by a rebound. As populations grew, territorial circumscription forced people to utilize more of the island. Larger populations during the Late Holocene would have settled more of the landscape to take advantage of resources that were less stressed by Middle Holocene populations. These newly settled areas may have been less productive at one time, but resource stress in other areas increased their relative productivity. Preliminary results of faunal studies from west end sites suggest that over time humans were collecting smaller and more diverse shellfish, which may indicate a broadening of the diet due to human overexploitation of local shellfish communities (Rosenthal and Jertberg 1997, 1998b; Vellanoweth 1996). Further work is required, however, to ensure that these patterns are representative of island-wide processes rather than sampling bias or other problems.

While it seems clear from our data that people lived on all parts of the island during the Late Holocene, what is not as clear are the changes in occupation intensity throughout this time. Why was San Nicolas Island more attractive during some parts of the last 3500 years and not others? Were broad regional factors at work? We know climatic conditions in western North America during the Late Holocene were highly variable (O. Davis 1992; Kennett and Kennett 2000; Larson and Michaelson 1989; Raab and Larson 1997; Stine 1994). Precipitation records for Southern California suggest that periods of aridity and extended drought alternated with periods of relatively wet conditions (O. Davis 1992; Heusser 1978; Stine 1994). Add to this the cyclical effects of El Niño events and it is evident that people of the Late Holocene were faced with extremely unpredictable climatic conditions. Ocean temperature and associated marine productivity also fluctuated throughout the Late Holocene. Kennett and Kennett (2000) proposed that cool (productive) marine conditions correlate with regional decreases in precipitation between about AD 450 to 1300. Although some of these fluctuations may reflect the quality, resolution, and scale of paleoenvironmental reconstructions, broadly speaking, the Late Holocene was a period of alternating intervals of dry and wet periods and cool and warm oceanic conditions, making it one of the most volatile times in the last ten thousand years.

It is difficult to compare directly the Late Holocene archaeological record of San Nicolas Island with regional climatic reconstructions, but some general conclusions can be drawn. Much like the climate record, the intensity of Late Holocene occupation on San Nicolas was highly variable. Based on 2 sigma intercepts for Late Holocene ^{14}C dates, there appears to have been a decrease in occupation intensity about AD 500 and between AD 1150 and 1300, times of extreme global climatic change (T. Jones et al. 1999). Decreases in occupation intensity for San Nicolas Island during these time periods seem to correlate with regional patterns, showing decreases in rainfall and ocean water temperature, and increases in interpersonal violence (Lambert 1994). The availability of fresh water on the island probably greatly influenced settlement history, especially because precipitation was generally low and surface water was limited to small springs and seeps.

Our data tend to support other evidence in the region calling for population growth during the Late Holocene, but how this translated into changes in land use patterns is not as clear. For instance, population growth may or may not have resulted in increased use of a particular area. Some areas may have experienced population declines as people aggregated in large settlements and restructured their settlement patterns in response to overall population growth and environmental changes.

In sum, human populations on San Nicolas Island fluctuated during the Late Holocene. When compared to the Middle Holocene, however, island population seems to have increased, which corresponds with an increase in overall land use. Our data suggest that occupation intensity fluctuated about every 750 to 1000 years during the first 2500 years of the Late Holocene. After about AD 1000, populations appear to have grown to an all-time high but crashed soon after contact with European explorers during the sixteenth and seventeenth centuries. The post-AD 1000 population peak was probably associated with increased sedentism, as early archaeological reports and regional patterns suggest. Social tensions brought on by land disputes, fishing rights, and other resource control issues would have become more common, creating the necessity for group cohesion and cooperation and individual understanding among members of society. Alternatively, social upheaval, interpersonal violence, and organized warfare may have increased during this period, although no direct island data support this.

San Nicolas Island's small size and relative isolation would have imposed added restrictions on Late Holocene populations, limiting the possibilities for social organization and political complexity. Mobility would have served as a source of power in the sense that control over the movement of people on and off the island could have been manipulated by certain individuals. Instead, group cooperation may have been the rule, negating the potential for exploitation by aspiring individuals. Either way, the island's small size and relative isolation were important factors in the formation and maintenance of the island economy and sociopolitical organization.

LATE HOLOCENE SUBSISTENCE

With population growth during the Late Holocene, acquiring enough nutritious food resources increasingly became an issue. Land tenure practices and political stability were also affected as population growth stretched the limits of critical resources. Because the island is relatively small and isolated, the Nicoleños had to develop self-sufficient survival means. Resource intensification, technological innovation, and trade were among the many devices they employed to deal with food and population imbalances and resource stress. An increased emphasis on fishing, a general pattern developed through time along the Southern California Coast, seems to hold true for San Nicolas and may have begun as early as 5000 years ago (Vellanoweth 1996; Vellanoweth and Erlandson 1999). Likewise, technological innovations may have developed earlier and may have been used more extensively on the island than elsewhere. We address some of these issues in subsequent sections, but first we provide a general outline of subsistence practices on San Nicolas Island during the Late Holocene.

In this section, we focus on the dietary contribution of marine shellfish, fish, sea mammal, and bird to the islander's diet during the Late Holocene. Our goal is to provide a general account of the subsistence economy during this time period. We choose to cover broad patterns, making this study conducive to regional comparative analyses. Before we present dietary reconstructions, it is necessary to describe briefly some of the problems and circumstances of the island that Late Holocene peoples inherited.

An Inherited Island

Getting something to eat on and around San Nicolas Island during the Late Holocene involved interacting with an environment already influenced by sea level stabilization; the impacts of previous islanders; the acquisition of technology for pursuit, capture, extraction, and processing; trade; and the sociopolitical rule of the day. As mentioned previously, sea level transgression and stabilization created new habitats on the island, especially rich kelp beds, productive rocky intertidal zones, and offshore rocky reefs. The development of new habitats offered a variety of subsistence opportunities to the Late Holocene islanders, even though these people inherited a landscape their ancestors significantly transformed.

The effects of long-term harvesting and predation on local plant and animal communities had a great impact on the availability of certain critical resources (Bleitz 1987; Martz 1994; Rosenthal and Jertberg 1997; Vellanoweth 1996). In some cases, this meant that easily procured species, such as abalones, mussels, limpets, and snails, had been under pressure from human foragers for many generations, leaving shellfish populations in a constant state of rebound and repair. The overall productivity of any particular stretch of coastline would fluctuate as the intensity of land use changed through time. Recent studies show that abalone shells from archaeological deposits are on average smaller than their modern counterparts, despite the effects of historic and modern fisheries on local shellfish populations (Vellanoweth 1996; Rosenthal and Jertberg 1997:102). Fuel supplies, an important commodity for cooking and heating, were also dramatically affected by previous islanders, limiting the amount of such resources available to Late Holocene people. Likewise, island data show an apparent shift from large pinniped hunting in the Middle Holocene to an emphasis on sea otter hunting in the Late Holocene. This pattern might indicate that human predation on high ranked pinniped populations occurred early in time, resulting in a subsistence shift to lower ranked resources as high ranked animals were over hunted or left the island in search of a safer haven away from hunters (Bleitz 1993).

While it is impossible to tell what social or political rules were in place and how these affected subsistence pursuits, it is worth mentioning that these factors certainly had an effect on islander economy. Ownership, control, and resource distribution, as well as food preferences and taboos, would have affected the flow and consumption of goods. Social and religious functions also would have affected harvesting and hunting schedules, further complicating the economy. Overall, these internal cultural factors were important in forming particular subsistence patterns, but by the same token they are difficult to identify in the archaeological record.

Dietary Reconstructions

To understand broad patterns of Late Holocene human subsistence practices on San Nicolas Island, we converted raw faunal data into more meaningful units of analysis. To do this, we chose to convert shell and bone weights into estimated meat yields using a series of conversion factors established by previous researchers (see Erlandson 1994). Dietary reconstruction via weight method conversions, like other zooarchaeological measures, is subject to a variety of problems (see Erlandson 1994:57-58; Klein and Cruz-Uribe 1984:26-29; Lyman 1982:359-363; Mason et al. 1998). For Southern California shell middens, however, which often contain relatively large amounts of heavily fragmented and unidentifiable bone, Erlandson (1994:111) argued that the systematic use of the weight method can provide valuable data concerning the relative importance of various classes of fauna at a site and on subsistence variation among sites. Recently, numerous archaeologists working on the Southern California Coast have used such methods to identify evidence of spatial and temporal variations in faunal use patterns (for example Colten 1993, 1995; Erlandson 1991a, 1997b; Erlandson et al. 2000; Glassow 1992c, 1993a; Glassow and Wilcoxon 1988; R. Peterson 1984; Vellanoweth and Erlandson 1999; Vellanoweth et al. 2000). We emphasize, however, that our dietary reconstructions for San Nicolas Island during the Late Holocene are general approximations of the relative importance of faunal classes. These estimates are subject to various sources of error.

Despite these cautionary notes, this method of dietary conversion effectively illustrates a number of methodological problems encountered in traditional shell midden analyses. In analyzing faunal assemblages from California shell middens, for example, different researchers generally analyze different faunal remains (shell, fish, bird, sea mammal, and so on.), often using different quantitative measures

Table 6.3. Late Holocene Dietary Reconstructions for San Nicolas Island.

	3000 CYBP					2000 CYBP		1500 CYBP
SITE	SNI-39	SNI-161	SNI-168*	SNI-168**	SNI-169	SNI-163	SNI-171	SNI-160
Volume	0.8 m³	0.6 m³	5.6 m³	12.8 m³	1.05 m³	1.05 m³	0.6 m³	1.72 m³
Weight	28.7 kg	9.27 kg	33.7 kg	54.6 kg	7.0 kg	3.8 kg	35.5 kg	221 kg
% Shellfish	72.8	10.2	89.4	68.5	96.8	9.0	69.3	25.2
% Fish	10.8	84.2	7.0	16.5	2.9	87.6	25.9	45.7
% Bird	0.3	0.1	1.4	0.8	0.1	0.5	0.09	0.4
% Sea Mammal	16.1	5.6	2.2	14.2	0.3	2.9	4.7	28.7

* Testing phase
** Data recovery phase

(MNI, NISP, weights). The results of various faunal studies are therefore often not directly comparable and are seldom integrated into any coherent picture of the overall diet or economy for a given site. In contrast, integrated studies of faunal remains using the weight method provide general measures of the relative importance of various types of animals through space and time. Our reconstructions also illustrate how raw shell and bone weights bias perceptions of the dietary importance of various animal resources. Shellfish, for example, make up over 90% of the total weight of the analyzed faunal remains from the Late Holocene component at SNI-161 but contribute only about 10% of the estimated meat yields. Conversely, fish bone comprises only about 18% of the total faunal weight but provides almost 85% of the overall meat yield in our site reconstructions.

Northwest Coast Sites

The northwest San Nicolas Island Coast is characterized by large parabolic and longitudinal sand dunes but otherwise is of relatively low relief. Numerous archaeological components are found within these dunes, making for extremely complex stratification (see Rosenthal and Padon 1995; Rosenthal and Jertberg 1997, 1998a; Vellanoweth 1996; Vellanoweth and Erlandson 1999). Here, we present dietary reconstructions for eight northwest coast sites, focusing on subsistence patterns between about 1000 BC and AD 500. Comparable data from sites on other parts of the island or different time periods are not yet available. Based on faunal analysis of sea mammals, birds, and fish from SNI-11, also located on the northwest coast, we infer the nature of subsistence at around AD 1000 but present no quantitative data.

SNI-39. Located on the south coast of Viscaino Point, SNI-39 is situated on a series of northwest to southeast trending longitudinal dunes. The site, covering an area about 350 m long and 75 m wide, has been heavily eroded by wind and water action, as well as trampled by sea lions that inhabit the area today. Surface finds include rocky coast shellfish species, marine mammal, fish, and bird bones, as well as numerous artifacts, including bone pry bars, sandstone bowl fragments and pestles, pitted stones, and lithic debitage. A 1.5 m² excavation unit was placed at the west end of the site on an upper marine terrace located away from the coast (Rosenthal and Jertberg 1998a:14). Diagnostic artifacts excavated from this unit include four pieces of asphaltum with cordage and basketry impressions, a spire-ground *Olivella* bead, an unfinished *Olivella* chipped disk bead blank, a worked spatulate-shaped marine mammal bone tool (probably whale), three notched and utilized metavolcanic flakes, two retouched metasedimentary and metavolcanic flakes, three utilized metavolcanic flakes, three cores with flake scars, and numerous pieces of expedient tool manufacturing debris. Three ^{14}C samples (2 charcoal, 1 shell) produced consistent 2 sigma calibrated ranges of 1260 to 920 BC, 970 to 830 BC, and 1110 to 910 BC, respectively, suggesting that the excavation unit tested a single component.

Analysis of the faunal remains indicates that rock-perching shellfish taxa dominate the assemblage, with black abalone, turban, owl limpet (*Lottia gigantea*), and sea urchin (*Strongylocentrotus* spp.) most abundant by weight. Rockfish (*Sebastes* spp.), surf perches (Embiotocidae), and California sheephead (*Semicossyphus pulcher*) make up the majority of fish identified from the unit. Of the identified bird bones, Brandt's cormorant, the extinct albatross (Diomedea), and mew gull (*Larus canus*) are represented. Identified sea mammal bones include harbor seal, sea otter, and one fossil whale bone, although only 12 mammalian bones were found throughout the entire unit. A total of 28.7 kg of shell and bone was used in the dietary reconstructions. Our estimated meat yields for the faunal remains indicate that shellfish provided most of the meat consumed (72.8%) by the site occupants (table 6.3). Sea mammals contributed roughly 16%, fish about 11%, and birds less than 1% of the edible meat represented in the faunal sample.

SNI-161. Located on the north coast of Vizcaino Point, SNI-161 lies on an east-west trending longitudinal dune that parallels a rocky shoreline for 200 m and is adjacent to a fresh water seep (see Vellanoweth 1996). This dune has accumulated on a Pleistocene terrace fronted by a 10 m high sea cliff. The crest of the dune is stabilized by vegetation, but the slopes are covered with deflated shell midden debris.

Although SNI-161 is a multicomponent site occupied between about 3350 and 950 BC, we include here only its latest occupation phase, Component 4. Component 4 was identified only in unit 5 (1.5 m^2), located on the highest crest of the dune in the central site area. The dark brown matrix consists of a silty sand mixed with shell, lithics, charcoal, and bone. Artifacts include a circular fishhook made from red abalone shell, a sandstone bowl fragment, and numerous retouched and utilized metavolcanic and metasedimentary flakes with associated manufacturing debris. Two ^{14}C samples from Component 4, one wood charcoal and one black abalone shell, produced calibrated midpoints of 1030 BC. This result suggests that the site was briefly occupied early in the Late Holocene, then abandoned.

For Component 4, 9.27 kg of shell and bone were used to estimate the diet of the site occupants. Conversion of these faunal remains to estimated meat yields suggests that fishing provided about 84% of the meat represented by the faunal sample, with shellfish contributing about 10%, sea mammals about 6%, and birds less than 1%. Black abalone continues to be the most important shellfish harvested, providing about 58% of all edible shellfish meat, with sea urchin (23%), turbans (14%), and limpets (8%) of progressively lesser importance.

SNI-168. Large (225,000 m^2) and heavily eroded, SNI-168 consists of a series of very active longitudinal dunes. Extensive weathering and erosion caused by, among other things, an abandoned road and an active drainage, has reworked and deflated much of the site's original archaeological deposits. One 1.5 m^2 and twelve 1 m^2 units were excavated in various loci during test excavations at the site (Rosenthal and Padon 1995:8). Many diagnostic artifacts were collected on the surface and from controlled excavations, including incised steatite pendants, an abalone disk bead, a *Mytilus* bead, a perforated stone, a pitted cobble, tarring pebbles, cores, and numerous retouched, utilized, and unmodified flakes. Six charcoal samples produced calibrated (2 sigma) midpoints between 1470 and 790 BC, with the majority clustering around 1000 BC. A charcoal sample from a newly exposed portion of the site yielded a Protohistoric date, but the constituents associated with this date are not included in this analysis.

Faunal analysis indicates that by weight, abalones, turbans, chitons (*Nuttallina* sp.), and limpets dominate the assemblage. Fish species consisted predominately of cabezon (*Scorpaenichthys marmoratus*), sheephead, rockfish, and kelp bass (*Paralabrax clathratus*). Raven (*Corvus corax*) was the only bird identified in the assemblage, while cetacea, sea otter, and undifferentiated marine mammal (probably pinniped) made up the remaining vertebrates. A total of 33.7 kg of shell and bone was used in our dietary reconstructions for the test phase of SNI-168. Shellfish contributed nearly 90% of the estimated meat yield, with vertebrates contributing slightly more than 10%, fish about 7%, sea mammal 2.2%, and bird 1.4%.

A subsequent data recovery phase of SNI-168 involved hand excavation of an additional 32 1 m^2 units. We separated the results from the testing and data recovery phases to highlight the influence of sample size and stratigraphic mixing on dietary reconstructions. Although the most abundant species for each major faunal class remained the same, a more diverse assemblage was collected, probably because of the larger sample. Most of the ^{14}C dates are consistent with the test phase dates, indicating the site was occupied primarily around 1000 BC. Two charcoal samples yielding mean calibrated intercepts of about 50 BC, three dates (2 charcoal, 1 shell) between AD 680 and 920, and two more Protohistoric dates indicate, however, the site was occupied at multiple times in the past. Unfortunately, the site deposits have been heavily damaged, and differentiating archaeological materials from discrete cultural components was difficult in some units. Consequently, our dietary reconstruction for the data recovery work provides only a general indicator of subsistence around 1000 BC. A total of 54.6 kg of shell and bone was used in this dietary reconstruction. Shellfish (68.5%) still contributed most of the edible meat, a decrease from 90% for the test phase results. Fish (16.5%) and sea mammal (14.2%) increased in dietary importance, while bird (0.8%) decreased slightly.

SNI-169. Located on the west end of the island, SNI-169 lies just north of SNI-168. It consists of a scatter of cultural material on two erosional surfaces connecting three partly deflated dunes with midden deposits (Rosenthal and Jertberg 1997). A 1.5 m^2 unit was centrally placed in one of the remnant middens. Artifacts collected from this unit include two silicious shale bifaces, a scraper, a sandstone net weight, 16 tarring pebbles, two retouched and three utilized flakes, and manufacturing debris. A calibrated shell date of 1265 to 955 BC is consistent with SNI-39, SNI-161, and SNI-168, while a charcoal date from the same component is slightly older (1930 to 1500 BC), perhaps because of the old wood problem (Schiffer 1986).

Shellfish remains, especially black abalone, turban, owl limpet, and other limpets dominate faunal assemblage. Rockfish, cabezon, surfperches, and scorpionfish comprise the bulk of identified fish collected from this site, while the remaining vertebrates consist of small unidentified fragments of marine mammal. No bird bones were found. We used 7.0 kg of shell and bone in our dietary reconstruction. Shellfish contributed over 96% of the estimated meat yield. All other major faunal classes appear to have been of minor dietary significance, with fish contributing almost 3%, sea mammals less than 1%, and nothing from birds. Because this site is heavily eroded, bone (especially fish) may be underrepresented.

SNI-163. Located southeast of Viscaino Point, SNI-163 consists of relatively intact shallow pockets of midden covering an area about 75 m long by 25 m wide. Artifacts collected from a 1.5 m^2 unit include a red abalone J-shaped fishhook and several circular shell fishhook fragments, a sea mammal bone barb fragment, a rockfish spine awl, two *Olivella* saucer beads, five metavolcanic and quartzite cores, as well as numerous retouched or utilized flakes and debitage. A single abalone shell produced a 2 sigma-calibrated ^{14}C date range from 380 to 170 BC.

The dominant shellfish species identified at the site are black and red abalone, California mussel, and sea urchin. Surfperches, sheephead, and rockfish make up the majority of well-preserved fish remains. Of the remaining vertebrates, harbor seal and sea otter were identified among the marine mammal remains, and double-crested cormorant (*Phallacrocorax auritus*) among the bird remains. Nearly 4.0 kg of shell and bone were used in a dietary reconstruction that suggests fish (87.6%) contributed the vast majority of edible meat. Only 9% of the meat diet came from shellfish, while sea mammals (2.9%) and birds (0.5%) were of relatively minor dietary importance. With the presence of shell fishhooks, it is not surprising that fishing was emphasized at the site. The dietary pattern is similar to that of SNI-161, where a circular shell fishhook was also associated with large quantities of fish bone.

SNI-171. Located on the west end of the island, SNI-171 is situated on an elongated linear dune about 245 x 100 m in area. A 1.5 m^2 unit was excavated at the southeast portion of the site in a still fairly intact area. The northwest sector of the site has been heavily disturbed by historic activities and reworked by wind erosion (Rosenthal and Jertberg 1997). Site erosion and deflation have exposed a number of artifacts on the surface, including a burnt sagebrush storage basket. Diagnostic artifacts collected from the unit include an obsidian (Coso) biface tip, a sandstone net weight fragment, 2 pieces of groundstone, 4 *Olivella* spire-lopped beads, a *Haliotis* fishhook fragment and nacre disk, tarring pebbles, and numerous retouched and utilized flakes. A wood charcoal sample yielded 2 sigma calibrated results from between 180 and 30 BC, suggesting this site was occupied about the same time as SNI-163.

Of the shellfish remains recovered, black abalone, California mussel, owl limpet, and turbans were the most abundant (Rosenthal and Jertberg 1997). Sheephead, rockfish, surfperches, and sculpins dominated the identified fish species, although the assemblage was highly fragmented, making identification difficult. Sea lion, harbor seal, sea otter, and cetacea made up the marine mammal assemblage, while cormorants and murrelets (*Synthliboramphus hypoleucus*) were identified among the bird bones retrieved. We used 35.5 kg of dry shell and bone to estimate the nutritional yields of major faunal classes retrieved from the site. Our dietary reconstruction suggests that shellfish provided almost 70% of the estimated meat yield for this sample. Fishing was relatively important, providing roughly 26% of the meat, while sea mammal contributed 4.7% and bird just 0.1%. The use of sea mammals and birds for tools and ornaments cannot be ignored, however.

SNI-160. Located on the north coast of Viscaino Point, SNI-160 is situated on a longitudinal dune that rests on a Pleistocene terrace. The site, about 500 m long by 50 m wide, is blanketed with a vegetated dune crest and steep sandy faces. Numerous whole and broken shells, bones, and artifacts are scattered on the site surface, attesting to the richness of its deposits. Rosenthal and Jertberg (1998b) described SNI-160 as a large site with intact stratigraphy and a wealth of evidence suggestive of village life. A 1.5 m^2 unit was excavated on the dune crest in the eastern site area (Rosenthal and Jertberg 1998b). Numerous diagnostic artifacts were excavated, including six steatite disk beads, a small broken steatite tablet with drilled holes filled with asphaltum, and a piece of indurated sandstone with pitted holes. Flaked stone artifacts include cores, choppers, perforators, retouched and utilized flakes, and an abundance of stone tool making debris. Numerous shell artifacts were uncovered, including one whole and 77 broken abalone shell fishhooks; 104 shell fishhook blanks, preforms, and fragments; five abalone margin tools; six abalone trays with asphaltum stains; six cut and abraded sea urchin spines; 54 *Olivella* beads; abalone disks; bead making detritus; and an assortment of cut, chipped, and abraded shells. Bone artifacts are represented by numerous awl tips of bird and mammal bone, numerous sea mammal spatulates, a bipoint gorge, a harpoon section, a bird bone needle and whistle, and many other pieces of worked bone. A twined bag, also excavated from the west wall of the unit, contained numerous stone, bone, and shell artifacts, including many shell fishhook blanks, scores of whole *Olivella* shells, a chert drill, a bird bone whistle and awl, and other items thought to represent fishing gear and bead making tools. Four charcoal samples from the unit yielded 2 sigma calibrated results of AD 240 to 410, AD 390 to 530, AD 660 to 780, and AD 900 to 1120, revealing a relatively continuous sequence of occupation spanning about 600 to 900 years.

Faunal remains show that species from rocky habitats dominate the assemblage. The most abundant shellfish species by weight are black abalone, sea urchin, turban, and owl limpet. While rockfish, surf perch, and sheephead dominate the fish identified at the site, warm water pelagic species such as yellowfin tuna (*Thunnus albacares*), barracuda (*Sphyraena argentea*), and Jack mackerel (*Trachurus symmetricus*) are also common. Brandt's cormorant and albatross are the most abundant bird species identified, while sea otter, harbor seal, and

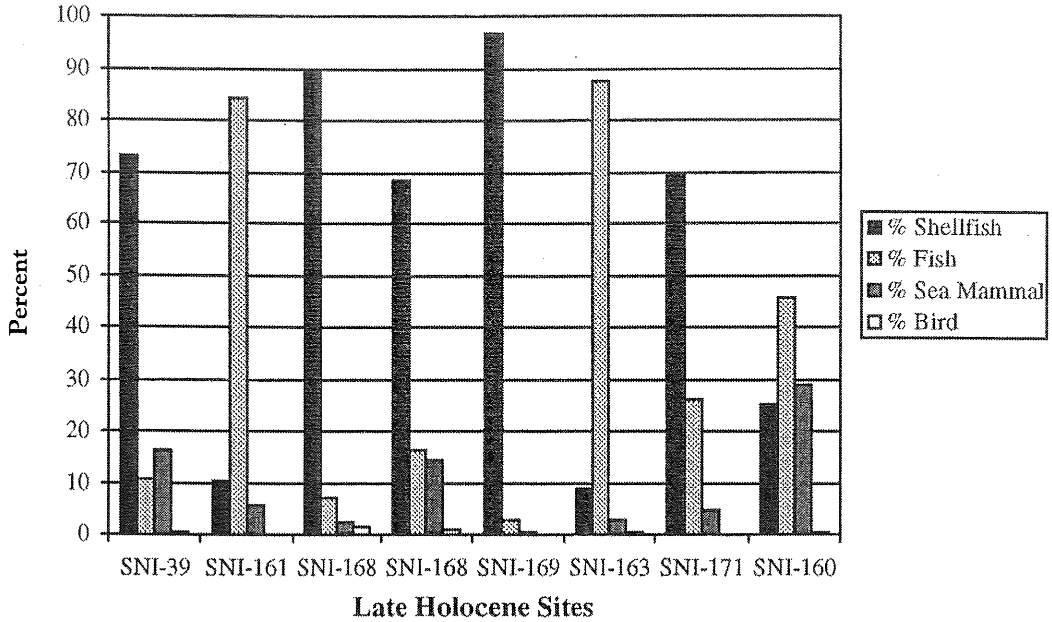

Figure 6.4. Estimated meat yields for faunal classes from several Late Holocene sites on San Nicolas Island

sea lion make up most of the marine mammal assemblage. In addition to these sea mammals, the remains of two foxes and a dog (Canidae) were among the vertebrates collected from the site. We used 221 kg of dry shell and bone to estimate the amount of meat contributed by each major faunal class. Our dietary reconstructions indicate that fish produced most of the edible meat consumed at the site (45.7%), sea mammal (28.7%) and shellfish (25.2%) contributed roughly equal amounts, and bird a minor (0.4).

General Subsistence Patterns

Overall, there is considerable variation in our dietary reconstructions, although a general emphasis on fishing is evident (figure 6.4). In all segments of the Late Holocene represented (3000, 2000, and 1500 year old sites), fishing appears to have been a major component of the subsistence economy. Some of our reconstructions show heavy reliance on shellfishing, a pattern similar to Early Holocene economies described for the region (for example, Erlandson 1994). In the following sections, we explain some of these differences and discuss how these data bear on the issue of cultural complexity.

Our dietary reconstructions for the 3000-year-old components demonstrate considerable variation. In general, sites SNI-39, SNI-168, and SNI-169 show an emphasis on shellfishing. These three sites are badly eroded, however, perhaps skewing the data in favor of durable shellfish remains (Rosenthal and Jertberg 1997, 1998a). The 3000-year-old component at SNI-161 is well preserved, probably because the sample is from a vegetated portion of the dune crest, normally the best place for preserved materials in these types of sites. At SNI-161, fish contributes the majority of meat to the diet, while shellfish is not very important. Sea mammal is of intermediate importance, and birds contribute very little.

We have quantitative data for only two sites dated to about 2000 years ago: SNI-163 and SNI-171. Although these dietary reconstructions highlight the importance of fish during this segment of the Late Holocene, there are still considerable differences. SNI-163 is better preserved than SNI-171 and shows heavy reliance on fish, accounting for roughly 88% of the total diet. At SNI-171, disturbed by historic activities and wind erosion, shellfish comprise almost 70% of the edible meat represented. If the integrity of these sites is factored into the dietary reconstruction, the importance of shellfish may be over represented at SNI-171. If the importance of shellfish is inflated because of site damage and erosion, then these data tend to support the regional pattern that suggests fishing activities intensified during the Late Holocene. The importance of sea mammals does not differ markedly from Middle Holocene reconstructions for this part of the island (see Vellanoweth 1996; Vellanoweth and Erlandson 1999), but sea mammal frequency generally decreases. Birds remain a supplemental resource throughout the Late Holocene, yet their contribution in terms of bone and feathers for tools and ornaments cannot be ignored. Likewise, sea mammal processing activities may have decreased representation of their bones in some archaeological sites, and they, too, would have contributed much more (in terms of blubber, hide, and bone) than just food.

Between about AD 500 and 1000, fishing activities continued to provide the fuel for growing populations in Southern California. For example, our dietary reconstructions for SNI-160, a well-preserved site, indicate that fish contributed the majority of meat to the diet. The large quantities of shell fishhooks and related technologies also attest to the importance of fishing to the subsistence economy of the islanders. In fact, after analyzing the vast quantities of fish bones recovered from SNI-11, a site located on the island's northernmost point, Salls (1988) felt compelled to compare the assemblage to a modern commercial fishery. Shellfish and sea mammals continued to be of intermediate importance, while birds contributed little to the diet during the latter part of the Late Holocene.

When viewed collectively, the dietary reconstructions for these sites show considerable differences, especially between the importance of fish and shellfish. Differences in sample size, site function, seasonal variation, and resource productivity may have contributed to this variation. In general, however, the better preserved sites contain more fish remains, while the eroded sites have fewer fish bones, and shellfish usually dominate the assemblages. This is not surprising considering that many fish bones are thin and fragile, with high surface-to-volume ratios. Although shellfish also break apart in eroded sites, they are generally stronger, heavier, and less affected by mechanical weathering or wind transport than fish bones. At SNI-39 and SNI-161, where roughly the same volume of materials was recovered from roughly contemporaneous components, it may be no coincidence that the better preserved faunal assemblage from SNI-161 shows fishing to have been more important to the subsistence economy than the heavily eroded SNI-39 assemblage. It is also possible, however, that some of these patterns might be real. It is conceivable that these roughly contemporaneous sites from the same general area represent different activities of one economic system. For example, overwhelming representation of a particular class of animal may indicate that the excavation sampled a specialized processing area. Also, both seasonal and long-term environmental fluctuations cause differential resource availability, perhaps leading to substantial changes in the subsistence economy. Many more sites must be analyzed before we fully understand the nature of maritime adaptations on San Nicolas Island during the Late Holocene. Our dietary reconstructions are a beginning, and from them many more questions and future research directions can be asked and explored.

TECHNOLOGY

General trends towards population growth, cultural diversification, and economic specialization characterize the Late Holocene in coastal Southern California. On San Nicolas Island, the challenge of feeding a growing population was met by increased fishing and technological innovations that focused on fishing gear rather than flaked stone manufacture (Mariani 1997; Rosenthal and Jertberg 1998a, 1998b; Salls 1988). It is during this period that circular fishhooks become abundant, along with evidence for the production of cordage for fishing, with a weight capacity exceeding the 20 lb. test line needed to catch large bottom dwelling rockfish and other kelp species (Mariani 1997; Strudwick 1986).

Functional fishhook analysis and fishing experiments demonstrate that the circular fishhook (commonly of shell, rarely of bone) was designed for a specific set of ecological and biological conditions based on fish anatomy, habitat, water depth, and feeding habits. As such, this incurved hook is a technological innovation for the efficient capture of soft-mouthed, bottom-dwelling fish. Many of these species are difficult to hook and pull up from great depths because they nibble at the bait and have soft mouths that tear easily. The incurving point of the circular fishhook is also less likely to foul in kelp or on rocky surfaces (Robinson 1942; Strudwick 1986; Tartaglia 1976).

While San Nicolas islanders were not the only coastal California people to use the circular fishhook, by 1986 more fishhooks had been recovered from the island than from any other locality (Strudwick 1986). This recovery suggests that hook-and-line fishing was an economic specialization that may have been more important to the Nicoleño than to other coastal groups. Fish bone analyses from several sites on San Nicolas Island indicate that fishing increased dramatically over time to become the most important subsistence activity of the Late Holocene. Fish bone densities suggest a fishing effort comparable with that of modern commercial fisheries, with bottom-dwelling rockfishes the most prevalent genus (Rosenthal and Jertberg 1997, 1998a; Salls 1988).

Success in capturing large bottom-dwelling rockfish and the fact that the fishhooks were made in a wide variety of sizes and according to a specific template reflects their importance as a technological innovation. The southern distribution of the San Nicolas Island fishhook type, a short knob variety, also provides evidence of affiliation with the Shoshonean cultural tradition. In an interesting response to what may have been the overexploitation of red abalone shell as a preferred fishhook material, the people of the Santa Barbara Channel substituted *Mytilus californianus* during the latter part of the Late Holocene, while on San Nicolas Island the shift was to *Norrisia norrisi* (Strudwick 1986).

In contrast to the care given to manufacturing shell fishhooks, most of the flaked stone artifact assemblage represents the expedient flaking of readily available, but not highly workable, metavolcanic and metasedimentary cobbles.

While a number of projectile points have been recovered from the island, especially by the antiquarians of the 1800s, a complex flaked stone technology has not been identified, and projectile points and formed tools are relatively rare (Rosenthal 1994, 1996; Woodward 1940a).

While flaked stone technology seems not to have been emphasized, probably because of the lack of terrestrial game animals and suitable available materials, ground stone manufacture seems to have been an area where San Nicolas islanders excelled. The sandstone shelves that form much of the rocky shoreline provide a source of well-indurated sandstone ideally suited for manufacturing ground stone implements.

Evidence to support the presence of an important ground stone industry is seen in the hundreds of mortars, pestles, and effigies collected from the island, including mortars and effigies in various stages of manufacture (Benson 1997; Bryan 1927, 1930, 1961, 1970; De Cessac 1882; Heizer 1951a; P. Jones 1969; Martz 2002; Meighan and Eberhart 1953; Putnam 1879; M. Rogers 1930a; Rust 1897; Schumacher 1875b, 1877; Schwartz 1998; Woodward 1939). The magnitude of production and the excellent craftsmanship suggest that these items were produced for trade. It should also be noted that, given the lack of oaks and acorns and the dependence on marine fish, the islanders probably could have gotten along quite well without mortars and pestles. The artistry expressed in these ground stone implements, especially the effigies, was noted by Schumacher (1877) and De Cessac (1882). These early explorers, who collected artifacts from the northern Channel Islands and mainland, found the workmanship on San Nicolas to be superior to that of the Santa Barbara Channel area (Heizer 1951a; Schumacher 1877:477). The effigies include "serpentine sculptures of sea lions, fishes, whales, and birds" (Schumacher 1877:477), as well as first-rate "stone vases" and mortars and pestles that are unique for their "beauty of profile and delicacy of execution" (Heizer 1951a:11).

It is probable that these items were highly prized and in great demand along the coastal trade routes. While sandstone was plentiful on the island, the steatite, talc, and chlorite used for manufacturing effigies were imported from Santa Catalina Island. One can imagine canoe loads of rocks being paddled from Catalina to the artisans on San Nicolas and then canoe loads of finished products, including heavy sandstone mortars, being transported to clients throughout the region. The ground stone industry must have been a highly profitable enterprise, to absorb the costs of the risky canoe trips.

San Nicolas islanders were also skilled in the production of a variety of shell and bone beads and ornaments, and fishhooks; bone whistles; and other implements, as well as cordage, baskets, mats, and skirts woven from sea grass. Many examples of these exquisite artifacts are housed in museums around the world. Clearly, the Nicoleño were highly industrious people, who, undeterred by the limitations of their remote territory, made the most of readily available resources. They developed the technology and skills necessary for an intensive maritime economy based on fishing, craftsmanship, and trade.

DISCUSSION AND CONCLUSIONS

Our analysis of the Late Holocene archaeology of San Nicolas Island indicates that many of the broad patterns that occurred in the rest of coastal Southern California also occurred on the island. These include a general increase in population density, a higher degree of sedentism, technological innovation, subsistence intensification, craft specialization, artistic and ritual elaboration, and relative cultural complexity. Our data also show very heavy reliance on fishing, an unusual degree of fine craftsmanship, and interesting fluctuations in occupation intensity over the past 3500 years. While more archaeological and paleoenvironmental data are necessary to elucidate some of these developments further, in the following discussion we examine how San Nicolas Island fits into broader Southern California cultural developments during the Late Holocene.

The data we have presented only scratch the surface of the potential San Nicolas Island has to contribute to the archaeology of the California Coast. The role the island played in the cultural geography of the broader region undoubtedly varied over time. Its outermost position, as well as its strategic location between the southernmost and the northern Channel Islands, makes it unique. It could have served as a meeting place for northern and southern groups and could have held an important role in the maintenance of social cohesion among these people.

The subsistence data we presented seem to mirror other coastal evidence suggesting the intensification of fishing during the Late Holocene. This intensification may, however, have developed earlier on San Nicolas Island than other areas in Southern California (Vellanoweth and Erlandson 1999). Faunal data from SNI-161 suggest that fishing intensified during the Middle Holocene, and circular shell fishhooks found in deposits dated to over 4000 years ago seem to support this. Perhaps the island's isolation, small size, and lack of significant terrestrial resources forced people to adopt intensive fishing strategies relatively early and to develop new technologies to deal with these limitations.

While the island's terrestrial resources are meager, the sea was home to a bounty of creatures able to support human groups both nutritionally and economically. Raw materials on San Nicolas Island formed the basis for islander participation in local exchange networks. Seashells, sea grass, and bones from marine birds and mammals were fashioned into beads, composite ornaments, and a variety of tools and weapons. Bowls and pestles were carved from local sandstone outcroppings scattered throughout the island's coastal strands. These manufactured items were then traded for raw materials, finished goods, and food stuffs not available on the island. The youngest site included in this analysis, SNI-160, contained numerous artifact examples suggestive of a complex economy and craft specialization, characteristics seen in other parts of Southern California during this time period. As their population grew, the people of San Nicolas Island were probably increasingly dependent on trade networks, as the size of the island and its limited resources demanded connections to the outside world. At the very least, festivals and social gatherings would have brought island populations to the mainland and vice versa, establishing social contacts and reaffirming economic partnerships.

San Nicolas Island is different from other coastal regions in California, because very little has been recorded of its native people. Also, until recently the island has seen relatively little development and CRM-related research. Unfortunately, this lack has led to some degree of intellectual marginalization by archaeologists, and the island's archaeological resources have been largely ignored. Yet the potential for San Nicolas Island to contribute to regional issues, as well as general theoretical and methodological developments, is strong. Some of the factors that have made the island difficult to include in regional syntheses also have made it an ideal laboratory for archaeological research. For example, the meager ethnographic record forces archaeologists to characterize islander life based solely on their material remains. Consequently, interpretations about economic relations, sociopolitical organization, and religious practices must be developed out of the archaeological record. These conditions, while difficult to overcome, present an interesting conceptual challenge for future research.

Many clues to unraveling the development of cultural complexity among San Nicolas Island's people can be found in museum collections worldwide. Because early collectors were attracted to finely made crafts, we can expect that much of what they collected was once part of a complex exchange network between the people of San Nicolas and the rest of Southern California and beyond. Unfortunately, without contextual data, most of these museum pieces have only aesthetic value to archaeologists. We need to rectify this problem through systematic examination of these artifacts; this task should include AMS ^{14}C dating of shell and bone objects to establish a basic chronology. We can also attempt to connect some of these artifacts with the few notes and site plans at our disposal. For instance, the Malcolm Rogers (1930a) collection, housed in the San Diego Museum of Man, has great potential for addressing issues of cultural complexity. Among these artifacts are some of the finest examples of the artistic accomplishments achieved by the people of San Nicolas Island. Rogers also excavated numerous house pits, sweat lodges, fire hearths, and cemeteries, recording data ideal for understanding the evolution of cultural complexity on the island.

Current archaeological investigations on the island are focusing on chronology, subsistence and settlement, site formation processes, and basic survey and inventory studies involving global positioning system (GPS) mapping, magnetometer survey, large-scale excavations, development of geographic information system (GIS) software, curation, and compliance with the Native American Graves Protection and Repatriation Act (NAGPRA). If San Nicolas Island is to be included in regional syntheses of California prehistory, then the contributions must come from archaeology. While such a prospect seems daunting and the limitations of the archaeological record difficult to overcome, it is precisely these problems that must be reconciled if we are to understand the dynamic lifeways of San Nicolas Island's Native peoples.

Acknowledgments. First and foremost, we thank the many people who helped us in the field and laboratory over the years. Without their hard work, this chapter could never have been written. Jane Rosenthal, Patricia Jertberg, and Beth Padon conducted some of the original research that contributed to this chapter. We also thank the US Navy for providing funds, logistical assistance, and support for our research, especially the Environmental Division, Naval Air Weapons Station, Point Mugu, California. This research was also supported financially by California State University, Los Angeles and the University of Oregon. We are indebted to Jon Erlandson for inviting us to participate in this volume and for his editorial efforts that substantially improved our chapter. Finally, we thank Jeanne Arnold, Terry Jones, Marilyn Beaudry-Corbett, anonymous reviewers, and the editorial staff of the Institute of Archaeology for their help in the editing and production of this chapter.

CHAPTER 7

A View from the Mainland

Late Holocene Cultural Developments Among the Ventureño Chumash and the Tongva

LYNN H. GAMBLE AND GLENN S. RUSSELL

In this study, we consider the development of prehistoric cultural complexity among hunter-gatherer populations in the Los Angeles Basin, Santa Monica Mountains, and coastal Ventura County of mainland Southern California (figure 7.1). The Tongva (Gabrielino) and Ventureño Chumash interacted here and adapted to the environment in generally similar ways. The archaeological record of the Late Holocene in this region indicates that significant cultural changes took place in aboriginal society during this time. Prior to European contact, society reached a level of sociopolitical complexity characteristic of chiefdom-level organization. Archaeological indications of increased cultural complexity include larger settlements and structures over time, evidence of increased exchange, elaborated mortuary practices, and subsistence intensification. By examining archaeological and ethnohistoric data regarding subsistence, settlement strategies, village organization, exchange, ritual organization, and mortuary remains, we identify mechanisms involved in the development of cultural complexity. Our goal is to better understand the development of complex coastal hunter-gatherer societies over several millennia.

We consider ecological, archaeological, and ethnohistorical data relevant to the development of increasingly complex social and economic organization. Drennan (1991a:119, 1996:31) argued that any of the factors proposed as causal mechanisms for the development of complexity can be discussed from the perspective of either a management or control approach. Drennan (1991b) also emphasized the need to address variation in cultural trajectories from region to region in order to begin to address the general process of chiefdom development. Flannery (1972) proposed that the mechanisms involved in the development of increasing complexity will vary regionally, but the general process may be universal. We attempt to identify which mechanisms and processes were important in the development of complexity on the Southern California Coast.

First, we review recent theoretical issues relevant to the development of cultural complexity. Then, using both archaeological and ethnohistorical data, we describe the level of cultural complexity characteristic of the region during the late prehistoric period, including economic, political, and religious organization. We then review and synthesize the archaeological and environmental data from the region relevant to the nature and development of cultural complexity. Our analysis includes consideration of settlement pattern and internal site organization, subsistence remains and technology, exchange, ritual organization, and status. We conclude with a discussion of the mechanisms and processes of cultural change operating in the region.

MODELS OF THE DEVELOPMENT OF CULTURAL COMPLEXITY

At contact, the coastal Tongva and Chumash were hunter-gatherers organized into settlements focusing on the intensive exploitation of both marine and terrestrial resources. In these relatively complex societies, social and political hierarchy was institutionalized: access to chiefly positions was restricted through hereditary succession. To address the nature and possible causes of such complexity, it is critical to consider the economic base of a society and how leaders participated in it. A useful approach is to identify changes in what has been referred to as the political economy (see D'Altroy and Earle 1985; A. Johnson and Earle 1987). Chiefs were supported by a political economy based on the extraction of a surplus from the subsistence or family economy. In a sense, then, emergent complexity can be seen in the emergence of a political economy.

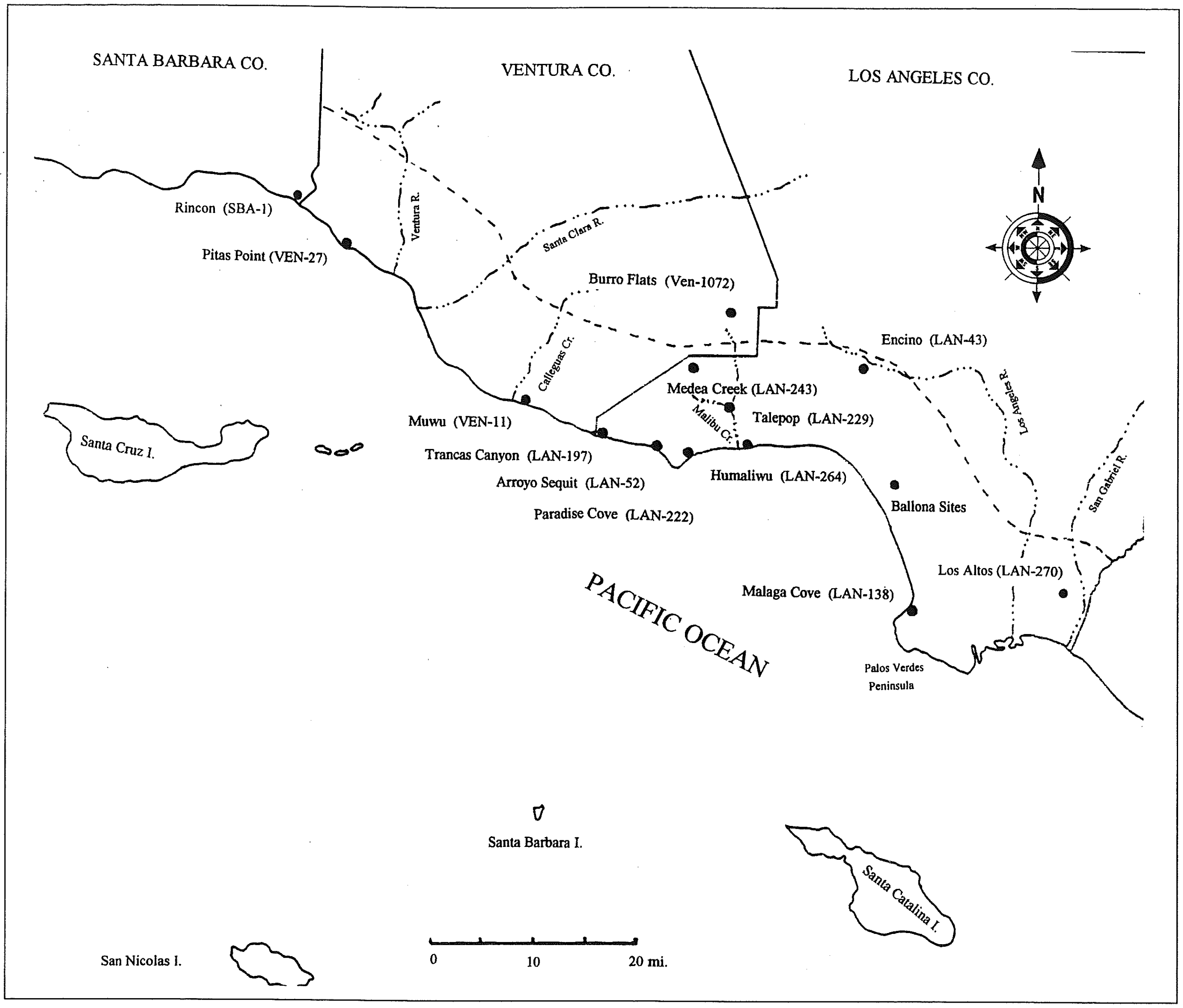

Figure 7. 1 Map of Ventureno Chumash and Gabrielino/Tongva areas, showing major sites discussed in text.

The various theoretical frameworks that account for the emergence of cultural complexity (see Arnold 1996a for a recent synthesis) tend to fall into two general camps or approaches. One approach emphasizes the benefits to society of cultural complexity, while the other focuses on conflict resulting from inherent social and economic inequality. Drennan (1996) noted that, broadly speaking, these two approaches to social change reflect the differences between an ecological-functional approach and a Marxist approach. These two approaches have been also referred to as "voluntaristic" and "coercive" (Carniero 1970), and as "management" and "control" (Earle 1987), respectively. Regardless of approach, various factors have been cited as important in the development of complexity, including population growth, warfare, exchange, subsistence intensification, and environmental degradation. In addition, earlier studies, which tended to emphasize one or another factor as prime movers in unilineal evolutionary schemes, have largely given way to multilineal explanations that consider a variety of conditions and processes.

The voluntaristic or management approach, which emphasizes adaptation, has been used by several authors to explain the development of social complexity. Flannery (1972) focused on mechanisms and processes in the evolution of civilizations. Based on a simple unilineal evolutionary scheme, Service (1962, 1975) similarly argued for the management approach to the origins of complex society.

Several authors have used the approach that emphasizes the importance of coercion or control in the development of complex societies (Carniero 1970; Fried 1967; and others). According to Earle (1991, 1997:203), to understand how increasingly complex political economies developed in a particular region, it is critical to consider how emerging leaders manipulated the various power strategies available to them. Chiefs choose to manipulate one or both components of the political economy, sometimes referred to as staple and wealth finance (D'Altroy and Earle 1985; Earle 1997). Staple finance involves the mobilization and redistribution of food and technological items. Chiefly feasts, prime examples of staple finance, are present in some form in virtually all complex societies. Wealth finance, on the other hand, involves the procurement or manufacture of symbolically valued items, either through control of long-distance exchange or some form of craft specialization.

Theoretical approaches in California have included both the management and conflict models. Management models for the organization of indigenous California societies are frequently based on ethnographic and ethnohistoric data. Bean (1976) and Blackburn (1976) suggested that sociocultural complexity is a result of specific social institutions that manage and redistribute resources. These institutions include economic and political alliances, ritual and kinship obligations, trade feasts, and restricted access to the production and redistribution of goods (Bean 1976:119-120). Blackburn stressed the importance of regular reciprocal ceremonial exchange, such as fiestas. He suggested that ceremonialism was an institutionalized way of redistributing resources that was both adaptive and contributed to the increasing complexity of political organization in Southern California (Blackburn 1976:232-233). Blackburn (1976:240) suggested that ceremonial activities provided a basis for political interaction among autonomous groups. Blackburn (1976:238) also recognized that the "unholy alliance" between chiefs and shamans provided coercive power that enhanced a chief's political authority. Management models continue to frame more recent studies, including Blackburn and Anderson's (1993) edited volume on "environmental management" by California Indians.

Management approaches can also be seen in archaeological research. C. King (1976:289) described the Chumash economic system as an adaptation to environmental variation. Chumash exchange resulted in a more stable subsistence base, an increase in population, and a greater need for intergroup maintenance. C. King (1990:200) interpreted changes in Chumash sociopolitical organization from an evolutionary perspective, where the Chumash for over 7000 years maintained social subsystems that were more efficient than those of surrounding groups.

In contrast, Arnold (1992a) explained economic strategies from the perspective of control of labor in the context of environmental degradation. She suggested that the manipulation of labor and products during stressful conditions by aspiring leaders might be an important mechanism in the development of social inequality. She proposed a model for the Chumash where the rise to a simple chiefdom level of society occurred during a time of environmental deterioration, with elites fortuitously gaining control over key resources and technologies. Arnold believed that environmental disruption occurred on Santa Cruz Island between AD 1150 to 1300 and that emerging elites organized and coordinated increases in the production of wealth, in particular craft specialization of shell beads. Arnold suggested that, as a result, by AD 1300 to 1400 a simple chiefdom level of organization arose in the Santa Barbara Channel area.

ENVIRONMENTAL CONTEXT

Our study area encompasses coastal Los Angeles and Ventura counties, including all areas within about ten miles (16 km) of the coast. The physiographic composition of the region includes several features that affected the location of sites and the nature of available resources: a series of alluvial plains transected by major watercourses, mountainous areas, and coastal shoreline. The region contains the coastal portions of the Los Angeles Basin, Palos Verdes Peninsula, Santa Monica Mountains, Oxnard alluvial plain, Ventura Basin. This includes portions of both the Transverse and Peninsular Ranges, and all major settlements with coastal access during the Late Holocene.

The Los Angeles Basin was a broad expanse of prairie crossed by a number of important watercourses, including the Los Angeles, Rio Hondo, and San Gabriel Rivers. The Santa Monica Mountains, rising steeply from the shore along much of the coastline, are located at the southwestern part of the Transverse Ranges and are divided in half by Malibu Creek, the most prominent watercourse in the Santa Monica Mountains. The Oxnard Plain is transected by two major drainages, the Ventura and Santa Clara Rivers. On the southeast portion of this coastal plain, Calleguas Creek drains into Mugu Lagoon.

A variety of vegetation communities occur in this region. Three coastal communities are Coastal Salt Marsh, Coastal Sagebrush, and Seashore. The Southern Oak Forest, Chaparral, Valley Oak Savannah, and Riparian communities are also found here. Plants and plant foods of economic significance to the California Indians include acorns, chia, grasses, islay, red maids, toyon, walnut, blue dicks and other bulbs, manzanita, and yucca (C. King 1994a:18).

Seashore and offshore habitats include rocky intertidal areas marked by rocky promontories and reefs, beach areas on exposed coastlines, sand dunes, bays, sloughs, and lagoons. Beyond the intertidal zone lie coastal waters with productive kelp beds, rocky and soft bottoms, and open waters. These coastal habitats provided a variety of resources important to the Tongva and Chumash, including fish, shellfish, birds, and sea mammals (McConnaughey and McConnaughey 1986).

Tectonic deformation has resulted in the faulting, folding, and tilting of various landforms on the Southern

California Coast. The many rock types found in the area which were significant resources for Chumash and Tongva tools include chert, chalcedony, quartzite, andesite, rhyolite, basalt, granite, tuff, gneiss, sandstone, and quartz crystal. Another heavily used raw material was asphaltum (Gutman 1979), the largest source of which is the La Brea Tar Pits in the Los Angeles Basin. Numerous asphaltum seeps are also found in Ventura and Santa Barbara Counties.

Archaeological discussions of environmental change in Southern California during the Late Holocene are numerous and varied (for example, Arnold 1991a; Glassow, Wilcoxon, and Erlandson 1988; Kennett 1998; Kennett and Kennett 2000; Raab and Bradford 1997; Walker and Lambert 1989). Raab and Larson (1997), who examined a range of paleoenvironmental and archaeological data, suggest that severe drought conditions during part of the Medieval Climatic Anomaly (ca. AD 800 to 1400) affected the health, complexity, and level of violence of Southern California tribes. Arnold (1997; Arnold, Colten, and Pletka 1997) attributed the environmental change that affected culture change to warmer sea temperatures and droughts, along with demographic conditions. She agreed that such conditions affected health and conflict patterns on the northern Channel Islands, but also saw them as crucial to changes in production, trade, labor relationships, and social organization.

More recently, Kennett (1998:298-300) proposed that climactic conditions were cyclical and not stable during the Late Holocene based upon newly generated oxygen and carbon isotopic data. Kennett (1998:363) and Kennett and Kennett (2000) argued that the warm water events cited by Arnold (1991a) were actually periods of cold marine conditions and high marine productivity. Nevertheless, Kennett (1998:363) acknowledged that settlement disruptions occurred in the Middle to Late period transition, but that they resulted from a series of droughts registered in paleoclimatic records throughout California. In years to come these models for culture change will be further tested with archaeological data from sites that span this significant time period. Paleoenvironmental data, which are still being fine-tuned, clearly indicate that cycles of warm and cold water events, along with droughts and wet periods, affected Native societies along the Southern California Coast. Unfortunately, archaeologists have been quick to adapt models of culture change using the latest environmental data, often without adequate archaeological information: certain environmental change may be so temporally restricted that it is difficult to discern clearly in the archaeological record. We recognize that environmental variation played a significant role in the lives of Late Holocene people on the Southern California Coast but suggest caution in linking specific environmental events to cultural changes. Ample ethnohistoric and ethnographic data from throughout California (see Blackburn and Anderson 1993) indicate that Native peoples were extremely knowledgeable about plants and animals in their environment and developed numerous strategies for surviving droughts and other conditions that affected their subsistence. There is no reason to doubt that these strategies, developed through centuries of experience, were employed in prehistoric times.

OVERVIEW OF CULTURAL COMPLEXITY

At the time of contact, the Chumash and Tongva Indians lived in permanently occupied settlements, and their population densities were significantly higher than those of most hunter-gatherer groups at any time in the world. They had elaborate economic systems characterized by shell bead money, craft specialization, hereditary chiefs, and a regional exchange network. Because the Chumash were some of the most complex hunter-gatherers on Earth, research into their economic, political, and religious interactions is an invaluable contribution to the goals of explaining complexity among nonagriculturalists. In this section, we present background information concerning the Chumash and Tongva, based on ethnohistoric, ethnographic, and archaeological data, to provide a context for examining the development of cultural complexity during the Late Holocene.

Economic Organization

The Chumash economic system is better documented than that of the Tongva. The use of bead money allowed the Chumash to redistribute efficiently the abundant resources available in different environmental zones (C. King 1976:317). The Tongva were integral participants in the economic interaction sphere of the Chumash. The production of shell bead money was a complex industry in which inhabitants of villages on the northern Channel Islands specialized in manufacturing goods to exchange for resources not available on the islands (Arnold 1987; Arnold and Munns 1994; C. King 1976; see also Munns and Arnold, chapter 8, this volume). King (1976) and Arnold (1987) have documented two types of craft specialization linked to the production of shell bead money: the manufacture of microblades used to drill shell beads and the production of shell beads. In return for bead money, coastal and interior inhabitants of the mainland traded subsistence and status items to the islanders.

The plank canoe, known as the *tomol* by the Chumash and the *ti'at* by the Tongva, was a major innovation for maritime adaptation and exchange (Arnold 1995a; Gamble 2002; Hudson, Timbrook, and Rempe 1978). It was used for fishing and sea mammal hunting, as well as transporting cargo and passengers. The plank canoe allowed the Chumash and Tongva to intensify exchange between the mainland and the Channel Islands, especially that of large items such as the steatite cooking vessels (ollas) made on Santa Catalina Island that were intensively traded to the Chumash. Because of their heavy emphasis on exchange, the Chumash were considered unique by the early Spanish chroniclers when compared with other California tribes.

Exchange at the time of the first sustained historic contact (AD 1769) and immediately prior to contact among the Ventureño Chumash and the Tongva involved a complex network of social interactions. It is likely that resources were redistributed during regular ceremonial fiestas, with chiefs organizing these efforts. Individuals attending these fiestas came from a wide geographical range, including island, mainland, and interior villages. Trade also transpired when fiestas were not taking place. Plank canoes were critical for trade between the mainland and the islands and along the mainland coast. Chiefs or wealthy individuals organized or paid for the materials and orchestrated the labor needed to build a plank canoe, which often took six months (Hudson, Timbrook, and Rempe 1978). Once canoes were built, chiefs and wealthy individuals who owned them exerted considerable control in the exchange system between the mainland and the islands. Individuals traded among the people within their village or among individuals from more distant villages when they traveled, whether on foot or by boat. Individuals may have also relied on chiefs or canoe owners, who undoubtedly took a percentage of the transaction to act as middlemen in economic transactions (Gamble 1991).

Political Organization

The political systems of the Chumash and Tongva were organized at the village level, with hereditary chiefs and many other specialists wielding considerable power (Bean and Smith 1978; Blackburn 1975, 1976; L. King 1969; McCawley 1996). There is some evidence that chiefs sometimes had jurisdiction at a regional level (Arnold 1996b:67; Blackburn 1975; Gamble 1991; McCawley 1996:91). Some villages with more than one chief have been classified as political centers (J. Johnson 1988). Chiefs determined the timing of festivals, ceremonies, and other important events, and maintained extra food stores for the villagers in case of need. Serving as economic advisers, the chiefs worked closely with the ceremonial leader (*paxa*) who assisted them. Chiefs were usually males, but there are historic references to female chiefs.

Tongva communities were composed of one or more lineages led by a chief (*tomyaar*) who inherited his position. The tomyaar served as chief administrator, fiscal officer, religious leader, legal arbitrator, and commander in chief (Bean and Smith 1978:544; McCawley 1996:90). While female chiefs have been reported for the Tongva, chiefs were usually males. The Tongva may have had provincial chiefs, but the evidence is limited (McCawley 1996:91). One of the largest historic Tongva villages, Suaagna, was located at San Pedro. This settlement was known as a political center for a cluster of other villages nearby, and the chief of Suaagna was also the leader of the associated villages.

The earliest evidence that the Chumash had regional chiefs with jurisdiction over many villages comes from the AD 1542 diaries of the Juan Rodriguez Cabrillo expedition. These accounts contain descriptions of two large provinces in the Santa Barbara Channel area, each of which was governed by a paramount chief, indicating that the Chumash Indians, at earliest contact, had a social system that included a chief with power over a wide area (Gamble 1991). Documents from later expeditions, ethnographic sources, and mission records confirm this concept of a regional chief for a group of villages (Hudson et al. 1977:15; J. Johnson 1988:118, 288; C. King 1990:57; L. King 1969; Horne 1981:57), although J. Johnson (1988:291) cautioned that the degree of political cohesiveness among villages is far from clear.

A number of detailed ethnographic and archaeological accounts describe regional sociopolitical organization along the Ventura Coast. Pico, a Chumash consultant to H. W. Henshaw (Heizer 1955) in the late nineteenth century, said an important chief resided at Point Mugu whose authority extended to Pt. Concepcion. He described a gathering that took place at Point Mugu every five years, where chiefs gathered from this large region to pass laws, conduct business, and feast for about a week. All the chiefs in the region were subject to the chief at Muwu according to Pico, but the exact nature of this authority is unknown. Ethnographic information from Fernando Librado (Hudson et al. 1977:11), one of John P. Harrington's Chumash consultants, confirms Pico's account that Muwu served as an important ceremonial and political center. Muwu has been identified as the capital of a regional Chumash organization known as Lulapin that existed at contact. It has also been suggested that the site of Malibu was an important regional center with jurisdiction over a large portion of the Santa Monica Mountains Chumash and the western Tongva (C. King 2000).

Chumash Religious Organization

Chumash religious beliefs and public rituals revolved around the worship of the sun and earth. The sun was viewed as a supreme supernatural male force that imparted vitality and life, but was also threatening and a possible bearer of death (Blackburn 1976:235-236). The earth (Hutash), in contrast, was viewed as a mother and benevolent god, who gave sustenance to people and all beings on the earth (Hudson et al. 1977:37). In August or September, Hutash was honored in one of the most important ceremonies held by the Chumash (Hudson and Underhay 1978:45-46). For five or

C14 Years	D.B. Rogers (1929)	W. Wallace (1955)	Warren (1968)	C. King (1990)	Calender Years
	Historic Chumash	Historic Cultures	Historic Cultures	Late Period Phase 3	
	________	________	________	________	AD 1782 (168 BP)
				Late Period Phase 2 ___AD 1500__	
		Horizon IV	Late Period	Late Period Phase 1 ___AD 1150__	AD 1670 (280 BP)
				Middle Period Phase 5 ___AD 900___	AD 1380 (570 BP)
AD 1000	Canalino	Late Prehistoric	(Yuman or Shoshonean)	Middle Period Phase 4 ___AD 700___	AD 1170 (780 BP)
			(Chumash)	Middle Period Phase 3 ___AD 400___	AD 980 (970 BP)
AD 0	_______?____	______?_____		Middle Period Phase 2 ___200 BC___	AD 580 (1370 BP)
	Hunting People	Horizon III Intermediate	Campbell Tradition	Middle Period Phase 1 ___600 BC__	800 BC (2750 BP)
				Early Period Phase Z ___1000 BC__	1490 BC (3440 BP)
				Early Period Phase Y ___4000 BC__	2850 BC (4800 BP)
-3000 BC-	________	________	______?____		
	hiatus? Oak Grove	Horizon II Millingstone	Encinitas Tradition	Early Period Phase X ___5500 BC__	5250 BC (7200 BP)
					6630 BC (8580 BP)
			_______?____	?	
	________	________		________ ?	8600 BC
-8000 BC-			San Dieguito Tradition		

Portions Taken from Erlandson (1994: Figure 3-1).

Figure 7.2 Selected chronological sequences from southern California.

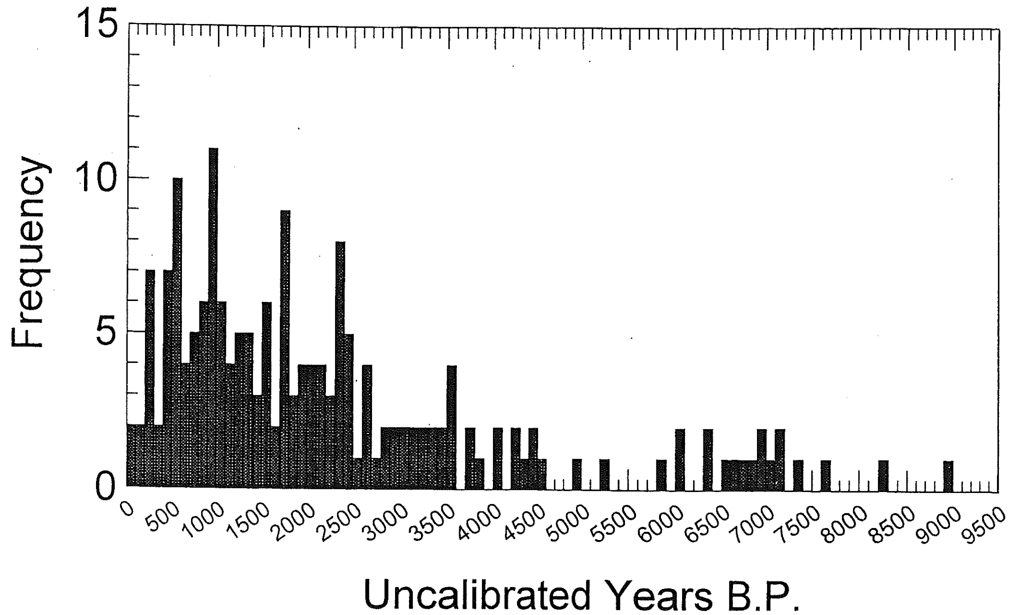

Figure 7.3 Temporal distribution of uncalibrated ^{14}C dates from Los Angeles and Ventura county sites.

six days, Chumash from the islands and the mainland, and visiting Yokuts, Kitanemuk, and Tongva, gathered in the large centers to perform rituals thanking Hutash for providing the harvest (Hudson and Underhay 1978:46). Songs, games, dances, and trading also occurred.

In addition to shamans and doctors, the Chumash had a formal religious organization known as the *'antap*. Each major village had twelve *'antap* members who were baptized into the society as children. Parents of these children were presumably from high-status families, because they had to pay a considerable amount of money for this privilege (Blackburn 1976:235-238). Chiefs and all members of their family were required to belong (Blackburn 1976:236-237). The primary responsibility of the *'antap* was to perform dances and other rituals at large public ceremonies (Blackburn 1976:236-237). The *'antap* society appears to have functioned as an integrative mechanism throughout the Chumash region (Blackburn 1976:237).

In one of the best reviews of Tongva religion, Hudson and Blackburn (1978) noted many similarities in religious and ritual practices among the Tongva, Chumash, and other Southern California tribes. They document that the Chumash and Tongva shared the *'antap* complex, which served not just as a religious society but as a system of political integration within and between Chumash and Tongva provinces (Hudson and Blackburn 1978:238).

Historic documents concerning the Chumash provide many references to feasts that political leaders organized among the Chumash and their neighbors. As they stopped at villages along the Santa Barbara Coast, the early explorers found the Chumash to be very friendly and willing to provide feasts with an abundance of food and entertainment in the form of singing and dancing.

Having summarized the cultural complexity of the Ventureño Chumash and Tongva at or immediately prior to European contact, we now review the Late Holocene archaeological record to examine how and when cultural complexity developed. We use archaeological data to trace developments in settlement, subsistence, exchange, religious organization, and status.

SETTLEMENTS

It is not possible to reconstruct comprehensive Late Holocene settlement patterns for this region because much of the area is covered by modern urban construction, and many sites remain unrecorded, undated, or inadequately dated. Our discussion of settlement change is based on a selection of excavated and other sites affording adequate chronological information.

One of the earliest and most thorough examinations of cultural development among the Chumash is D. B. Rogers' (1929) work in the Santa Barbara Channel area. Rogers proposed a chronological sequence for the Santa Barbara Channel area that included three periods, with a different ethnic group characterizing each (figure 7.2). Very few researchers in the Chumash region support Rogers' ethnic replacement model. C. King (1980:3-29) explained that changes in Chumash settlement distributions resulted from changes in social organization. King (1980:3-29) noted a number of changes between about 3500 and 600 BC in settlement distribution and size due to increases in social complexity. King (1980:3-30) proposed a greater emphasis on boats and ocean resources, increased regional organization and greater populations, and less emphasis on defensive locations by 600 BC. Over time, as boats became larger and more important, greater emphasis was placed on settlements at ports (C. King 1980:3-30). There was a general trend towards larger village sizes over time, and after 1000 BC, villages in the Chumash area grew about two to five times larger (C. King 1990:91).

Leonard (1971) was one of the first to address settlement patterns in the Santa Monica Mountains area. Leonard noted a broadening in the resources and habitats exploited during the Intermediate period, including increased acquisition of sea mammals, fish, deer, and acorns. He suggested that offshore areas and the interior of the Santa Monica Mountains were first used systematically and that temporary sites appeared during this time (Leonard 1971:127-128). Leonard believed these trends continued in the Late period and proposed that rock shelters in the Santa Monica Mountains were first occupied after about AD 1000 to 1200.

The nature of Late Holocene Chumash sites in the Santa Monica Mountains interior and their relationship to coastal settlements have also been foci of discussion. Van Horn (1987a) suggested that coastal groups used interior sites as camps, while Clewlow, Wells, and Pastron (1978) suggested that inland groups were independent of coastal populations. Dillon and Boxt (1989), supporting the independence of inland groups, proposed a shifting village model in which inland populations congregated in larger winter settlements and dispersed into smaller family groups in spring and summer.

When considering the relative frequencies of ^{14}C dates from coastal Los Angeles and Ventura counties (figure 7.3), there is a significant increase in the frequency of dates over time, especially in the Late Holocene. Interpreting these data is difficult, but the increasing number of dates probably correlates with greater population size in the region. The large size of many sites along the southern Santa Barbara Channel region supports the concept of large Late period coastal settlements. A. Brown (1967) noted that approximately 200 to 300 people lived in the larger coastal settlements of the Ventureño Chumash at the time of historic contact; these sites were smaller than many mainland villages in the Santa Barbara area. Historic and archaeological data indicate that the historic settlements in the Santa Monica Mountain region were permanent and had been occupied over a long period of time (C. King 1994a:68). These sites appear to be located in areas along the coast where boats could easily access the shoreline. Evidence of large cemeteries in this region prior to the beginning of the Late Holocene (see Gamble and King 1997) suggests that the settlements were probably permanent. The faunal and floral assemblages from these sites also indicate year-round occupation (C. King 1982, 1994a).

Information regarding the organization of Late Holocene sites among the Ventureño Chumash indicates that people were living in settlements with clustered houses, and, that houses, along the shoreline were arranged lineally (Gamble 1995). There are many examples of structural remains in the Chumash region (Gamble 1991, 1995), but only two archaeological sites from the coastal Ventureño area provide important data concerning village layout and organization. The first of these is VEN-27 at Pitas Point, occupied between about AD 1000 to 1500. Structural remains (figure 7.4) from this site indicate that houses were clustered in a row, with the cemetery at one end of the village (Gamble 1983; C. King 1978). The historic village of Muwu (VEN-11) also provides data regarding internal organization. In 1932, Woodward mapped house depressions for a sweat lodge and a cemetery (figure 7.5) located at opposite ends of the Muwu residential area. The clustering of houses along the shoreline and the location of the cemetery are similar at both sites, indicating some level of continuity in the structure of village sites between the late Middle and contact periods. This clustering may have strengthened the defensive capabilities of these settlements and may also indicate significant political authority at the settlement level. Houses at Pitas Point and Muwu were approximately the same diameter, indicating continuity in house size over time (Gamble 1991:Table 3.1).

Changing settlement patterns in the Tongva region have been discussed by several scholars. Altschul, Homberg, and Ciollek-Torrello (1992) summarized settlement patterns in the Ballona area, suggesting the area was used sporadically or abandoned until about 3000 years ago, at which time a lagoon developed and occupation became more continuous. From around 1000 BC to AD 1000, sites typically were large, with extensive middens exhibiting relatively few artifacts and little shell (Altschul, Homberg, and Ciollek-Torrello 1992:366). They offered that these sites were occupied only intermittently throughout the year. Van Horn (1987b) suggested that these sites were temporary camps, although J. Brown (1989) proposed that they were occupied more intensively. By AD 1000, Ballona Lagoon had almost silted in, an estuary had developed, and sites shifted from the bluff tops to the base of the bluffs by the water (Altschul, Homberg, and Ciollek-Torrello 1992; Van Horn 1987b). Grenda, Homberg, and Altschul (1994) debated whether the large Late period sites at this time were permanent or repeatedly occupied seasonal settlements.

Settlement strategies among the Tongva, at least at the time of contact, indicate that settlements in the Los Angeles Basin were larger than contemporary settlements in the Santa Monica Mountains, and that these larger settlements were fewer in number and more dispersed. These data are based on populations derived from mission registers currently being analyzed by C. King (2000).

This brief synthesis of settlement strategies among the Ventureño Chumash and the Tongva leaves many questions unanswered. The debate about whether sites were temporary

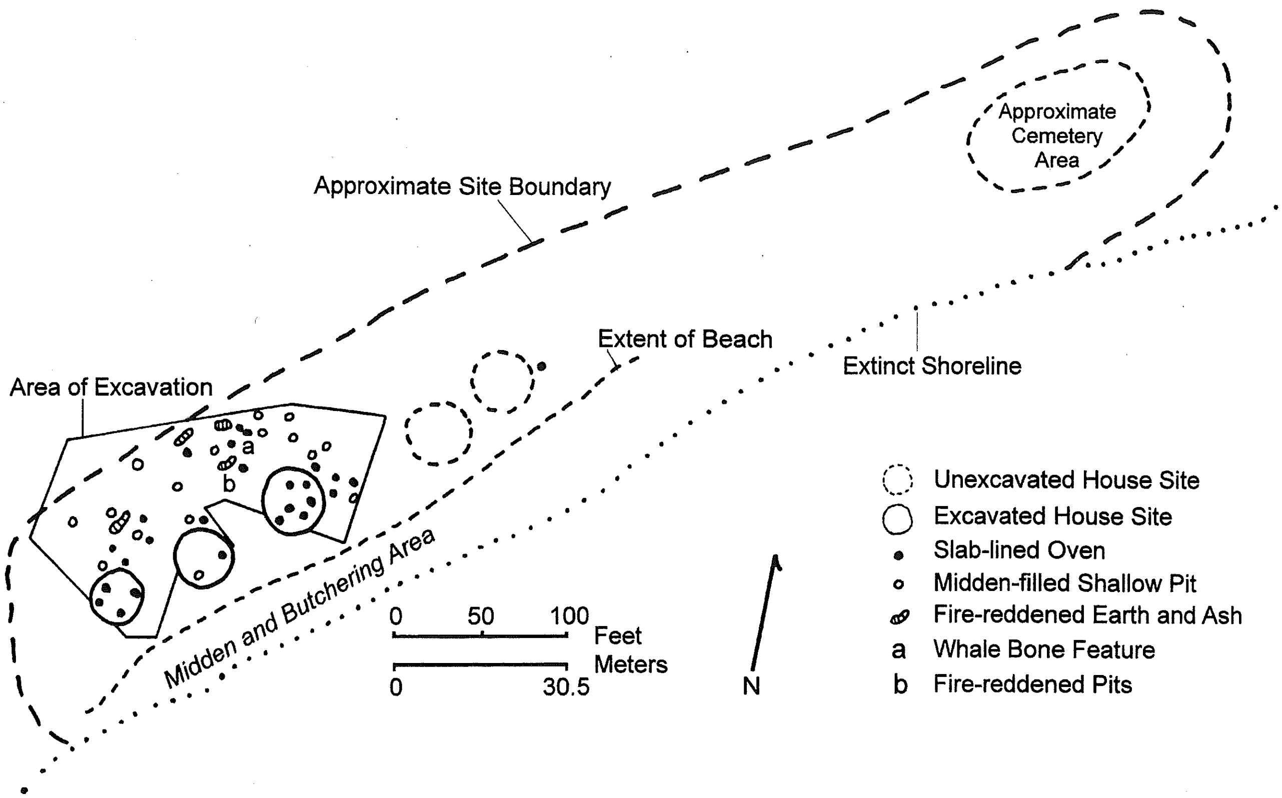

Figure 7.4 Distribution of structures and features at Pitas Point (VEN-27). *After King 1978: figure 6*

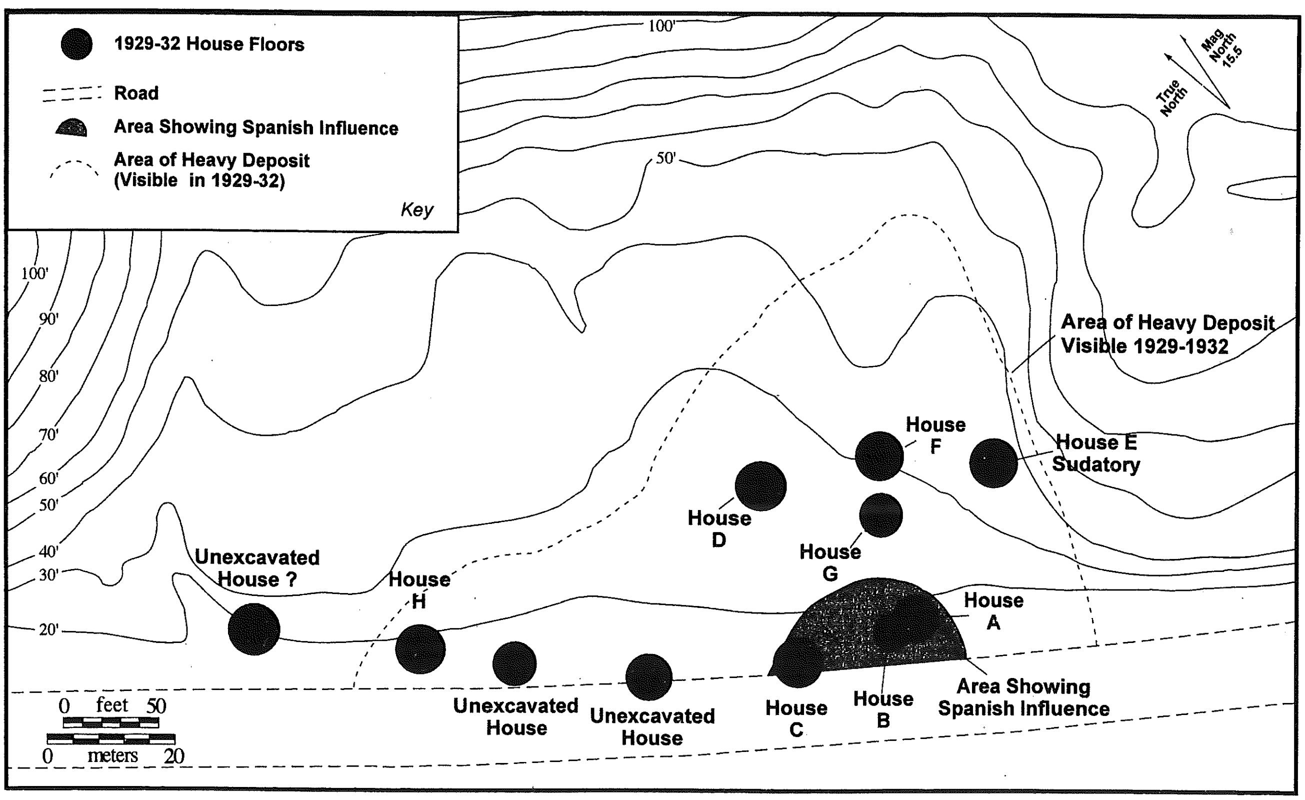

Figure 7.5 Distribution of house structures and midden deposits at Muwu (VEN-11)

or permanent is unresolved. Permanent coastal settlements at the time of contact have been documented for both regions (Bean and Smith 1978; Johnston 1962; C. King 1975), but archaeological methods of identifying the permanence of occupation are problematic. Based on multiple lines of evidence (for example, burial data, subsistence remains, historical accounts), we propose that permanent settlements existed in our study area throughout the Late Holocene. The extent of permanent settlements and the changing settlement strategies of their inhabitants are poorly understood, however. Researchers are attempting to address these questions, but until more complete information is collected and more standardized methods of assessing permanence of settlements are developed, these issues will continue to be debated

SUBSISTENCE REMAINS AND TECHNOLOGY

Significant changes in subsistence occurred during the Late Holocene in our study area. These changes, including greater importance of marine resources and associated technology, correlate with other trends, such as increases in population size and sociopolitical complexity. Possible control or management of access to food resources, either through resource ownership or control of technology and exchange, may have been an important component in the development of complexity. Consequently, we document changes in subsistence resources and technology and consider what opportunities for management or control they provided. Archaeological data concerning subsistence organization and change in the region are uneven, but we synthesize the existing data to examine changing subsistence practices during the Late Holocene. Reconstructing subsistence from archaeological data is difficult due to variability in field and laboratory methods. In many earlier excavations, screens were not used and faunal remains were not collected systematically. The use of screens in archaeological excavations greatly increased both the quantity and quality of subsistence data, allowing the calculation of relative quantities of different subsistence remains in many cases. Still, variation in mesh size makes comparison of subsistence data from different projects problematic. Many species, particularly fish, are seriously underrepresented in samples collected using 1/4 inch mesh and some are underrepresented by 1/8 inch mesh. Water screening also significantly improves the recovery of faunal remains, especially when residues are sorted in the laboratory. Preservation problems also affect the interpretation of subsistence remains, particularly that of plant foods. Many plant foods were eaten in their entirety or preserved only when carbonized, inhibiting quantitative analysis. For most excavations, no attempt was made to recover botanical remains systematically. In the few projects where carbonized plant remains were systematically recovered and analyzed, it is still not possible to quantitatively compare the contribution of plant and animal foods to the diet.

Finally, methods of data standardization and comparison also affect the reconstruction of subsistence. For many sites, a species list is all that is available or, some faunal classes are reported while others are not. Different quantification methods are also employed making inter-site comparisons difficult if not impossible. Given the variation in data recovery techniques, preservation, quantification, and presentation, we can only use the available data to identify important trends in Late Holocene subsistence.

Ventureño Chumash

Marine Resources. For the Ventureño Chumash area, evidence suggests that fishing became increasingly important beginning in the early part of the Late Holocene. This increase is seen in changes in both fishing technology and fish bone assemblages from several sites in the region. Fish bone data from the coastal village of VEN-87 indicate that fishing became more important at approximately 1000 BC, particularly for species that could be taken in shallow coastal waters using simple technology, such as a beach seine or hook and line (Fitch 1975; Roeder 1976). Based on the total weight of fish bone compared to other vertebrate fauna and shellfish, Glassow (1965) suggested that the earliest (1000 to 700 BC) inhabitants of the Malibu site (LAN-264) subsisted primarily through fishing. While maritime adaptation at Malibu continued from 700 to 400 BC (Glassow 1965:9), hunting of Guadalupe fur seal (*Arctocephalus townsendi*) became the major subsistence activity. Beginning about 300 BC, subsistence shifted from a focus on sea mammal hunting to a more diverse strategy, with increasing contributions from land mammals, birds, shellfish, and, judging by a large increase in the number of grinding implements, acorns and hard seeds. An emphasis on inshore fishing continued between about 200 BC and AD 200 (C. King 1990). Tartaglia (1976:173), who analyzed the faunal remains from Malibu, noted an emphasis around 500 BC on species caught in inshore waters. Tartaglia (1976:173-175) also stated that, although pelagic fish are present in levels dated to about 500 BC, yellowtail and some species of rockfish are not common until about 300 BC. Tartaglia (1976:175) also suggested that there was an overall cyclical trend in the presence of pelagic fish at Malibu over 3000 years and that the pattern parallels the major climatic shifts over the same period of time. Unfortunately, he presented no quantitative data regarding species diversity by level, so it is not possible to evaluate his suggestion.

Data regarding fishing technology corresponds with the fish bone data. Prior to about 600 to 500 BC, the only bone or shell artifacts associated with fishing were bone gorges and compound bone fishhooks. There is no evidence of harpoons or circular or j-shaped hooks prior to this time. The

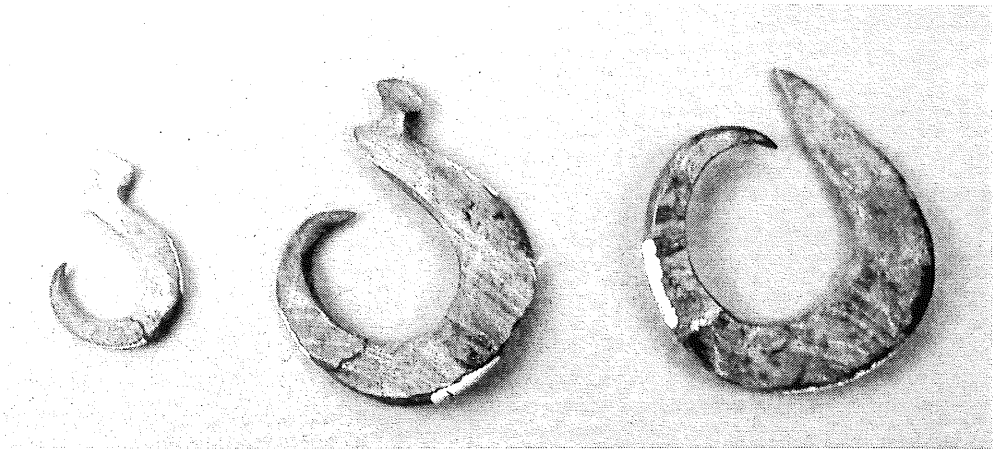

Figure 7.6 Shell fishhooks from Malibu (LAN-264).

absence of deep-water species suggests that plank canoes were not an important aspect of fishing technology. Changes in fishing technology support continued emphasis on inshore fishing from 200 BC to AD 400, with increased importance of deep-water species by AD 200 to 400. The earliest single-piece bone and shell fishhooks recovered at LAN-264 come from a level dated from about 640 to 480 BC (C. King 1990:83). Tartaglia noted a bimodal distribution in the size of fishhooks and suggested that the large hooks (figure 7.6) found after about 400 BC were used to catch rockfish in kelp beds over 200 feet deep.

Fish remains from the Century Ranch site (LAN-227) provide important data for the period from about AD 600 to 1400 (Follett 1963a). The occupants of this inland Santa Monica Mountains site probably obtained fish from Malibu (C. King 1990:85). Large pelagic fish, rockfish, California halibut, kelp bass, and sheephead were all important. The presence of these fish species correlates with developments in fishing technology that continued to be used up to protohistoric times; this includes the appearance of harpoon barbs about AD 600 to 800, which became relatively common by about AD 1000 (C. King 1990:85). Harpoons may have been used to hunt sea mammals, but ethnohistoric data suggest primarily fishing (see C. King 1990:47-50). Harpoons could have been most effectively used from stable boats. Evidence for the development of the plank canoe from contexts that date to between AD 400 and 700 includes large trifacial drills, canoe effigies, and asphaltum caulking from a plank canoe (Gamble 2002 and see discussion under "Exchange," this chapter). The earliest evidence of fishing for swordfish, probably taken with harpoons from plank canoes, also dates from about 50 BC (Davenport, Johnson, and Timbrook 1993:261), although Rick and Glassow (1999) noted that swordfish remains were found in a much earlier context at the Aerophysics site (SBA-53).

At the same time, bone gorges became less common. In addition to bone harpoon barbs, large bone points, possibly used to tip harpoons (C. King 1990:86) or fish arrows (Bennyhoff 1950), began to be used. By AD 1400 bipointed curved shell and bone fishhooks were replaced by curved fishhooks with grooved shanks to which the fishing line could be tied. It has been suggested that this technological change may correspond to increased fishing from canoes in deep water (C. King 1990:86). After AD 1400, deep-water fish, probably taken with harpoons and fishhooks from canoes, continued to be an important resource. Harpoon barbs and shell fishhooks are common in Late period sites, with frequencies of the latter peaking just prior to European contact (C. King 1990:87).

The analysis of fish remains at the inland site of Talepop (LAN-229) presents a useful reconstruction of Late period fish use. This analysis provides data concerning the importance of pelagic and other deep-water fishes during the Late period, similar to other late prehistoric sites in the Santa Barbara Channel area (Gobalet 1990, 1992; J. Johnson 1982a:12-23). For the late prehistoric components of the site, the most abundant species, based on calculations of MNI and live weight, are sardines, soupfin, anchovy, mako, angel shark, bat ray, horn shark, shovelnose guitarfish, blue shark, and juvenile Pacific mackerel (J. Johnson 1982a:12-21). The data imply a mixed strategy of net, fishhook, and harpoon use, probably from plank canoes. The presence of shell fishhook fragments and bone barbs (C. King 1982:3-20) probably indicates that the inhabitants of Talepop took part in fishing activities. It is also possible that these artifacts were lodged inside fish obtained through trade with nearby coastal villages such as Malibu (J. Johnson 1982:12.23-12.29).

Additional data on Late period fishing comes from Muwu (VEN-11), a coastal village occupied through the contact period and excavated by Woodward and Van Bergen from 1929–1932 (figure 7.5) and by Love and Resnick from 1976–1978. Uncalibrated ^{14}C dates suggest that the site was first occupied around 350 to 60 BC, but that it was primarily occupied from about AD 1050 into the Historic period. Love and Resnick (1977; Love 1980; Resnick 1980) focused on reconstructing subsistence activities at the site. Fish, including lagoon and deep-water species available year-round and some migratory pelagic species, dominated the Late period diet. Of the 26 fish species identified, most could be exploited from waters in the lagoon or within 100 feet of shore. Seven species, however, including broadbill swordfish, bonito, striped marlin, yellowtail, rock cod, tiger shark, and great white shark, are deep-water species probably taken from watercraft in an open ocean habitat, although some may have been taken from the edge of the kelp beds or in submarine canyons. The presence of numerous fishhooks, nets, sinkers, gorges, and harpoon barbs supports this interpretation.

At Pitas Point (VEN-27), occupied from about AD 1000 to 1550, Gamble (1983) identified fish remains from a stratified midden deposit that indicate nearshore and deep-water pelagic fishes were used throughout the occupation of the site. Deep-water species likely to have been taken from boats include skipjack, albacore, and yellowtail. This interpretation is supported by evidence of activity areas used to repair and manufacture fishing equipment, including fishhooks, harpoons, net weights, and canoes (Gamble 1983:121-122). The site of Shisholop (VEN-3) at Ventura also provides data on late prehistoric Chumash fishing. Greenwood and Browne (1969) noted that fish vertebrae were the most common component of the bone remains, and Fitch (1969) estimated that the site inhabitants consumed four times as much fish meat as shellfish.

Overall, fishing appears to have become increasingly important during the Late Holocene, eventually providing the largest contribution of meat to the diet, at least for coastal villages. Fishing of inshore waters was important throughout this period, but fishing for pelagic and other deep-water species was increasingly significant later in time as part of a mixed fishing strategy that included both nearshore and deep-water fishing.

Salls (1988, 1989:117) presented a different perspective, emphasizing the importance of nearshore fishing at coastal sites, and dismissing the importance of deep-water fishing. Although nearshore fishing probably provided the largest contribution of fish meat to the diet, the presence of large deep-water fish in archaeological middens is well documented and suggests that deep-water fishing was also a significant subsistence practice.

Data regarding variation in Ventureño Chumash shellfish exploitation through time suggest that changes in local habitat conditions affected collection strategies. Glassow (1965) noted that shellfish, particularly *Protothaca* sp. and *Mytilus* sp., became increasingly important as part of a generalized subsistence strategy at Malibu after 300 BC and continued into historic times. Shellfish, however, remained a minor portion of the diet during all periods of occupation at the site (Glassow 1965:7). Tartaglia (1976) and Botkin (1980) analyzed shellfish remains from LAN-264. Based on shell weight calculated from the 1/4 inch size fraction of a column sample, Botkin (1980:135) identified a shift from the collection of *Mytilus* to *Protothaca* beginning about 850 BC and continuing until *Protothaca* became the more common taxon after about AD 950. Procurement costs for *Mytilus* are relatively low, and the shift to *Protothaca* was probably related to the decreasing availability of *Mytilus*. A decrease in *Protothaca* size over time supports the interpretation of intensive human predation on shellfish resources. Although these shellfish data may not indicate subsistence stress, the shellfish species and size data are possible indications of overexploitation and subsistence intensification during the Late Holocene (Tartaglia 1976:174). Although he did not describe his methods in comparing the relative contribution of shellfish, fish, and mammal meat to the diet, Tartaglia (1976:176) suggested that, after about 350 BC, shellfish made the most significant contribution of meat to the diet.

The analysis of shellfish from VEN-11 column samples also indicates that shellfish exploitation was largely conditioned by local environments (Love 1980; Resnick 1980). Four taxa collected from the nearby lagoon and rocky shore habitats dominated the Late period levels: *Mytilus*, *Chione*, *Ostrea lurida*, and *Protothaca staminea*. Although there was a slight shift in the relative frequencies of species with depth, there was no indication of significant change in shellfish exploitation over time. In addition, Love and Resnick suggested that the majority of meat consumed at the site came from fish, contrary to Woodward's earlier assertion that shellfish contributed most of the meat to the diet. The presence of small black abalone shells noted by Woodward (1930) may indicate overexploitation of larger specimens (Raab and Yatsko 1992), but this species formed an insignificant portion of the 1976–78 assemblage, and the significance of Woodward's comment cannot be evaluated.

Shellfish data from inland archaeological sites suggest that intersite variability in shellfish use relates to differences in shellfish habitats accessible to the sites. At Talepop, shell was dominated by *Mytilus* (71.8%), with lesser contributions of *Protothaca* (13.0%), *Tegula* (6.8%), and chiton (1.5%) (Bloomer 1982). At the nearby Century Ranch site (LAN-229), a similar pattern is evident, with the most common species being *Mytilus* (68%) and *Protothaca* (16%) (Levine 1968). At other inland sites, *Mytilus* dominates, but secondary shellfish species vary. For example, at Oak Park (VEN-294), the most common taxon is *Mytilus* (69%), but the second most common is *Haliotis* (15%) (Hector 1978). Similarly, at nearby VEN-125 (Wells 1978), *Mytilus* (55.4%) is followed by *Protothaca* (14.7%) and *Haliotis* (13.9%) in abundance. At the Mulholland site (LAN-246), *Mytilus* also dominates (36%), followed by *Haliotis* (32%) and *Protothaca* (10%).

Data from the site of Malibu provide useful information concerning the importance of sea mammals during the Late Holocene (Glassow 1965). Based on bone weights, Glassow indicated that sea mammal hunting was not important during the early occupation (1000 to 700 BC). Sea mammal hunting, particularly for Guadalupe fur seals, became the dominant subsistence strategy from 700 to 300 BC. From 300 BC until the historic period, sea mammal hunting was less important, and a pattern of diversity, including the increased importance of land mammal, shellfish, and plant foods, characterized subsistence (Glassow 1965:9).

Sea mammal bone recovered during the 1976–78 excavations at VEN-11 (Love 1980; Resnick 1980), expressed as a percentage by weight, was significantly less important than fish and shellfish. Of all recovered mammal bone, 80% was sea mammal, including harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), and sea otter (*Enhydra lutris*). The 1929–32 excavations included four additional species: Stellar sea lion (*Eumetopias jubata*), Pribilof fur seal (*Callorhinus alascans*), Guadalupe fur seal, and northern elephant seal (*Mirounga agustirostris*) (Lyon 1935, 1937). The 1929–32 sea mammal material included 74% Guadalupe fur seal, 14% sea otter, 7% California sea lion, and 5% other species. Lyon (1935) suggested that the Guadalupe fur seal and sea otter were exploited primarily for their fur and only secondarily as food. For both the 1929–32 and 1976–78 excavations, sea mammals were more common than land mammals in the upper levels of the site, a possible indication of a shift from land to sea mammal exploitation over time.

Some data indicate the possibility of trade in sea mammal meat on the northern Channel Islands and coastal villages during the late Middle period. Trade of seal forequarters from the islands to the mainland has been suggested for the late Middle period levels at Pitas Point (Walker 1997). Trade for sea mammal forequarters has also been documented from island sites (Colten 1993).

Terrestrial Resources. Data regarding the use of land mammals at coastal and inland Chumash sites is less common in the literature than that for the use of fish, shellfish, and sea mammal. The available data suggest that deer was the most important species, followed by rabbit and a variety of small rodents. One study (Read-Martin 1972) compared the terrestrial faunal assemblages from four Middle and Late period sites (LAN-167, LAN-246, LAN-243, and VEN-39). At all four sites a diversity of species was hunted, with an emphasis on deer and rabbits. Read-Martin's analysis of deer bone elements indicated that deer were hunted individually and brought back to village sites more or less whole, then butchered and roasted (Read-Martin 1972:183). Unlike some evidence for sea mammals, evidence for trade in deer meat is inconclusive.

Land mammal remains, accounting for 6% of the vertebrate fauna from Muwu, were far less common than marine mammal bone in the 1976–78 collections (Love 1980; Resnick 1980). These included mule deer, jackrabbit, and cottontail rabbit. The remaining 8% of the vertebrate fauna included wood rat, ground squirrel, mice, coyote, domestic dog, gray fox, and an unidentified feline. Bird bone from the 1976–78 excavations at VEN-11, the least important vertebrate expressed by bone weight, was not analyzed to the species level (Love 1980; Resnick 1980). Gull and cormorant (*Phalacrocorax* sp.) bones were present, however. Information regarding the 1929–32 excavated bird bone is incomplete, but based on the existing incomplete species list, the most numerous species were nonmigratory. These species included cormorant (48% of sample), albatross (*Diomedea* sp., 12%), brown pelican (*Pelicanus occidentalis*, 10%), common loon (*Gavia immer*, 8%), double crested cormorant (*P. auritus*, 5%), and fourteen other species (Resnick 1980).

Changes in the use of plant resources by the Ventureño Chumash, although critical for understanding changing subsistence strategies, are relatively poorly understood. The shift from manos and metates to mortars and pestles appeared to have occurred before the beginning of the Late Holocene (Gamble and King 1997). During the late Early and early Middle periods, both manos and metates and mortars and pestles were used. Manos and metates are not common after that time and are nearly absent from Late period sites. This change in technology is widely believed to be associated with a shift from processing small hard seeds to acorns, which became a staple in the prehistoric diet in this region.

There are good summaries of ethnohistoric and ethnographic Chumash plant use in the region (see C. King 1994a). The relevance of burning and other protoagricultural management activities to the rise of cultural complexity is recognized ethnographically (Bean and Lawton 1993). It is also recognized that prehistoric populations actively manipulated their environment through such practices as burning to promote wild plant harvests (Timbrook, Johnson, and Earle 1982). Unfortunately, archaeological sites provide too few data to allow a synthesis of change over time in Chumash plant management and use. From the Late period levels at Talepop, a variety of wild plant food remains was recovered, including (in order of abundance) acorns, grass seeds, chia seeds, yucca, a variety of bulbs, walnuts, and manzanita berries (Hammett and Wohlgemuth 1982). This study confirms the prehistoric use of ethnographically recorded plant species. Many more such studies are needed to provide a record of changing plant use during the Late Holocene in Ventura and Los Angeles Counties.

Changes in archaeological features also provide information concerning prehistoric plant use. The development of the yucca roasting oven was an improvement in cooking facilities possibly associated with intensified yucca exploitation. The earliest yucca roasting ovens identified from sites in our study area date between about 1500 and 800 BC (C. King 1990:89), although Erlandson (1997b:99) dated a probable yucca roasting feature from the Santa Barbara Coast to about 2900 BC. Similar ovens were used at some late Middle period coastal and inland sites, such as LAN-2, Oak Park (VEN-1020), and VEN-39 (C. King 1990, 1993, 2000). Slab-lined earth ovens also have been identified from Middle period sites, including VEN-27 and Soule Park (VEN-61) (C. King 2000:81). These ovens were probably used to bake a variety of foods, including bulbs, and for steaming greens (C. King 2000). Slab-lined earth ovens are not known from Late period contexts.

Tongva

Fewer subsistence data are available for the coastal Tongva, partly due to the destruction of archaeological sites in the sprawling Los Angeles urban area. Some of the best data come from the Del Rey Hills site complex, including several sites located on the bluff tops and lagoon edge along Ballona Creek (Van Horn 1987b:270; Altschul, Homburg, and Ciolek-Torrello 1992; Grenda, Homburg, and Altschul 1994). The Del Rey Hills sites provide a record of subsistence change from well before 1000 BC into Protohistoric times.

Based on the dominance of oyster in the earliest levels of the Del Rey (LAN-63) and Loyola sites (LAN-61b), Van Horn (1987b) suggested that an open lagoon habitat was exploited early. Shellfish from the later prehistoric levels at the Marymount site (LAN-61c) are dominated by *Chione*, probably collected from nearby mud flats. The latest occupied site, LAN-59, is dominated by Pismo clams collected from a sandy shoreline after AD 1000 when the lagoon had silted in.

Additional data indicate that settlements after AD 1000 shifted from bluffs to lagoon edge (Altschul and Ciolek-Torrello 1990). There was an accompanying shift from lagoon and nearshore fish to land mammals, shellfish, and birds. The Del Rey Hills sites demonstrate a generalized subsistence strategy, including a broad mixture of terrestrial and marine resources, focusing on locally available resources as the lagoon silted in.

There is little evidence for the exploitation of deep-sea resources. Fish bone analysis at the Marymount (Salls 1985), Del Rey (Salls 1987), Centinela (LAN-60), and other nearby sites (Salls and Cairns 1994) indicates that fishing was concentrated in nearby bay, estuary, and beach habitats, with essentially no use of pelagic or deep-water species. Van Horn (1987b:271) noted that shell fishhooks are not found at these sites and that the shell artifact manufacturing common at many coastal sites is missing. Bone and stone beads and fishhooks are present, but shell beads account for only 1% of beads. The possibility that this absence of shell artifacts reflects differences in preservation, not human behavior, cannot be ruled out.

Additional subsistence data for the Tongva come from LAN-283, the San Pedro Harbor site (Butler 1974). The artifacts suggest that the site was occupied for about 4000 years, including the entire Late Holocene. The available data do not allow fine chronological distinctions, but broad patterns of faunal use at the site are worth noting. Analysis of column samples (Frey 1974) and vertebrate fauna from the excavations (Langenwalter 1974) suggest that shellfish, fish, birds, and mammals were hunted and collected from nearby terrestrial, bay, and estuarine habitats. Again, there is no evidence for the use of pelagic or deep-water fishes.

Bow and Arrow Technology

The bow and arrow were first used in California about AD 500 (Lambert 1994; Moratto 1984). In the Santa Barbara Channel area, Lambert (1994:149-153) identified victims with small projectile point wounds dating between about AD 600 and 1000, clearly linking the adoption of the bow and arrow to violent conflict among the Chumash. She also noted that sub-lethal conflict occurred by 500 BC, prior to the introduction of the bow and arrow.

Changes in the shape of arrow points over time in the region are best documented for the convex-and concave-based points most common in the latter part of the Late Holocene. Other arrow point styles, including stemmed and notched varieties, are also probably time sensitive, but their chronological placement is not well documented. Convex-based points apparently first appear in the archaeological record in the Ventureño and Tongva region with the introduction of the bow and arrow. Larson (1982) examined collections of convex- and concave-based points from six different sites in the Ventureño Chumash area and found convex-based points were more common prior to about AD 1500, after which concave-based points were more common (figure 7.7). Van Horn (1990) examined changing point types at the Marymount site and proposed that the introduction of stemmed Marymount points is evidence of Shoshonean occupation sometime after AD 500. He supported this hypothesis with the presence of burned human bone at the site.

Subsistence Change Summary

Although uneven, the subsistence data provide a picture of general change over time in the region. For both the Chumash and Tongva regions, Late Holocene populations employed broad subsistence strategies that used a variety of terrestrial and marine resources. For the Chumash, a trend over time is toward the increased use of pelagic and deep-water fish species. This trend is probably associated with the development of the plank canoe, harpoons, and larger single-

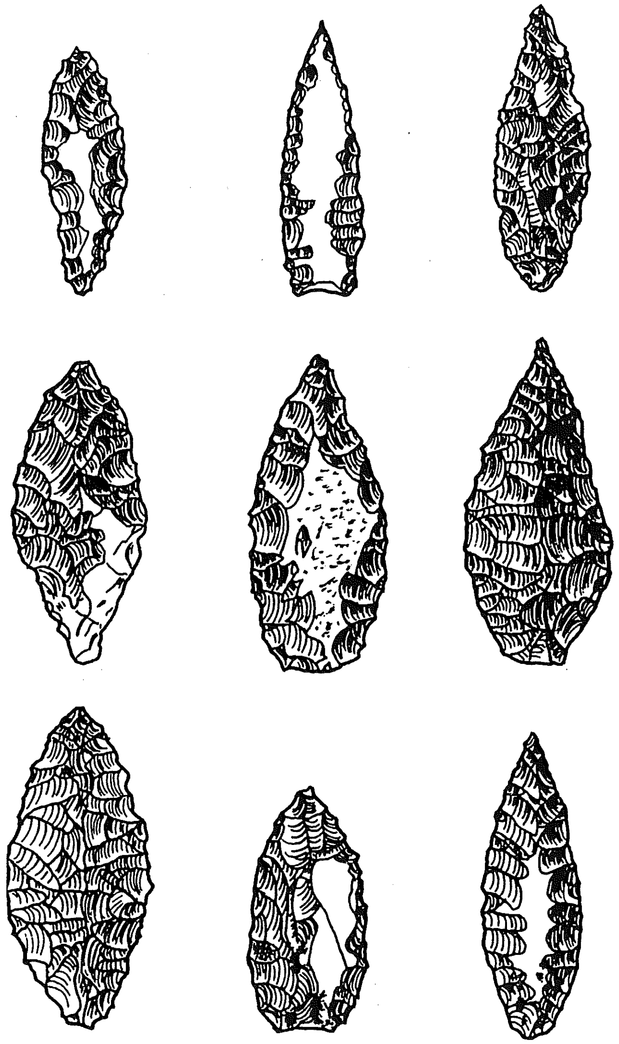

Figure 7.7 Arrow points from Pitas Point (VEN-27) (actual size)

piece fishhooks. Based on changes in ground stone technology, acorn exploitation intensified during the Late Holocene. The overall pattern for the Ventureño Chumash, particularly for the larger coastal villages, is one of intensification of both marine and terrestrial resources. This trend appears to be long term, beginning in the early part of the Middle period and continuing through the Late period.

This pattern contrasts with the limited data available for the mainland Tongva region, where the inhabitants focused on local resources and do not appear to have made significant use of deep-water fishes. Harpoons and shell fishhooks associated with deep-water fishing commonly found at coastal Chumash sites are infrequently recovered from mainland Tongva sites. Although Tongva subsistence strategies changed over time, the data suggest that these changes were in response to local environmental shifts and did not include the intensification of marine resources characteristic of the southern coastal Chumash. We also note that the plank canoe did not seem to occur south of Malibu on the mainland coast, although it was used between Catalina Island and the Chumash (Gamble 2002).

EXCHANGE

The development and mechanisms of exchange systems among the coastal Ventureño Chumash and the Tongva are poorly known. Researchers interested in long distance exchange have focused on the exchange of beads and obsidian, especially in the Great Basin and the southwestern United States (Basgall 1989; Bouey and Basgall 1984; Bennyhoff and Hughes 1987; Ericson 1981; Hughes 1994a; Jackson and Ericson 1994; C. King 1990; Singer and Ericson 1977), although very little has been synthesized for our study area.

A variety of artifacts made from materials imported into coastal Ventura and Los Angeles Counties has been recorded for the region. Recent research into obsidian exchange in California indicates obsidian was transported primarily as completed artifacts or preforms and not as large unaltered pieces (Jackson and Ericson 1994:393). According to Jackson and Ericson, exchange systems in California expanded and peaked during the end of the Middle Holocene and the beginning of the Late Holocene. The character of exchange began to change about AD 500 when commodities traded over long distances decreased in many areas and the intensity of local exchange systems increased in most areas (Jackson and Ericson 1994:394). It may not be coincidental that the shift in long distance exchange about AD 500 occurred at the same time the bow and arrow was introduced into California. Small arrow points allowed people to use smaller pieces of raw material, opening up new sources of materials for the manufacture of arrow points that may have been inadequate for larger tool types. Moreover, Meighan (1978) proposed that after AD 1250 obsidian was reused from earlier artifacts.

Most obsidian imported into the region came from the Coso area and to a lesser degree from Casa Diablo. These sources are approximately 280 km to the east in the southeastern Sierra Nevada. Obsidian from both sources is recorded at Malibu, and Coso obsidian was recovered from one of the Porter Ranch sites (LAN-324) in the San Fernando Valley (Ericson 1981:189-192). There are many more examples of obsidian in the region, especially in the CRM literature, but few pieces have been characterized to identify their source.

Fused shale was an important raw material that Late Holocene people in the Ventureño Chumash and Tongva region used for chipped stone bifaces and tools. Fused shale, usually available only in small nodules, is exposed in burned Miocene shale beds in Grimes Canyon and Happy Camp in eastern Ventura County (Edberg and Singer 1981; Pierce, Clingen, and Gamble 1982; Singer 1986). Although this region is within Ventureño Chumash territory, it is outside of our coastal study area and over 20 km from most sites in the study area. Also found in the Santa Ynez Valley, fused shale was an important material in many sites in our study area. Changes in material preferences over time at Talepop and other sites in the region indicate that at about AD 700 fused shale was used more frequently to make arrow points when compared with Monterey chert (Gamble 1982). It appears that the use of fused shale peaked between about AD 1050 and 1500 (Gamble 1982:8-61), at about the same time the bow and arrow were introduced into the region. Freeman and Van Horn (1987:61, 89) reported eight convex-based fused shale points and 292 small flakes from the Del Rey site (LAN-63) on the Ballona Bluffs, as well as other fused shale points from the site. They estimated that there were three times as many fused shale points as obsidian points (Freeman and Van Horn 1987:105-106). These proportions are interesting when compared to the debitage from the site, which has five times the number of obsidian flakes than fused shale. They suggest that the obsidian probably came from the Coso Mountains in the form of large bifaces later reduced to arrow points. In contrast, they propose that fused shale probably was imported into the region as completed arrows, including the hafting. C. King (2000:2) noted that the Santa Monica Mountains Chumash specialized in the manufacture of arrows for trade to the Tongva.

Originating near the Obispeño Chumash boundary approximately 150 km away, Temblor Range chert also occurs primarily in small pieces. Unlike fused shale, however, Temblor chert is found in thin lamina, has a dense amorphous surface, and is waxy. Artifacts of Temblor chert, mostly knives and arrow points, have been found at Pitas Point (VEN-27) and Talepop, among other sites. They seem to date primarily to the latter part of the Late Holocene, but a more refined temporal framework for the exchange of Temblor chert is needed before more details of its first use can be determined.

The other important exotic chipped stone material found in the region is Franciscan chert. This chert occurs in Franciscan formation outcrops and alluvial deposits in the Santa Ynez and San Rafael Mountains (Pierce, Clingen, and Gamble 1982: Table 7.1). Cobbles have also been seen in sedimentary deposits in the Ojai Valley. Artifacts made from Franciscan chert have been identified at a number of sites in the Ventureño Chumash coastal region, including Rincon (SBA-1) and Talepop.

Chester King's research into the exchange of beads and ornaments exported from Southern California indicates a different pattern of exchange with these types of artifacts. King (1990) suggested that the export of beads outside the Chumash region increased over time, with the use of beads as valuables kept for exchange instead of display also increasing in importance. King (1990:xiv-xv) based these observations on the export of *Olivella biplicata* beads to the American Southwest that appears most prevalent between about 300 BC and AD 1600. In contrast, Bennyhoff and Hughes (1987:147) argued that exchange in Pacific shell beads between the western Great Basin and California markedly declined after about 2200 years ago. They note that this situation is different from patterns of exchange within California. Their observations, more similar to those of Jackson and Ericson, may be related to shifts in alliances and long distance exchange patterns that are not entirely understood.

The plank canoe was an important means of transportation in the Chumash and Tongva exchange system (Hudson, Timbrook, and Rempe 1978). Recent research undertaken by Gamble (2002) indicates that the earliest evidence for the plank canoe dates between about AD 400 and 700. Evidence of the plank canoe dating to this period includes two long slender, drills (triangular in cross section) and a stone canoe effigy. Both drills are from Simo'mo (VEN-26), and analysis of polish confirms the interpretation that they were used to drill wood. The other boat type used by the Chumash was a tule boat. Neither dugouts nor tule boats were very seaworthy compared to the plank canoe (Arnold 1995a; Hudson, Timbrook, and Rempe 1978). The Chumash in the Santa Barbara Channel region lacked the large trees that could be used to make seaworthy dugout boats.

Other evidence of the plank canoe, although less direct, is the presence of harpoon barbs and swordfish bones (Davenport, Johnson, and Timbrook 1993). The large pelagic swordfish (*Xiphias*) were probably harpooned from seaworthy offshore boats. Davenport, Johnson, and Timbrook (1993:261) suggested that the earliest swordfish remains from an archaeological site in the Santa Barbara Channel area date to about 50 BC, but Rick and Glassow (1999) have argued that swordfish remains were found at the much older Aerophysics site (SBA-53).

Exchange between the Ventureño Chumash and the Tongva flourished during the Late Holocene. Chumash artifacts found in Tongva sites include shell beads and fused shale points and tools, among many others. The most prevalent artifacts of Tongva origin at Chumash sites are comals and ollas made from Catalina Island steatite (G. Romani 1982). Finnerty et al. (1970) proposed that large ollas, bowls, and comals made from Catalina Island steatite are most common in the Protohistoric (AD1542 to 1769) and Historic (after AD 1770) periods in the Chumash area (see also C. King 1990:90). It has also been suggested that metal tools may have been used to manufacture these items (Schumacher 1879; Wlodarski et al. 1984). Evidence of steatite production from Catalina Island indicates that steatite artifacts had been produced on a limited scale at Little Harbor since at least 2000 BC (Meighan 1959:384). The intensity of steatite exchange among the coastal Ventureño and the Tongva appears to have oscillated, however. Steatite objects were common between about AD 700 to 900, followed by a disruption of steatite exchange until about AD 1650, at which time steatite vessels became very common. Steatite vessels appear to have been used primarily for cooking, and judging from the tremendous size of some Late period ollas, they may indicate that feasting appeared during the latter part of the Late Holocene.

Within the Chumash region there is some archaeological evidence of subsistence exchange. Trade of sea mammal forequarters from the islands to the mainland has already been discussed (see Colten 1993; Walker 1997). Ethnohistoric sources also suggest that the coastal Chumash imported a number of subsistence resources from the interior, including pine nuts, seeds, fruits, game, and fox skin shawls (C. King 1976). Unfortunately, the remains of many of these items are not well preserved in the archaeological record. There is some evidence at Pitas Point that baskets, another class of perishable artifact, were produced in numbers that may have exceeded occupants' needs (Gamble 1983). Large numbers of tarring pebbles (n=651) at the site suggest that many asphaltum-lined baskets (water bottles, etc.) were made there, and some of these may have been produced for export. There is also evidence of pestle making at the site.

Exchange in the region involved the import and export of items from both short and long distances within the Chumash and Tongva region. Obsidian was more commonly imported into the region during the earlier rather than the latter part of the Late Holocene, although more archaeological evidence of this pattern is needed. Many other material goods were undoubtedly imported during the Late Holocene from groups outside the Chumash and Tongva area, but this pattern has not been well documented archaeologically (Ruby and Blackburn 1964). Early historic accounts indicate that the Mojave Indians came into the Chumash and Tongva region for fiestas, bringing items for trade, including red ochre (C. King 1976:305). Other historic documents indicate that the Yokuts traveled to the Chumash region about once a year, bringing pine nuts and wild tobacco to exchange for shell beads (C. King 1976:306). Voeglin (1938) documented what appears to be a form of silent trade between the Tubatulabal and the Ventureño, where the Tubatulabal left a bag of pine nuts on the ground. The Chumash took what they wanted and left shell money in payment. Red ochre cakes that appear standardized in form have been found with many Late Holocene burials. While likely that some of the red ochre came from the Mojave, geochemical characterization of the ochre sources has not been performed (see Erlandson, Robertson, and Descantes 1999). To our knowledge, archaeological examples of wild tobacco and pine nuts have not been found in the region, but it is likely that these and other foods were imported into the region prehistorically. There is some archaeological evidence for ceramics from the Colorado River area in the latter part of the Late Holocene, but this does not appear to be a common imported item.

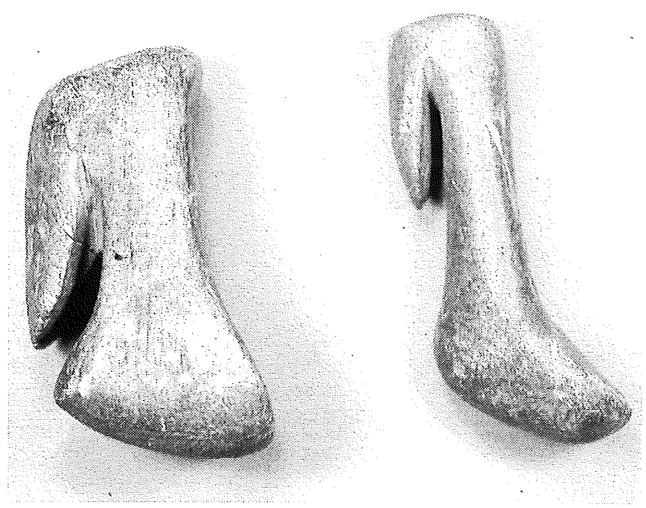

Figure 7.8 Pelican stones from the Santa Monica Mountains

The long distance export of shell beads during the Late Holocene from the Chumash region to areas such as the San Joaquin Valley, the Colorado Desert, the Great Basin, and the Southwest is documented archaeologically and ethnohistorically. It is not clear, however, whether the Ventureño Chumash were involved in this exchange system except as middlemen. Exchange within the Chumash and Tongva region is more common than long distance exchange during the Late Holocene.

We have focused on materials for which exchange has been most clearly documented, but other items including mortars, have been reported coming from the islands. More work on documenting sources and exchange through chemical characterization will provide important data for understanding the development of exchange during the Late Holocene.

ARCHAEOLOGICAL EVIDENCE OF RELIGIOUS ORGANIZATION

A variety of objects related to religious practices have been recovered from the region, many of which were identified from ethnohistoric and ethnographic accounts (Bean and Vane 1978; Hudson and Blackburn 1986; C. King 1990). Late Holocene ceremonial artifacts include bone hairpins, bone whistles and flutes, charm stones, effigies, pipes, portable rock art, quartz crystals, and medicine bowls. Effigies are particularly significant because certain types are distributed primarily in coastal sites of Ventura and Los Angeles Counties, including the southern Channel Islands. These include effigies of fish, sea mammals, pelican stones (or birdstones) (figure 7.8), and spikes. Pelican stones and spikes have been found with burials and in caches. Two caches (Wallace 1987;

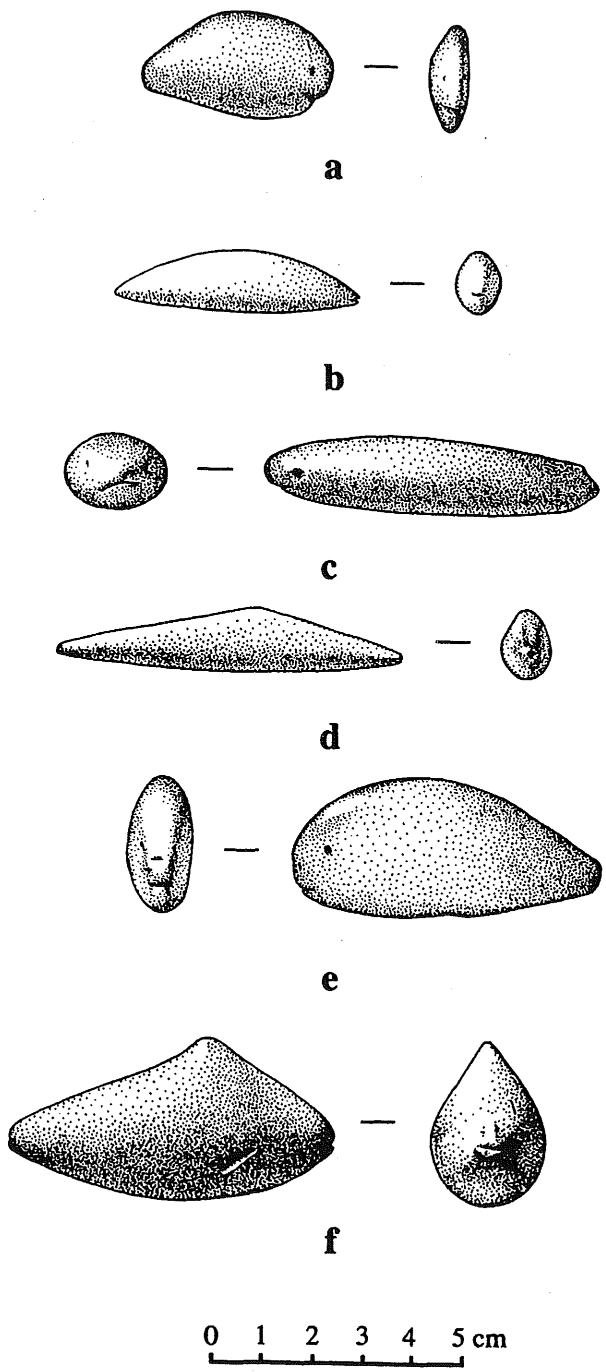

Figure 7.9 Effigies from Malibu (LAN-264).

Wallace and Wallace 1974), one in Palos Verdes and the other in Pacific Palisades, were found outside the perimeters of domestic settlements or site boundaries. Wallace (1987:57) suggested that these caches may have been hidden in safe places because they represent valuable religious paraphernalia or that a secret ritual took place in the areas. Blackburn (personal communication,) suggests that these may be "sacred bundles" kept by chiefs, such as those known ethnographically for the Cahuilla and the Tongva (Bean and Smith 1978:544). Spikes and pelican stones have been found on the southern Channel Islands, north to Paradise Cove in the Santa Monica Mountains, in Los Angeles County, and into Orange and northern San Diego Counties.

Fish and sea mammal effigies are more widely distributed and include the northern Channel Islands and northern mainland coast, although they are more common in the same areas in which pelican stones and spikes have been found. They are also associated with burials and in caches. At Malibu, 62 effigies were found with burials excavated from a cemetery dating between AD 950 and 1150 (C. King 1996; Gamble et al. 1996) (figure 7.9). Two of these are pelican stones, one is a whale effigy, and the rest appear to be fish effigies. The entire historic cemetery was excavated at Malibu and no effigies were found, indicating that they were no longer buried with individuals at this time. Pelican stones, spikes, and effigies of fish, sea mammals, and sharks were also found with burials at the Palmer-Redondo (LAN-127) site near the southern periphery of our study area (Van Valkenburgh 1931). Such effigies are found in both the Tongva and Ventureño Chumash areas, supporting the idea of a shared ritual system during the Late Holocene prior to European contact (see Hudson and Blackburn 1978; Kroeber 1925).

ARCHAEOLOGICAL EVIDENCE OF MORTUARY PRACTICES AND STATUS DIFFERENTIATION

Mortuary remains provide information concerning ritual behavior surrounding the disposition of the dead, as well as the social identity of a person when they were alive, including their status (Goodenough 1965; Saxe 1970). Both cremations and interments occurred in our study area during the Late Holocene (table 7.1). Mortuary remains from Ventureño Chumash sites indicate that cremations were rare. Less than 2% of the burials at the Medea Creek cemetery showed evidence of burning; most of them were apparently dismembered and then only partially burned (L. King 1982:147-159). L. King tentatively interprets these remains as purposely mutilated.

Cremations are more characteristic of Takic speakers to the east and south, including the Tongva. In the Takic area, cremation practices are associated with honoring the memory of the mythical chief and deity Ouiot (L. King 1982:58). C. King (1990:199) noted that cremations are associated with Middle period (phase 1) bead types, suggesting that Uto-Aztecan speakers may have moved into eastern and Southern California near the beginning of the Late Holocene. Moratto (1984:161-162) stated that this movement to the coast is not well dated, but occurred in the region between the Chumash and San Diego. He noted that "Shoshonean" elements could be seen in the archaeological record in the form of pottery, triangular arrow points, and cremations.

Table 7.1 Archaeological sites in the Ventureño Chumash and Tongva area with cremations and burials

SITE	BURIALS	CHRONOLOGY	CALIBRATED RADIOCARBON DATES	FUNERARY ASSOCIATIONS	CULTURAL AFFILIATION	REFERENCES
Tank site (LAN-1)	No cremations, 11 extended burials probably date to Late Holocene.	earlier than 3000 BC and 3000-1000 BC*			Chumash	Moratto 1984; Treganza and Bierman 1958; Treganza and Malumud 1950
Tank site (LAN-2)	All burials were flexed, no cremations, not clear how many are associated with Late Holocene occupation at the site.	3000-1000 BC*; and after about 1000 BC*	cal BC 798 (532) 390, A-0094. cal BC 1002 (830) 786 A-0197.		Chumash	Johnson 1966; Moratto 1984; Treganza and Bierman 1958; Treganza and Malumud 1950
Trancas (LAN-197)	106 inhumations, all extended	300-420 BC. King thinks it is 200 BC-AD 200*	cal BC 347 (222) 152 UCLA-1370	Mortars, pestles, ochre, abalone dishes and cairns of broken rock and groundstone assoc. w. burials. no maritime artifacts	Chumash	Martz 1984
Simo'mo (VEN-26)	176 inhumations	AD 300-700 King thinks it is AD 700 – 900*	cal AD 1038 (1218) 1319 UCR 0710. cal AD 996 (1154) 1290 UCR-0712. cal AD 693 (867) 1024 UCR-0709	Evidence of plank canoe	Chumash	Martz 1984
Rincon (SBA-1)	many inhumations	cemeteries range in time from late Early period to Middle period	cal BC 945 (821) 763 Beta-33993	Unknown	Chumash	King 1980; Stickel 1968
Rincon (SBA-119)	many inhumations	cemeteries range in time from late Early period to Middle period		Unknown	Chumash	King 1980; Stickel 1968
Rincon (VEN-62 a and b)	many inhumations	cemeteries range in time from late Early period to Middle period	cal AD 121 (230) 336 Beta-031203 (VEN-62a)	Unknown	Chumash	King 1980; Stickel 1968
Calleguas Creek (VEN-110)	96 discrete inhumations. Some cremated bone (Walker p.c.)	AD 1016-1283	Most dates range between cal AD 1186 (1256) 1299 Beta-013630 to cal AD 889 (987) 1044 I-14629.	Unknown	Chumash	Lambert 1994; Raab 1998 (see for all C-14 dates); Walker 1998
Malibu, Middle Period Cemetery (LAN-264)	114 inhumations, no cremations	AD 950-1150*		Grave goods abundant with some individuals, others with nothing	Chumash, near boundary	Gamble et al. 1996; Martz 1992; Walker et al. 1996

continued

Table 7.1 (*continued*)

SITE	BURIALS	CHRONOLOGY	CALIBRATED RADIOCARBON DATES	FUNERARY ASSOCIATIONS	CULTURAL AFFILIATION	REFERENCES
Pitas Point (VEN-27)	inhumations excavated by farmer/owner, no cremations	AD 1000-1550*	cal AD 1191 (1231) 1277 USGS 1621 cal AD 1019 (1034) 1158 USGS 1622 cal AD 775 (829) 902 USGS 1618 cal AD 606 (659) 694 USGS 1619	Unknown	Chumash	Gamble 1983
Century Ranch (LAN-840C)	6 cremations	AD 280	cal AD 395 (428) 536 Beta-022155 cal AD 180 (287) 399 Beta-022154	Associated with botanical remains, bone beads, and stone and bone tools	Chumash, near boundary	Wheeler et al. 1989
Century Ranch (LAN-840A)	12 burials, at least 3 of which were cremations	AD 1000-1500*		Flower pot mortar and mountain lion bone whistles	Chumash, near boundary	Wheeler et al. 1989
Century Ranch (LAN-227)	1 cremation, 21 inhumations; redeposited cremation of adult and child in pit with 2 inhumations	AD 1500-1650*	Material unknown RCYBP 420 +/- 100	Adult and child cremation assoc. w. asphaltum lined basket and ochre	Chumash, near boundary	King et al. 1968
Arroyo Sequit (LAN-52)	Burials	Protohistoric-Historic	cal AD 1407 (1437) 1475 WSU-3646 cal AD 623 (666) 776 WSU-3645	Unknown	Chumash	Curtis 1963
Medea Creek (LAN-243)	447 individuals, less than 2% were cremations; two burials partly burned	AD 1500-1650	cal AD 1495 (1637) 1652 UCLA 1411B	Some individuals with many goods and others with nothing	Chumash, near boundary	L. King 1969, 1982
Malibu, Historic Cemetery (LAN-264)	139 inhumations, no cremations	AD 1785 ca. AD 1805*		Some individuals with many and others with nothing	Chumash, near boundary	Gamble et al. 1996; Gibson 1975:117; Martz 1992; Suchey et al. 1972; Walker et al. 1996
Oxnard (VEN-506)	20 +Burials -- 1 burned cranial fragment	AD 1250-1500*		Beads, points	Chumash	Wlodarski and Romani 1985
Encinal Canyon (LAN-114)	32 + Burials				Chumash	Singer 1988
Malaga Cove (LAN-138)	cremations and inhumations, number not specified		cal AD 918 (1029) 1155 UCLA 0680 cal AD 257 (399) 515 UCLA 0681	Cremation found near large platform cairn of rocks and artifacts	Tongva	Walker 1951

continued

Table 7.1 (*continued*)

SITE	BURIALS	CHRONOLOGY	CALIBRATED RADIOCARBON DATES	FUNERARY ASSOCIATIONS	CULTURAL AFFILIATION	REFERENCES
Loyola Marymount (LAN-61)	95% of bone was cremated; dispersed and clustered human bone, 1 inhumation poss. secondary	1000 BC to AD 1000	Most dates range between cal BC 1010 (912) 822 Beta-013021 to cal AD 1290 (1323) 1402 Beta-013018		Tongva	Van Horn 1987; White 1985
Encino (LAN-43)	Approximately 13 cremations, exact number not given, 21 inhumations; cremations in a definitive portion of site and possibly chronologically discrete.	600-200 BC*	Most dates range between cal BC 42 (cal AD 36) cal AD 130 UCR-2014 to cal AD 1405 (1439) 1486 UCR-2009	Cremation area had soapstone bowls, haliotis discs, and an olivella grooved bead. These artifacts indicate Middle period, phase 1 (600-200 BC)	Tongva	Cerreto 1986; Mason 1986; Whitney-Desautels 1986
Palmer-Redondo site (LAN-127)	9+ burials, prone position	Unknown		4 burials associated with effigies	Tongva	Van Valkenberg 1931
Walker Cairn site, Chatsworth (LAN-21)	30 cairns, ? cremations Bone is fragmentary. Area A has very small pieces of human burned bone, and B has unburned skull frags. and long bones. Bone all seems secondarily deposited, not cremated in place.	2 cemeteries, one early Middle, 1 late Middle (King 2000) Late period		Many cairns contain one or numerous artifacts, including mortars, pestles, & soapstone fragments.	Tongva, near boundary C. King (2000) claims it is Tataviam based on mission register research	King 2000; Tartaglia 1980 Walker 1951
Big Tujunga (LAN-167)	26 cremations and 15 inhumations	AD 900-1200*		Some of the human bone burned, some not, much is scattered, and 26 bowls, each contained frags. of burned bone	Tongva C. King claims it is Serrano based on mission register research	King 2000; Walker 1951
Mulholland site (LAN-246)	1 cremation, 21 inhumations; Cremation inside a flower pot mortar; more cremations apparently dug by pothunters or amateurs (King 2000)	Ca. AD 900-1500*	Cal AD 1312 (1336) 1417 UCLA-1489A Cal AD 1289 (1372) 1393 UCLA-1489C Cal AD 1276 (1287) 1376 UCLA-1489B	Some individuals with many and others with nothing.	Tongva, near boundary	Galdikas-Brindamour 1970

continued

Table 7.1 (*continued*)

SITE	BURIALS	CHRONOLOGY	CALIBRATED RADIOCARBON DATES	FUNERARY ASSOCIATIONS	CULTURAL AFFILIATION	REFERENCES
Hughes Aircraft Site, Peck site (LAN-62)	Cremations and two inhumations; burned human bone scattered throughout site.	Late prehistoric, Middle period cremations w. poss. secondary burials		Shell beads more numerous in area around cremations	Tongva	Peck 1947; Altschul et al. 1992
Admiralty Site (LAN-47)	inhumations and no evidence of cremations	AD 1050-1150*	Most dates range between cal AD 1323 (1407) 1447 TX-6974 cal AD 1255 (1303) 1358 TX-6976.		Tongva	Altschul et al. 1992
Sheldon Reservoir (LAN-26)	2 cremations, 53 inhumations; cremations associated with boulders and upper level.	Prehistoric, probably mostly Late 2 (King 2000)		2 levels of burials. One had platform cairns with many stones and broken pestles, bowls, scrapers, and arrow points, 10' from cemetery. Lower level burials had triangular form points, slightly concave	Tongva C. King (2000) claims it is Serrano based on mission register research	King 2000; Walker 1951
Los Altos (LAN-270)	More than 1 cremation and 20 inhumations; Scattered burned bone throughout indicates presence of other cremations	Late period		Arrowpoints and pottery. Cremation has turtle shell frags., bone tubes, and many other artifacts. Some individuals with many and others with nothing.	Tongva	Bates 1972
Yaangna? (LAN-1595/H)	15 inhumations and 5 cremations (Cremations appear to be protohistoric)	AD 1020-1810		Shell beads, bone awls, bone pins, arrowpoint, steatite bowl, basketry	Tongva	Goldberg et al. 1999
Carson, possibly *Suangna* (LAN-98)	Burials	Unknown		grave goods include stone pipes, ear ornaments, grinding stones, crystals, & deer bone whistles	Tongva	Dillon and Boxt 1989

* = These dates are uncalibrated and based on King's (1990) chronology.

In our analysis of mortuary remains, we included data from thirteen archaeological sites in the Tongva region that date to the Late Holocene. All of these sites had evidence of both cremations and inhumations, but there is no evidence of cremations in the area during the Middle Holocene (Gamble and King 1997). Some of the best evidence regarding the chronological sequence of inhumations and cremations in the Tongva region is derived from E. Walker's (1951) excavations at Malaga Cove (LAN-138). In one of the lower levels of the site that dates to the Middle Holocene, only inhumations with rock cairns, manos, and metates were observed. A stratum above this level contained numerous cremations, with associated platform cairns and whole and fragmentary mortars, pestles, fishhooks, fishhook blanks, and other artifacts (E. Walker 1951:63). Manos and metates are not associated with this stratum. In the uppermost level, cremations are rare compared with inhumations, and arrow points and arrow shaft straighteners appear for the first time.

The earliest evidence of cremations in the Tongva region appears to be from Encino (LAN-43) in the San Fernando Valley, where a distinctive portion of the cemetery was used for cremations. Unfortunately, only limited information concerning the excavations at Encino has been reported (Langenwalter 1986; R. Mason 1986; Taylor et al. 1986; Whitney-Desautels 1986a, 1986b). Some of our information is from individuals who were involved in or observed some of the excavations. On the basis of artifact types, C. King (2000) suggested that this part of the cemetery was used between about 600 and 200 BC. There were approximately 13 cremations and 21 inhumations at the site (table 1) (Cerreto 1998). The cremation area exhibited soapstone bowls and abalone disk beads (C. King 2000). Although mortuary information is limited, a detailed publication of the animal burials from the site is available (Langenwalter 1986).

Ethnographic evidence indicates that animal burials were part of an elaborate tradition of ceremonies related to tribal and lineage religious practices (Langenwalter 1986:65). Of the thirteen animal burials from the site, eleven were dog inhumations, one a red tailed hawk burial, and one a cremated canid. This cremation is the only example at the site, and to our knowledge in the Tongva region, of an animal burial with grave associations. The cremated canid was found in situ in an abalone shell with 63 *Olivella* shell disk beads. The fact that none of the other animal burials had grave associations supports the idea that high status individuals were cremated. Other evidence of cremations with numerous grave goods can be seen at the Los Altos site (LAN-270) in Long Beach, where there was at least one cremation compared with 20 inhumations (Bates 1972). The cremated individual was associated with turtle shell fragments, bone tubes, and many other significant artifacts. Inhumations ranged from those with no grave goods to those with many.

Cemeteries have been documented for at least two sites from the bluffs above the Ballona Wetlands, LAN-61 and LAN-62. At LAN-61, dated between about 1000 BC and AD 1000, 95% of the human bone had been cremated. LAN-62 evidenced only two inhumations and an unspecified number of cremations. Peck (1947) noted that there were more shell beads in the vicinity of the cremations. The latest evidence of cremations in the Tongva region comes from LAN-1595/H, possibly the ethnohistorically documented village of Yaanga (Goldberg et al. 1999). Fifteen inhumations and five cremations were recovered from the cemetery, dating between AD 1020 and 1810, but the cremations appear to be Protohistoric. Relatively few grave goods were associated with some of the inhumations and cremations, including shell beads, bone awls, bone pins, an arrow point, a steatite bowl, and basketry. The distribution of cremations in our study area and the presence of grave associations in cremations are complex and most probably relate to temporal, social, and geographic variables. Nevertheless, the data suggests burial customs changed at the beginning of the Late Holocene and that this change might be a result of the influx of Takic speakers into the Tongva region.

The Late Holocene Chumash mortuary data from this region are based on sixteen Chumash burial sites (table 7.1). A detailed examination of six sites from the Santa Monica Mountains where large portions of cemeteries, or in some cases complete cemeteries, were excavated provides valuable information regarding social status. The earliest cemetery in this series is LAN-197 at Trancas Canyon (Thomas and Beaton 1968), where 106 burials were excavated from a Middle period phase 2a occupation. According to Martz (1984), only two people from this site were buried with ritual artifacts; moreover, only one individual was buried with beads. Sixty percent of the individuals had no grave associations (Thomas and Beaton 1968), suggesting that there was a differential distribution of wealth in this early Middle period cemetery. It may be of some relevance that the Trancas cemetery was disturbed in the 1950s (Thomas and Beaton 1968), with portions having been looted prior to excavation.

At Simo'mo (VEN-26), Van Valkenberg excavated 176 burials through the Van Bergen-Los Angeles Museum expeditions (now the Los Angeles County Museum of Natural History). Van Valkenberg was associated with the expeditions from 1929 to 1932 (Coleman 2002). Years later in 1955, a UCLA field class recovered two more burials from the site. Martz (1984), who analyzed the grave associations from this cemetery, found that 51% of the burials were associated with grave goods. This cemetery was used between about AD 300 and 700, after the Trancas cemetery. There are also indications of differential distribution of wealth and other items from this cemetery.

The third cemetery, Calleguas Creek (VEN-110), located very close to Simo'mo, was used from approximately AD 900 to 1250. This cemetery overlaps in time with the cemetery at Malibu. Raab (1998) reported that 96 discrete burials were found, most of which were inhumations, although P. Walker (1998) reported some cremated bone. Of the 96 burials, 67 had beads, but only 21 of these had more than 50 beads. An infant had nearly half of the beads in the cemetery (N=19,062), with the next largest lot containing 4359 beads. Individuals with greater quantities of beads were clustered in the northern part of the cemetery, interpreted as evidence of ascribed status (Raab 1998:23-24).

Burial data from Malibu indicate a similar pattern. Two cemeteries were excavated, one dating between about AD 950 to 1150, and the other entirely to the Historic period. Comparing data from both Malibu cemeteries (Gamble et al. 1996; Gamble, Walker, and Russell 2001), it is clear that wealth was not equally distributed among all individuals. Some people had large quantities of beads in both time periods, whereas others had few or none. During the late Middle period, women may have owned and controlled religious objects, since most of the effigies were associated with them. Walker, Drayer, and Siefkin (1996) identified the individual from the earlier cemetery with the greatest number of beads and ornaments as a child. This is just one aspect of multiple lines of evidence that suggest the possibility of ascribed status during the Middle period (Gamble, Walker, and Russell 2001). These mortuary data are relevant to ongoing debates about the timing and causes of the emergence of sociopolitical complexity among the Chumash (see Arnold 1992a; Kennett and Kennett 2000; C. King 1990). Many aspects of mortuary behavior, in combination with evidence of plank canoe development, more intensive subsistence strategies, and increased exchange, suggest that sociopolitical complexity was well developed by at least AD 1000. These data further suggest that the emergence of ranked society characteristic of historic Chumash chiefdoms appeared earlier than Arnold argued (1992a).

The distribution of shell beads (Gamble et al. 1996), status-related differences in health, and other evidence in the historic cemetery at Malibu suggest that status differentiation still existed among the Chumash after Spanish contact. This interpretation is based in part on the large quantities of shell beads associated with children (Gamble, Walker, and Russell 2001). Of nine individuals with 1600 or more beads and ornaments in the historic cemetery, five were children or infants; an infant burial evidenced the most beads. Also of note are the individuals with fewer than 15 or no beads. A cluster of these individuals is located at the western edge of the cemetery, and generally speaking along most of the perimeter of the cemetery (Gamble, Walker, and Russell 2001). Additional information from the historic cemetery suggests that certain members of Chumash society had contact with the Spanish and were working on the ranchos as cowboys.

The sixth cemetery from the Santa Monica Mountains is Medea Creek (L. King 1982). Based on uncalibrated radiocarbon dates, obsidian hydrations dates, and shell and glass bead types, the cemetery was in use from around AD 1500 to 1785. The data from Medea Creek confirm the observation that there was differential distribution of wealth among the coastal Chumash, and that this wealth appeared to be inherited. It is assumed that status was also inherited and ascribed.

CONCLUSIONS

Significant changes took place during the Late Holocene in both the Ventureño Chumash and Tongva societies. As Drennan (1991a, 1996) has suggested, changes in society may be interpreted from both the management and control theoretical perspectives. A variety of models proposed for the development of sociopolitical complexity among the Chumash focus on various causes, including population growth, technological innovation, and climactic change. We conclude with a brief review of relevant trends during the Late Holocene and discuss the data that will be necessary to achieve a better understanding of the changes that occurred.

There is evidence for the development of a complex political economy in the Ventureño Chumash and Tongva areas during the Late Holocene. Villages grew in size and larger settlements appeared along the coast, some with several hundred people. By contact, these settlements were integrated into regional sociopolitical organizations. Some have suggested that one purpose of the increased regional political integration seen prior to contact was to reduce warfare (C. King 2000:73-74). This interpretation reflects a management perspective that views the Late Holocene development of more complex regional economic and political organization as a means to use resources more efficiently from a wide variety of environments as population increased. These large coastal settlements were located where boats could easily access the shoreline, a factor most likely related to the intensification of exchange and maritime technology.

Relatively large cemeteries segregated from the living areas were apparent among the Ventureño Chumash by the beginning of the Late Holocene, if not before. Houses were clustered in rows along the coast. Comparable data on intrasite organization are not available for the mainland Tongva, but mission record research suggests that settlements were larger in the Los Angeles Basin than in the Santa Monica Mountains area during the Historic period (C. King 2000). Based on multiple lines of evidence, we suggest that permanent settlements existed throughout the Late Holocene. Settlement patterns are not clearly defined, however, and the distribution of permanent villages relative to other types of sites is poorly understood, especially in the early Late Holocene.

Broad subsistence strategies employed during the Late Holocene used a variety of terrestrial and marine resources. For the Chumash, clear evidence shows that intensification, with the introduction of new fishing technologies such as the plank canoe, circular fishhooks, and the harpoon, occurred during the Late Holocene. The Chumash emphasis on exchange was noted by most early explorers and is well documented (C. King 1990). Development of the plank canoe, probably before about AD 600, is an aspect of elaboration of both subsistence and trade. Exchange intensified, including the trade of food, shell beads, steatite cooking vessels, and fused shale. To support their economic system, the Chumash developed craft specialization and sophisticated means of transportation. We know from ethnographic and ethnohistoric accounts that canoe owners were the wealthier individuals in Chumash society and wore special cloaks representative of their status (Hudson, Timbrook, and Rempe 1978). Obviously, wealthy individuals had some control over the exchange system and certain intensive fishing practices. Through canoe ownership, they most likely became even wealthier. At the same time, they provided others with access to this important form of transportation and other benefits this technology offered.

Mortuary data suggest that great disparities in wealth existed during the Late Holocene. Although there is documented evidence for interpersonal violence among the Chumash during certain time periods, it does not appear that warfare was a significant strategy used by elites to extend or consolidate political power. Most sites during the Late Holocene were not located in defensive positions, and there were no defensive walls or palisades surrounding sites. Neither do we see large investments in monumental architecture, such as mounds or very large ceremonial structures that reinforced the political or religious status of those in charge and represented a significant investment of public labor. Instead, we see a tremendous investment in an economic system that relied on shell beads for money. It appears that management of exchange and ideology were key strategies for emerging elites. The initial appearance of cremations in the Tongva region and their significance are important to many scholars who believe that cremations represent the appearance of Takic speakers who migrated to the coast from the east by at least around 600 BC (C. King 1990:199, 2000:69; Moratto 1984:161-162).

The absence of religious objects from late prehistoric Chumash cemeteries has been interpreted as evidence that religious authority was becoming institutionalized and religious objects were no longer owned by and interred with individuals (C. King 2000:74-75). This view is consistent with the ethnohistorically documented *'antap* society, an elite religious and ceremonial institution that served an important integrative function that legitimized the authority and political positions of its members.

The distribution of stone effigies indicates a shared ritual system between the Tongva and the Ventureño Chumash, although they do not appear to have shared some ritual behaviors such as cremation. There is also evidence among both groups of feasting, as seen by the increased number of large steatite ollas just prior to historic contact. Ethnographic accounts indicate that chiefs sponsored feasting, usually associated with religious ceremonies. Among other things, these fiestas served to redistribute food and possibly technological items.

Numerous scholars have suggested that environmental change played a significant role in the development of sociopolitical complexity among the Chumash during the Late Holocene (Arnold 1992a; Kennett 1998; Kennett and Kennett 2000; Lambert 1997; Raab et al. 1995; Raab and Larson 1997). Kennett and Kennett (2000:381) suggested that there was high marine productivity and sustained drought between AD 450 and 1300 in the Santa Barbara Channel area. This view contrasts with Arnold (1992a:69), who suggested there was an unfavorable warm water period in the region between AD 1150 and 1250. Kennett and Kennett (2000) provided an excellent summary of the recent debate about palaeoclimactic changes in the region. Most of these climactic models of culture change are based primarily on environmental data, with limited archaeological evidence necessary to document subsistence stress. Where are the changes in documented settlement patterns that reflect adaptation to drought conditions? Exactly how did these climactic changes result in greater sociopolitical complexity? We do not have the answers to these questions in this paper but believe that archaeologists need to rely more heavily on the archaeological record when suggesting that the development of sociopolitical complexity was a result of climactic change. Certainly, sustained drought conditions may have affected subsistence, settlement sizes and locations, and regional interactions.

Lambert (1994:155-156) noted an increase in violence commencing about 500 BC in the Santa Barbara Channel area. Lethal projectile wounds appear to increase around AD 600, about the same time the bow and arrow were introduced. Was this increase primarily a result of climactic change or is it a continuation of violence that began over 1000 years earlier and changed with the introduction of more lethal weaponry?

Drought and other climactic change generally have a greater impact on agricultural rather than hunter-gatherer societies that rely heavily on marine resources. The ethnographic and ethnohistoric record documents the multiple strategies California Indians had for adapting to changing environmental conditions (Blackburn and Anderson 1993). Nevertheless, recent research by archaeologists studying the Chumash has focused on the development of sociopolitical complexity resulting from climactic change. Relatively little has been accomplished in developing the broad regional archaeological database necessary to document cultural responses to climactic change. We have progressed slowly in understanding settlement strategies, intrasite organization, and changes in artifact assemblages, especially on the mainland coast of Southern California.

The Late Holocene is clearly characterized by the development of increasingly complex regional systems that included greater economic, political, and ritual integration, both within and between the Ventureno Chumash and Tongva. We hope our review and synthesis help other researchers as they continue to record new data and develop better explanations for the underlying causes of the changes that occurred during the Late Holocene.

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Late Holocene Santa Cruz Island

Patterns of Continuity and Change

Ann M. Munns and Jeanne E. Arnold

Santa Cruz Island, the largest and most ecologically diverse of the eight Channel Islands, was home to substantial populations of Cruzeño Chumash throughout the Late Holocene. In this synthesis of the final 3500 years of precolonial habitation of the island, we highlight archaeological discoveries from the past century that contribute to an understanding of cultural continuity and change in the region. The residents of Santa Cruz Island, like those of California's other offshore islands, relied heavily on marine resources for their subsistence. From the outset, the circumscribed nature of the island economy, a growing population, seasonal and more extended disparities in resource availability (including fresh water), and longer term fluctuations in marine resource productivity presented a series of challenges to island inhabitants. The nature of these challenges; the economic, social, and political options available for dealing with them; and the specific strategies that islanders ultimately selected present an exciting array of archaeological research issues.

The contact-era Chumash occupied mainland coastal and inland areas, as well as the northern Channel Islands. Ethnohistoric accounts and oral histories collected during the early twentieth century describe the Chumash as a simple chiefdom-level society characterized by hereditary leadership positions, occupational specializations, and an active intraregional exchange system that included the offshore islands. Ethnohistorically, multiple villages on the islands were reportedly unified under a higher tier of leadership, as were comparably sized areas on the mainland (Blackburn 1975; J. Johnson 2001).

The antiquity of these cultural characteristics and the conditions surrounding their emergence have been debated. Some researchers see evidence for the development of ascribed positions of leadership and greater concentration of wealth and status in an elite social stratum at AD 1150 to 1300, while others have argued that this cultural transition occurred at least 1500 years earlier. While it is not our intent here to extend this debate, one of our objectives is to evaluate the quality and quantity of the archaeological data available from various phases of the Late Holocene on Santa Cruz Island. In this way, we hope to identify the types of data required to further evaluate this and other important questions surrounding the Late Holocene archaeology of the region.

Santa Cruz Islander subsistence focused strongly on marine resources from the beginning of occupation at least 8000 years ago. Although shellfish appeared as an important subsistence constituent throughout the island's prehistory, the Middle and Late Holocene witnessed considerable expansion of dietary breadth in localities where fish or sea mammals abounded. The influence of interregional resource variability on subsistence persisted throughout the Late Holocene despite the vigorous late prehistoric cross-channel exchange in subsistence goods.

ENVIRONMENTAL SETTING

Santa Cruz Island is located about 40 km south of the modern city of Santa Barbara and is approximately 249 km^2 in area (figure 8.1). Despite its large size and rugged topography, the maximum straight-line distance from the ocean to any point on the island is only about 5 km, typically no more than about two hours walking time. This relative ease of access to inland areas, together with a strong maritime focus and fairly limited terrestrial resources, appears to have encouraged the placement of larger, more sedentary settlements at or very near the shore. Perennial streams can be found in many of the larger arroyos where they empty into the ocean, and the island is generally well watered.

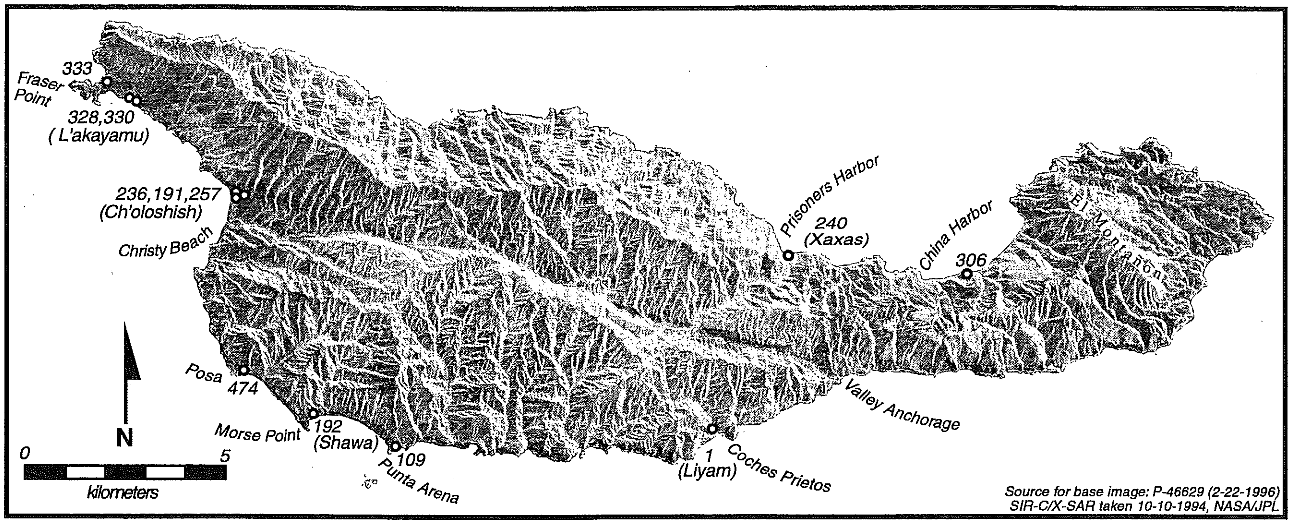

Figure 8.1 Map of Santa Cruz Island.

The short list of endemic terrestrial vertebrate species on Santa Cruz includes the island fox, spotted skunk, mice, bats, and several species of reptiles. Remains of domesticated dogs, introduced to the island prehistorically, have been recovered from archaeological contexts. A range of birds, including sea and shore birds, migratory waterfowl, and terrestrially oriented species (including several raptors), can be found on the island. Notably absent from the endemic faunal list are deer, rabbits, and burrowing rodents, the latter absence accounting for the largely undisturbed condition of most site strata.

Modern terrestrial plant communities are dominated in many areas by introduced annual grasses and other exotics. Nonetheless, many native species remain, and their rough precontact distribution can be surmised from current slope, soil, and moisture conditions. Despite lower species diversity than found on the mainland, Santa Cruz supports an array of vegetation communities, including coastal sage scrub, chaparral, pine forest, oak woodlands, stands of manzanita and ironwood, and several small near-coastal wetlands (Jones et al. 1993; Junak et al. 1995). Some island plant species used by the Chumash differ from their mainland counterparts in terms of their greater yields, fewer spines, or longer annual fruiting periods (Timbrook 1993:49). Certain economically important plant species—including some used for food, textiles, other manufactured goods, medicine, and ceremonial applications—are rare or absent on the island, however.

The island is dominated by two east-west trending mountain ranges separated by a central valley. Coastal topography is characterized by quite a diversity of landforms, including steep cliffs and large marine terraces dissected by arroyos and canyons. These forms present variable challenges to overland travel. The eastern end of the island is separated from the rest by a high volcanic range. Large patches of chert-bearing strata of the Monterey formation are exposed at the surface immediately west of this range, and smaller outcrops are found to the east (Arnold 1987; D. Kennett and D. Morris, personal communications 1997).

Intertidal and subtidal zones fringing the island vary significantly and strongly influence the types of shellfish, fish, sea mammals, and other marine resources found at a given location (Colten 1993; Glassow 1993a; Pletka 1996). The northern shore is dominated in most places by rocky intertidal and subtidal zones that are very steep west of Prisoners Harbor. Sandy substrates are more common along the island's southern shores, although rocky promontories predominate.

Several paleoclimatic reconstructions have been developed from data collected in California. Stine's (1994) study of relict lacustrine tree stumps in the Sierra Nevada showed periods of prolonged, severe drought in the Late Holocene from AD 912 to 1112 and from AD 1210 to 1350. Larson et al. (1989) and Raab and Larson (1997) reconstructed southern coastal rainfall patterns using dendrochronological data from the Southern California mountains. These patterns, offset from the Sierra data, indicate a very wet period locally from AD 800 to 1000 and drought through much of the twelfth century.

Marine paleoenvironmental records have been the subject of considerable research in the Santa Barbara Channel area. The marine temperature curve developed by Pisias (1978, 1979), using radiolarian populations from a varved marine sediment core to infer changes in sea surface temperatures, has been widely cited by archaeologists working in the region. This curve, which now appears to have a problematic chronology, shows notable fluctuations in sea surface temperatures over several thousand years, including a prolonged period of unusually warm sea surface temperatures between approximately AD 1150 and 1250. Even though the Pisias curve may have to be rejected, warm sea temperatures are independently signaled during this same time by the black abalone growth patterns reflected in hundreds of whole shells excavated from undisturbed, tightly dated stratigraphic sequences from several archaeological sites on western Santa Cruz Island (Arnold and Tissot 1993).

Recent analyses of a new marine sediment core from the Santa Barbara Channel reported by Kennett (1998), Kennett and Kennett (2000), and Kennett and Conlee (chapter 9, this volume) indicate sea temperature patterns differing from those reported by Pisias for several key portions of the Late Holocene. According to their analysis—in conjunction with a study of isotopic data derived from archaeological mussel specimens—fluctuating and predominantly cool water temperatures characterized part of the period from AD 1150 to 1300. At this time, it is unclear how best to reconcile these interesting new data with the strong warm water signal in the black abalone shells from AD 1150 to 1300, but further investigations are obviously warranted.

ISLAND PREHISTORY: DATA AND OVERVIEW

Approximately 23% of Santa Cruz Island has been systematically surveyed during the modern era (Arnold 1993a; Glassow 1977; R. Peterson 1994; Chris Williams, personal communication 1998), resulting in more than 600 recorded sites, 35 of which have been ^{14}C dated. Most of these dated sites are located within 200 m of the modern coastline, and all are within one km of the ocean. This spatial sampling bias reflects the fact that the sites most likely to be selected for excavation or column sampling are the dense, stratified, shellfish-bearing deposits close to the shore. Large numbers of other island sites have been dated through their chronologically diagnostic artifacts, including most of the Historic period sites (Arnold 1990a).

Fieldwork of some duration has been conducted at several dozen island sites, and a few investigators have published date estimates based on stratigraphy and artifact-based seriation (for example, see Glassow 1977; Hoover 1971; Olson 1930). Virtually all of the original fieldwork carried out during the first half of the twentieth century focused on cemeteries. Field screening for enhanced artifact or faunal recovery was rarely conducted. Most sites tested during that era date to the Late Holocene when several large, highly visible villages were situated along the island's coasts.

Despite recovery biases, some of the early collections included smaller artifacts such as ornaments, beads, and microdrills. During the 1970s, C. King (1990) analyzed several collections from Santa Cruz Island sites as part of his research on cultural evolution in the Santa Barbara Channel region. Human skeletal materials collected during this early exploratory period have also been the subject of modern research, including several recent studies of violence, health, and division of labor, summarized later in this chapter.

Very few cultural resource management projects have been conducted on the island, and these have been associated primarily with small communications installations. Beginning in the mid-1970s, however, a number of problem-focused research programs were initiated involving survey and site recording, small-scale testing at multiple sites, and more extensive excavations at stratified habitation sites. Results reported for several of these projects, along with recent analyses of early twentieth century mortuary collections, form the main body of data for reconstructing the island's prehistory.

Overall, modern archaeological field investigations on Santa Cruz Island have focused most heavily on the last 1000 to 1500 years of island occupation. This research has yielded finer grained data than are available for earlier portions of prehistory. The coastal bias in ^{14}C dates noted above is also reflected in modern research programs, which have focused principally on the eastern, western, and southwestern island perimeters. Comparatively few inland sites have been tested, and most of these await reporting.

To date, the sole data set available regarding subsistence and settlement reconstruction for the first 6500 years of island prehistory is Glassow's (1993a) analysis of column samples collected from 13 Santa Cruz Island sites. Several other midden analysis projects encompassing these early millennia are under way (including those by Glassow and by Peterson), but results are not yet available. Because Glassow's (1993a) report is a major source of information for the following summaries of the Early, Middle, and Late Holocene, we include brief comments regarding that study.

Glassow estimated the relative protein yields represented in various site strata for three broad faunal categories: shellfish, sea mammal, and fish. He cautioned against overinterpretation of these data because of the small sample sizes, the gross character of the protein estimates, and the undoubted importance of nutrients other than protein. Our synopsis below separately discusses Glassow's Early, Middle, and Late Holocene samples.

Early Holocene (ca. 8000–4700 BC)

The Santa Barbara mainland coast during the Early Holocene has been characterized as populated by small, dispersed, and somewhat sedentary groups whose mixed subsistence adaptation relied heavily on shellfish, incorporating small proportions of nearshore marine and terrestrial food sources as well (Erlandson 1991a, 1994). Erlandson (1997a:91) described societies of the western Santa Barbara mainland coast as "relatively egalitarian, with less pronounced divisions of labor, less interaction with neighbors, less need for elaborate ritual and ceremonial activities, and a more generalized technology" than the contact-era Chumash. These characterizations probably apply to early island populations as well, although some notable differences are to be expected given the lack of terrestrial protein sources (see also Erlandson 1991b).

One of the few Santa Cruz Island sites dated to the Early Holocene is located at Punta Arena (SCRI-109) on the island's southern shore. Glassow (1993a) reported heavy reliance on shellfish at the site, with fish and sea mammals making relatively minor protein contributions. Another island site (SCRI-277), containing a component that may span the transition between the Early and Middle Holocene, is located on the far northwestern cliffs of the island. As with SCRI-109, this component shows a pattern of primary subsistence reliance on shellfish.

Middle Holocene (ca. 4700–1400 BC)

On the channel mainland, modest population growth and expanded dietary breadth accompanied the shift to the Middle Holocene. Societies were still nonhierarchical, but by late in this period sedentism and community size apparently increased. Dietary emphasis on plants and diverse marine foods increased and was accompanied by a number of technological innovations, including the appearance of the mortar and pestle and new kinds of fishing gear (Erlandson 1997a, 1997b; Glassow 1997a).

Glassow has inferred that pre-3450 BC island populations were very small. Shortly after this time, the number of sites (and presumably the number of people) increased. Eighteen Santa Cruz Island sites contain components dating to the Middle Holocene, seven of which are included in Glassow's (1993a) analysis of island column sample data. Five of these seven components are characterized by continued emphasis on shellfish and only small fish and sea mammal contributions. The remaining two sites appear to reflect the increased dietary breadth observed for the mainland, and Glassow suggested that variable local abundance in nonshellfish resources, rather than functional differences among sites, was responsible for these patterns. SCRI-277 shows a notable decrease in the contribution of shellfish, balanced by an increase in the contribution of marine mammals. At SCRI-292 on the southern shore, two later Middle Holocene levels from 3000 to 1600 BC (King's [1990] Phase Eyb) show a similar rise in the contribution of sea mammals, but this change was accompanied by a comparable increase in the importance of fish (Glassow 1993a: Table 1).

Environmental data indicate that ocean temperatures from 5900 to 4500 years ago were cooler and more variable than modern conditions. Glassow et al. (1994) linked cooler water conditions to shell midden lenses dominated by red abalone shells, suggesting that the responses of several marine species to these cooler waters may have been sufficient to promote changes in islander subsistence practices.

In general, the Middle Holocene was characterized by growing populations, continued occupation of coastal areas and interior zones, and a continued marine subsistence focus. Some expansion in dietary breadth is manifested at several sites by increases in the contribution of fish and sea mammals where these resources were locally abundant.

Late Holocene Overview (ca. 1400 BC–AD 1800)

The Santa Barbara Channel region chronology (figure 8.2), formulated by C. King (1982a, 1990) and amended by Arnold (1992a) to incorporate a Middle-to-Late period transition (or Transitional period), provides a framework for our discussion of cultural continuity and change during the Late Holocene. To develop his chronology, King conducted seriation analysis centered on burial-associated artifacts drawn from sites throughout the channel region, including several on Santa Cruz Island. King used observations of temporal changes in artifact styles and frequencies, along with their changing spatial associations in cemeteries, to infer regional shifts in sociopolitical, economic, and ceremonial or religious organization. The boundaries between various periods, phases, and subphases were drawn to reflect significant cultural developments and were positioned in time using relative dating and, in some cases, ^{14}C dates.

Temporal resolution varies significantly among the chronological subdivisions, depending on the abundance and quality of available data. For example, King's subphase Eyb spans 2000 years and is linked with sparse data, primarily from 27 individuals at one Santa Cruz Island site (SCRI-B-162[1] on the northern shore [C. King 1990:31]) and supplemented by single burials from two other sites. The more recent portions of the sequence are based on more abundant data, including historic accounts, and are generally characterized by finer chronological subdivisions.

The 1990 version of King's chronology included revisions to the segments predating the third phase of the Middle period (M3). King (1990:27) based date changes on reservoir effect corrections to marine shell ^{14}C dates and on interpretations by Bennyhoff and Hughes (1987). Significant uncertainty persists, however, regarding the accuracy of the associated ^{14}C dates. In addition, King's call for the incorporation of additional dates to improve confidence in the temporal boundaries remains largely unfulfilled. This situation is worrisome for the earlier portions of the sequence, which lack a comparative abundance of well-documented, highly time-sensitive artifact associations and more direct links with historical records. Despite these concerns, most archaeologists now use the 1990 chronology.

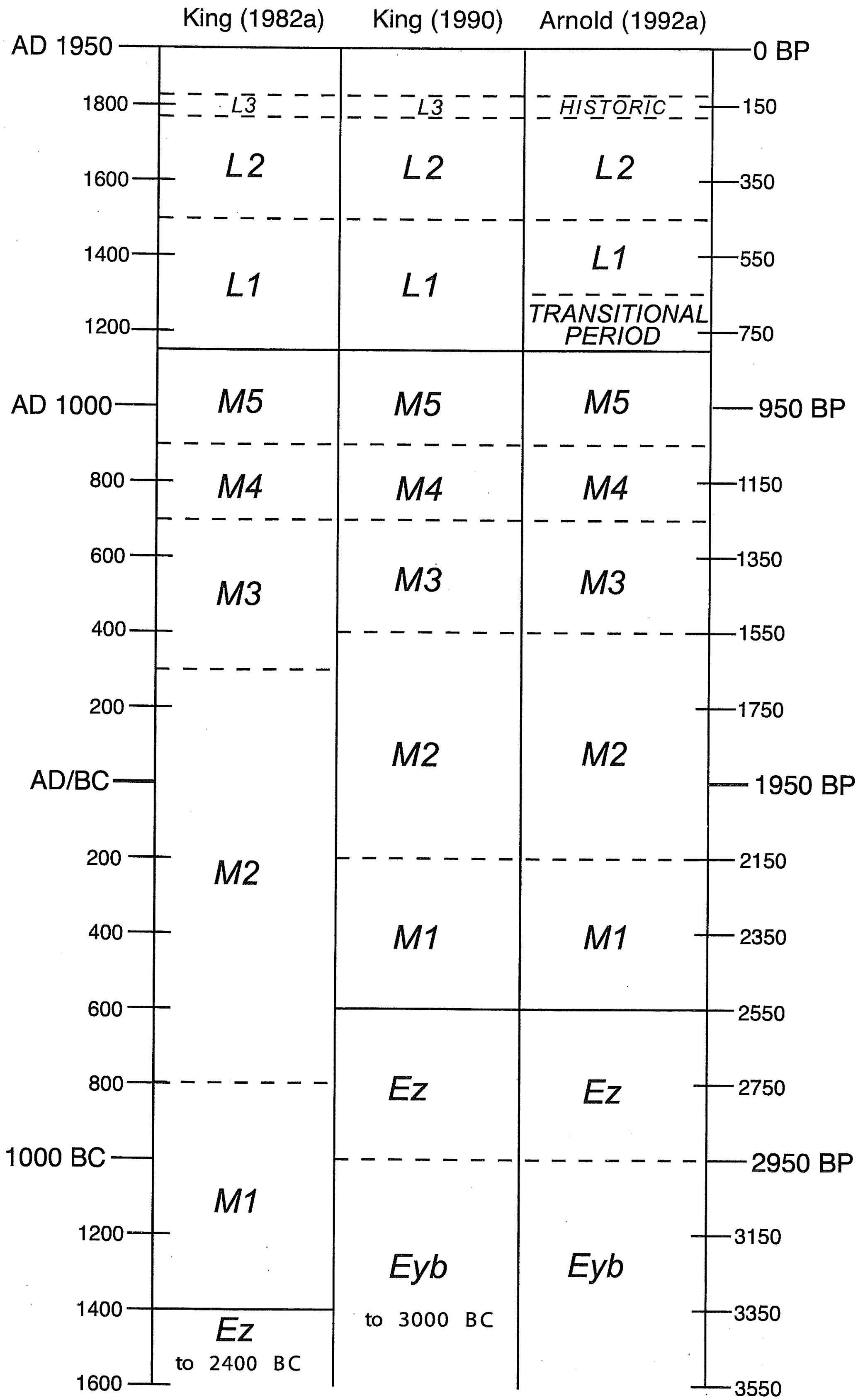

Figure 8.2 The Late Holocene Santa Barbara Channel region chronological sequences. The chronology, originally developed by C. King (1982a), was modified by C. King (1990) and Arnold (1992a).

The beginning of the Late Holocene coincides approximately with the later part of the Early period in this region and thus does not happen to match any of the major boundaries or periods in King's (1990) sequence.

King's discussion includes assemblages from eight Santa Cruz Island cemeteries spanning the period circa 3500 years ago to AD 1800. In the following summary of the Late Holocene, we review key cultural developments presented by Arnold (1992a, 1992b), Colten (1993), Hollimon (1990), C. King (1990), Lambert and Walker (1991), and others. For more detailed discussions concerning changes in beads, ornaments, and other artifacts through time, see C. King (1990), Gibson (1992), Bennyhoff and Hughes (1987), Arnold and Munns (1994), and Arnold and Graesch (2001).

Early Period (1600–600 BC). Sparse subsistence data from the later Early period indicate a heavy reliance on shellfish as a marine protein source. Osteological studies suggest overall fair to good human health. Even during these early times there are indications that mainland goods, often from very remote locations (for example, obsidian), were finding their way to Santa Cruz Island. Use of some form of watercraft to traverse the channel is certainly implicated not only by the long-established presence of island residents but also by these exotic objects.

The later portion of the Early period is linked with a preponderance of *Olivella biplicata* whole shell beads manufactured by removing one or both ends of the shell via grinding, chipping, or both. These types constitute 70 to 80% of the shell beads in use during this era. Other whole shell beads, including those manufactured from *Trivia*, *Cypraea*, and *Dentalium*, were also used. In contrast to later periods, the shaped shell beads of the Early period (flat bead types made from *Olivella*, *Mytilus*, and *Haliotis*) are almost exclusively rectangular. For this period, strong similarities among artifact types have been observed throughout much of Central California and Southern California, extending into the western Great Basin (C. King 1990:29).

Although other researchers have challenged the notion (see discussion below), C. King (1990:xix, 31-32, 93-98) has hypothesized that the emergence of hierarchical social organization occurred at the end of the Early period (600 BC), based on his analysis of the mortuary assemblage from a cemetery at SCRI-333. Yet a growing corpus of empirical evidence suggests to many archaeologists in the region that this era was characterized by nonhierarchical organization.

Middle Period (600 BC–AD 1150). The importance of shellfish in the islander diet declined during the Middle period as fish and in some cases marine mammals became increasingly more significant contributors. New fishing technology appeared, including new styles of fishhooks and harpoons. Researchers also assign Middle period dates to the development of the plank canoe, used in the area at the time of contact, with full refinement of the watercraft by AD 1000 (Arnold 1995a; Hudson et al. 1978; L. King 1982). Osteological indicators show a decline in overall islander health during the latter half of the Middle period, coinciding with a peak in violent conflict (Lambert 1994). The observed peak in indicators of *sublethal* violence occurred, however, during the early Middle period. For the last half of this period, the evidence suggests an increase in the importation of mainland lithic materials from within the Chumash region and an eventual decrease in exotic lithic artifacts from farther afield (Arnold 2001).

Among the changes documented in Middle period artifact assemblages is a shift from rectangular to circular-shaped shell beads, the first appearance of *Megathura* sp. ornaments (which continued to be used until the protohistoric era), the emergence of *Olivella* spire-ground whole shell beads (often diagonally ground), an increase in the use of whole shell beads made from *Trivia* and other species, and changes in the styles and relative frequencies of bone, stone, and shell artifacts (C. King 1990:32-39). Bead and ornament types from this period exhibited changes in their diameters and other stylistic features, useful in distinguishing among the Middle period phases and subphases. Regional differentiation in bead and ornament styles appears to have increased from Early period times (C. King 1990:32). Among the most time-sensitive bead types is the *Olivella* split-punched bead, linked with the terminal Middle period (Bennyhoff and Hughes 1987:125-126; Gibson 1992:33; King 1990:39). New Santa Cruz Island data indicate that split-punched beads are chronologically sensitive but may have been used for as much as a century longer than previously surmised (Arnold and Graesch 2001).

Beginning about AD 900, expedient flake drills, used for localized and very small-scale bead production throughout the region during the preceding centuries, were replaced by more formal microdrills made primarily from Santa Cruz Island chert. These microdrills, trapezoidal in cross section, began to be produced in fairly substantial numbers, as were *Olivella* beads (Arnold 1987, 2001). Both Santa Cruz Island chert microblade cores and microblades were produced principally on eastern Santa Cruz near the source areas, but cores and finished microliths (and shell beads) were also produced at sites on the mainland and the other northern islands during this time (Arnold 1987).

Transitional Period (AD 1150–1300). The Transitional period, as defined by Arnold (1992a), extends from AD 1150 to 1300 and spans the first half of C. King's (1990) phase L1. This period is marked by the first beads manufactured from the thick, callus portion of the *Olivella* shell (although wall beads continued to be made and used). It is also marked by the first appearance of sturdy triangular microdrills with flaked dorsal ridges, by a dramatic constriction in the distribution of microblade cores and associated debitage to a handful of sites within several kilometers of the eastern Santa Cruz Island chert source areas, and by markedly increased volumes of shell bead production on the islands, as indicated by quantities of manufacturing waste (Arnold 1987, 1990b, 1991a, 1992a, 1992b, 2001; Arnold and Munns 1994). Shell bead making became rare at mainland sites during this time.

Comparatively few island sites have been securely dated to the Transitional period. Arnold (1991a, 1992a, 1992b, 1993b) proposed that shifting sea surface temperatures and drought conditions spanning this period may have in part stimulated a fundamental restructuring of the allocation of labor on the islands. Whatever their specific causes, these major changes in labor organization had implications for subsistence, settlement, production, exchange, and sociopolitical evolution. This era marked the emergence of shell bead and microlith production specializations, hereditary leadership positions, consolidation of island settlements, and intensified subsistence resource extraction and exchange strategies. The subsistence changes marking the Transitional period included the increasing dominance of fish as marine protein sources, firmly supplanting shellfish as the dietary mainstay at many villages on the island. Frequencies of exotic projectile points in island middens show some increases during the later Middle and Transitional periods, further evidence of accelerated trade activity (Pletka 2001a). Osteological indicators suggest declines in overall islander health (Lambert 1994).

Late Period (AD 1300–1782). The Late period, as we have defined it, includes C. King's (1990) late phases L1 through L2, the latter corresponding to protohistoric times after first contact with Europeans but prior to the establishment of a permanent Spanish presence in the area. Beginning in the Transitional period and appearing in ever greater numbers in the Late period, *Olivella* callus beads were differentiated into several recognizable styles, including "cupped" forms and the "lipped" forms that incorporated portions of the adjacent wall material (Arnold and Munns 1994). *Olivella* wall beads continued to be made, although their frequencies decreased relative to callus bead types. Other shell bead types made their first notable appearance on the island during these two periods, including red abalone epidermis disks (Arnold and Graesch 2001).

Both bead and microlith production activities constituted bona fide occupational specializations limited almost completely to sites on the offshore islands (Arnold 1987, 1991a, 1992a, 1992b; Arnold and Munns 1994). Microlith production appears to have been restricted to a small number of sites on eastern Santa Cruz Island in the general vicinity of the chert sources. Islander health improved somewhat in the Late period, and osteological evidence of violent conflict declined. This period was characterized by large coastal villages and small temporary camps located away from the coast. Several lines of evidence point to well-defined positions of hereditary leadership, intensified intraregional exchange across ecological zones, and at least modest population growth (Arnold 1992a, 2001; L. King 1982; Martz 1984). C. King (1990:100) hypothesized the differentiation of a secular economy from the political economy during the Late period, calling it "a major structural change in southern California social organization."

Historic Period (AD 1782–1819). Changes in Chumash lifeways accompanied the onset of the Historic period. Sustained, direct contact with Europeans began in this region in AD 1782. Diseases such as smallpox and measles resulted in epidemics that greatly affected the mainland populations and may have spread, in part, in advance of this date (Erlandson and Bartoy 1995; Preston 1996). Deaths of trading partners, political leaders, religious practitioners, and others holding specialized knowledge and skills resulted in changes to all aspects of mainland Chumash life, but much less is known about their effects on the islands.

Among the many foreign artifacts introduced into the region, European glass beads and iron needles had particularly complex effects on the regional economy. Some island-made shell bead types experienced vastly expanded production, and others such as *Olivella* callus beads began to be made in much smaller quantities. Studies of Historic-era bead production make it clear that the island-based shellworking industries did not collapse; indeed, for at least 30 years they were strong and productive (Arnold and Graesch 2001). However, some decline in the demand for chert microdrills due to the influx of iron needles may have been to blame for the fairly early exodus of the lithic craft specialists to mainland missions (Arnold 1987:249-250; 2001). The last recorded Santa Cruz Islander left in 1819 (J. Johnson 2001), but Cruzeño baptisms at the missions peaked between 1814 and 1817, spurred by the cumulative effects of cultural disruption, depopulation, and severe drought (J. Johnson 1993; Larson et al. 1994). In 1824, following a revolt by mission neophytes, a small group of Chumash fled to Santa Cruz Island for a few weeks. Johnson (1982b:76) reported that some of these refugees may have remained on the island, and that other former residents may have returned to Santa Cruz Island during the later Mission period, although there is currently no archaeological evidence that can be clearly linked to this latter phase.

POPULATION

Several types of data, each subject to limitations, have been used to estimate prehistoric populations in the region, including radiocarbon date frequencies, total site areas, numbers and sizes of houses, and mission baptismal records.

Of these methods, those based on historical records appear to have generated reasonable estimates for islander populations for the period immediately preceding contact.

Johnson (1982b:114; 1993:20) placed the total population of the northern Channel Islands at the onset of Spanish colonization at approximately 3000, based on extrapolations from baptismal records (reflecting the village of birth rather than residence). Of the 1264 Island Chumash baptisms recorded at five Southern California missions, 731 (approximately 58%) were recorded for Santa Cruz Island people (J. Johnson 1993: Table 1). Assuming approximately equivalent baptismal rates from each of the islands, the population of Santa Cruz Island alone would have been 1740.

Even this rather robust number could be low. It is possible that European diseases may have spread in advance of direct, intensive contact with the Spanish, resulting in a pre-1782 population decline (Erlandson and Bartoy 1995, 1996; Preston 1996). If this were the case, precontact populations might have been notably higher. Furthermore, the five mainland missions that recorded islander baptisms did so with varying levels of consistency and rigor (J. Johnson 1982b, 1988, 1993). Finally, some villages may have more fiercely resisted the efforts of the Franciscans to integrate them into the mission system. Strong resistance and longer delays in relocation would have increased the likelihood that a greater proportion of a village's population might have succumbed to new diseases before being counted on mission registers.

Ten coastal Santa Cruz Island villages are noted in historic mission documents, accounts by early European explorers, and ethnohistoric interview data (Arnold 1990a; Brown 1967; J. Johnson 1982b, 1993; C. King 1975; Kroeber 1925). Baptismal data suggest that these Santa Cruz Island villages ranged widely in population from fewer than 10 to more than 200 residents (J. Johnson 1982b, 1993). Eight of these 10 locations have been linked definitively with discrete archaeological sites. One (Swaxil) is linked with either of two archaeological sites on the eastern tip of the island, still under debate. The archaeological site correlate for the last village (L'alale) remains to be firmly identified, although the general vicinity on the north-central shore is specified in historic records. In every case investigated to date, these historic site deposits are continuous with protohistoric and prehistoric Late period habitation (Arnold 1990a).

Efforts to evaluate baptism-derived population estimates against other measures have met with limited success. Arnold (1990a) investigated the agreement between village-specific baptisms and total site area and the numbers of house depressions for Santa Cruz Island, revealing little correlation among these variables. Site-specific baptismal frequencies show no significant positive relationship to site size or to the number of house depressions visible on the surface. Although higher baptismal frequencies do suggest larger village size, smaller baptismal frequencies may be attributable to a range of factors (Arnold 1990a:125), including epidemics, consistency and detail of register recording, and other variables.

Other measures of precontact period Santa Cruz Island populations—particularly those offering the best estimates for earlier phases of prehistory—continue to be stymied by the lack of available data. Gross relative population measures for the broader Santa Barbara Channel region, spanning comparatively long periods of time, have been successfully constructed using frequencies of radiocarbon dated site components (Erlandson 1997a; Gerber 1992; Glassow 1997a). Such data for Late Holocene Santa Cruz Island are still too sparse to be of much utility. As indicated above, only 5% of the more than 600 island sites have associated ^{14}C dates, and these are drawn almost exclusively from the coastal zone. Moreover, most Middle, Late, and Historic sites can be effectively dated with abundant diagnostic artifacts; ^{14}C dating has thus far been used very selectively.

Given the current status of this small body of island ^{14}C data, such information is more useful in the context of a discussion of settlement patterns (see below) rather than as a proxy measure of relative population size. We do know that there were quite a few (at least 10) large Late period coastal villages and an overall Santa Cruz Island population of 1200 to 1740 at contact. This estimate may well be larger than the Middle period population, but the data do not allow us to determine how much larger. The Transitional period population appears to have aggregated for a time at relatively few villages near the island's best sources of fresh water (Arnold 2001).

SETTLEMENT PATTERNS

Several investigators have employed systematic survey methods to examine site distributions across the island landscape. For the most part, these efforts await full reporting in the published literature. Glassow (1977) outlined survey projects conducted prior to the late 1970s, including both nonsystematic reconnaissance and survey and more recent investigations employing modern coverage and recording standards. Those using contemporary methods include a 1967 survey of the Coches Prietos watershed directed by Jim Hill (University of California, Los Angeles [UCLA]) and a 1973 survey co-directed by Albert Spaulding and Michael Glassow (University of California, Santa Barbara [UCSB]) involving a sample of approximately 10% of the island's watersheds. The latter project was designed to "determine the relationship between spatial variations in subsistence-settlement patterns and variations in the locations of terrestrial and marine resources" (Glassow 1977:128).

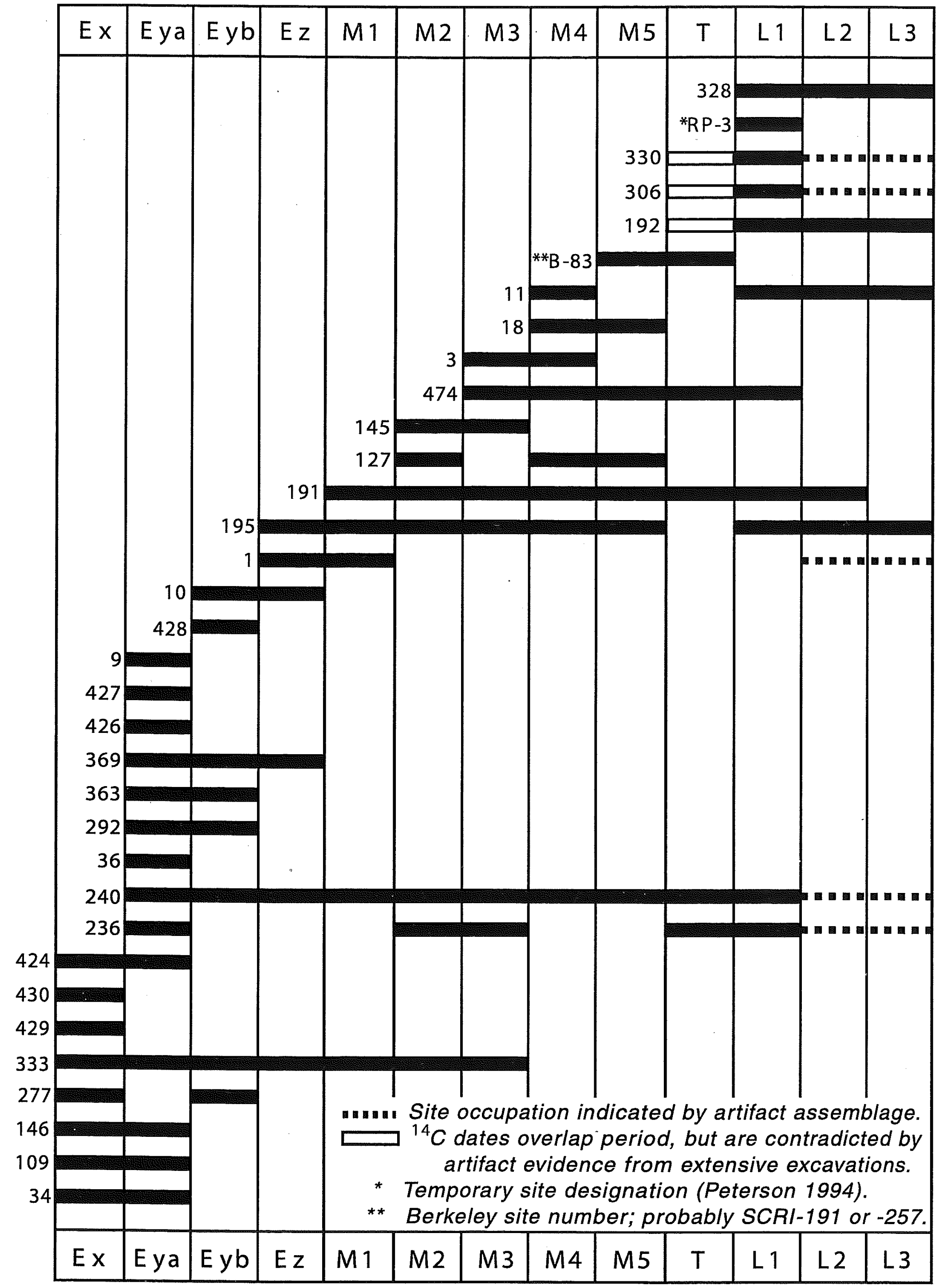

Figure 8.3 Radiocarbon evidence for site occupation through time (data from Breschini et al. 1996, Peterson 1994). Figure illustrates ^{14}C dates within phases of C. King's (1990) chronological sequence at 1 sigma confidence interval and should not be interpreted as evidence of uninterrupted site occupations. Except where specifically noted, dates shown are unmodified by artifactual evidence for site occupation. (Note: dates have been corrected for estimated fractionation and, in the case of shell dates, for estimated local reservoir effect values [225 ± 35 years]). Dates were calibrated using CALIB 3.0.3 (Pearson and Stuiver 1993; Stuiver and Braziunas 1993; Stuiver and Pearson 1993; Stuiver and Reimer 1993). Calibrated ages for dates with reported standard deviations greater than 50 years were rounded to the nearest 10 years. One sigma ranges, calculated using the probability method, were used to evaluate chronological sequence temporal affiliations.

More recently, several island survey projects have produced preliminary reports available at the Central Coastal Information Center at UCSB (Arnold 1993a; Glassow 1992a, 1994, 1995, 1996a, 1996b, 1997b). A number of these surveys included coverage of the otherwise underrepresented inland reaches of the island. Several final reports are forthcoming, including a survey by C. Williams of an area between the Coches Prietos and Laguna drainages. These projects should provide data valuable in reconstructing a more complete picture of island settlement.

Peterson's (1994) preliminary report on site distributions in the Coches Prietos drainage has enhanced our understanding of island settlement patterns. He identified three variables influencing site positioning on the island: access to ocean habitats, level space for dwellings, and proximity to fresh water. He suggested that terrestrial plants are unlikely to have exerted significant influence on habitation location because of their overall scarcity and the relative ease of overland travel. Peterson identified 39 sites in this watershed, including a few large habitation sites possibly occupied for hundreds of years, small outlying residential bases (some containing burials or evidence of bead production), and numerous lithic scatters located along inland ridges. Earliest use of the Coches watershed occurred during the Middle Holocene (ca. 2500 to 3000 BC) at two sites on inland ridges. Two midden sites within the watershed first date to the late Early period[2] (ca. 1000 BC): the shoreline village of Liyam and a site situated at a low elevation several kilometers inland. Both exhibit at least minimal evidence of occupation into the Late period. By the last half of the Middle period, eight sites show evidence of use, ranging from the coast to 3 km inland.

The Late period in the Coches drainage is marked by a significant increase in sites, totaling 13, ranging from short-term, small-group, inland occupations to large, dense middens nearer the coast. Roughly half of these sites also show evidence of occupation during the Middle period. None of the Coches sites has produced ^{14}C dates in the Transitional period. The close of the Transitional period appears, however, to be represented by occupation at an inland rockshelter. Peterson (1994:219-222) suggested that the Coches data point to "an additional component to Late period settlement that consisted of a number of outlying small sites occupied by 1 or more family units." Forthcoming analysis of flotation samples recovered from Peterson's inland sites should provide evidence useful in evaluating the hypothesis that the increase in Late period interior occupation might reflect intensified use of island terrestrial plant resources.

As a source of settlement system data, the complete array of Late Holocene Santa Cruz Island ^{14}C dates (figure 8.3; Breschini et al. 1996; Peterson 1994) reveals several interesting patterns despite strong bias in favor of near-coastal locations. Temporal affiliations shown in figure 8.3 represent calibrated ^{14}C age ranges (1 sigma) for dated site components—that is, the occurrence of at least one ^{14}C dated sample within a particular phase. Uninterrupted occupation of sites within a phase should not be assumed. Except as noted, the figure does not reflect separate and occasionally conflicting artifactual evidence of site occupation.

The earliest phases of the Late Holocene are associated with comparatively large numbers of inhabited sites. Although many of them appear to represent temporally limited occupations, associated provenience information in most cases suggests that the dated stratum is overlain by additional undated habitation debris that in some instances corresponds to later chronological phases. These data are thus most useful in identifying the numbers of sites *first* occupied during each temporal segment. Several sites show occupations (or reoccupations) spanning thousands of years, reflecting locations near particularly productive water sources and resource zones and perhaps indicating the importance of other strategic considerations. These sites include SCRI-333 near Fraser Point, SCRI-195 southeast of Forney's Cove, SCRI-236 and SCRI-191 at Christy Beach, and SCRI-240 at Prisoners Harbor. SCRI-1 at the Coches Prietos drainage is linked with two Early period ^{14}C dates and a third sample too recent to reliably calibrate. Artifact assemblages from SCRI-1 clearly indicate further site occupation during the Late and Historic periods.

Several biases in ^{14}C sample selection limit the interpretive value of these data (see Gerber 1992). For example, the comparatively greater frequencies of sites dating from 5500 to 3000 BC may be partially explained by investigators' tendencies to date basal site strata so as to identify the onset of site occupation. In addition, despite the small number of ^{14}C dated protohistoric and historic sites shown in figure 8.3, more than 10 major villages and numerous smaller sites are known to date to these phases, based on abundant and chronologically diagnostic artifacts from surface collections or recently excavated strata. Investigators rarely submit radiocarbon samples from such levels because the ages of the deposits are clear and already more precise than a ^{14}C date.

The Transitional period is represented by occupations at four island sites: SCRI-240 (Prisoners Harbor), SCRI-191 and SCRI-236 (Christy Beach), and SCRI-474 (Posa) (figure 8.3). A site designated as B-SCRI-83, from which a bone collagen date was obtained from a burial (Breschini et al. 1996:68), refers to an early Berkeley survey site number and is most likely SCRI-257 or SCRI-191 from the Christy Beach site complex. Corrected and calibrated 1 sigma age ranges from three other sites (SCRI-330, SCRI-306, and SCRI-192) also partially overlap the Transitional period boundaries, but analysis of substantial artifact assemblages recovered from excavations (Arnold 1987, 1992a, 1992b) has not produced evidence of occupation during this time span.

In summary, island settlement pattern data show early occupation of both coastal and more inland areas. Habitation at several coastal sites first occupied during the Middle Holocene continued (whether intermittently or more continuously) for thousands of years. Data from the Transitional period reveal a notable disturbance in island settlement patterns, with apparent aggregation of island residents into relatively few locations. Data from the Coches watershed suggest that the Late period settlement system may have been dominated by, but not limited to, large sedentary shoreline villages and outlying special-activity camps.

SUBSISTENCE

Compared with our understanding of islander settlement patterns, much more is known of prehistoric changes in subsistence. Studies have focused on materials other than plants, a predilection common in coastal California midden studies. With several exceptions, most of what is known about important floral resources is derived from analyses of historic documents, including early European explorers' accounts of cross-channel trade and oral histories collected following the Mission era. These sources indicate that gaps and shortfalls in locally available island plant supplies were overcome by using substitute materials or by exchange with mainland groups (C. King 1976; Timbrook 1993).

Timbrook (1993) has provided the most focused discussions of island plant resources, incorporating knowledge of modern plant spatial distributions with historical accounts of their use. She suggested that islanders used a wide range of strategies to augment scarce local supplies. Several plant types (for example, some species of island oaks) may represent intentional or accidental prehistoric introductions (Timbrook 1993:57). Other plant community management techniques, such as intentional periodic burning to encourage growth of selected species, were practiced on the mainland and may also have been employed on the islands (Timbrook 1993:57).

Archaeological studies of islander plant use will eventually allow us to transcend sole reliance on historical records and plant distributions. Hevly and Hill (1970) reported successful recovery of pollens from four Santa Cruz Island sample locations, and Martin and Popper's (2001) study of flotation residues and other plant remains from Arnold's excavations at four west end sites constitutes the first systematic integration of floral resource use into an islander subsistence study. Preservation of carbonized plant parts is excellent, and it is clear that both local and imported plants were used during the Late Holocene (Martin and Popper 2001). Indirect evidence of the relative importance of plant foods in the islander diet can also be gleaned from a range of procurement and preparation artifacts and features (Timbrook 1993). Delaney-Rivera (2001) analyzed many Santa Cruz Island and mainland groundstone assemblages to assess regional plant use and exchange. This study showed that milling equipment frequencies changed on the island from the Middle to the Late period when the importation of essential processed plant foods from the mainland may have increased.

The onset of the Late Holocene shows considerable continuity with Middle Holocene faunal subsistence patterns in the emphasis on shellfish and locally abundant fish and sea mammal resources from nearshore ocean habitats. Two site components dating from 1400 to 600 BC (the Late Holocene portion of the Early period) are included in Glassow's (1993a) column sample analysis. Both strata show that shellfish was a dietary mainstay, and smaller contributions of protein came from fish and marine mammals.

Subsistence reconstructions indicate that the trend toward increased dietary breadth became firmly established during the Middle period. This period is represented by components at six sites in Glassow's (1993a) column sample study, and although shellfish remained important, the relative contribution of fish at all sites was significantly greater than for earlier occupations. Sea mammal contributions peaked at locations adjacent to pinniped haulouts. Some of the Middle period subsistence variability may be due to differences in local availability of sea mammals and nearshore fish, but the data also show site functional variability (Glassow 1993a:86).

By the onset of the Late period, fish routinely ranked as the dominant protein contributor at a variety of sites, although shellfish continued to be consumed in significant amounts. Glassow (1993a) reported that fish protein contributions consistently exceeded 50% for Late period components, whereas shellfish contributions were typically limited to approximately 15%. Late period sea mammal use appeared to decline from Middle period levels, regardless of site location with respect to haulouts, typically constituting less than 10% of protein. Recent analyses by Colten (2001) largely reinforce these observations.

Summarizing the primary trends, the overall dietary importance of marine mammals declined from the late Middle through the Late period on the island (Colten and Arnold 1998). At the same time, the importance of fish in the islander diet increased significantly. Colten (1993, 2001) investigated whether an inverse relationship existed between craft activities and animal procurement at Late period bead production sites on the island. It appears that a village's commitment to intensive bead manufacturing can in some cases be correlated with decreased investment in animal procurement activities, although the pattern is not strongly developed.

In a recent fine-grained faunal study, Pletka (2001b) investigated changes in islander fishing strategies within the context of the environmental and cultural changes characterizing the late Middle through Late periods. He found that although the overall importance of fish increased during this span, the importance of fish procured by netting decreased on the island, perhaps due in part to difficulties in obtaining sufficient plant materials for large-scale net making and maintenance. Fishing practices also appear to have been influenced by local marine substrate conditions, where sandy substrates favored netting but rocky substrates (dominant at the island) did not.

Glassow (1993a:86-90) cited population growth and technological effort as the primary variables explaining the Late Holocene subsistence trend toward increased emphasis on fish (and at some locations, sea mammals) over shellfish. He viewed the increasingly populated island landscape as the ultimate impetus fostering increased sedentism, which would have increased exploitative pressure on shellfish beds near villages. Increasingly costly alternative food resources were thus exploited during this process.

Both sea mammal and fish procurement required significant investments in technology. Greater emphasis on sea mammal procurement appears to have been limited largely to villages located near haulouts, increasing hunters' chances for regular, successful capture. Fishing also required an increased commitment of time compared to shellfish collecting, particularly when the costs of boats and nets were factored in, but it produced higher returns on average and embraced a wider range of possible tool options and strategies than did sea mammal hunting. Analyses by Colten (1993) and Pletka (2001b) suggest that village inhabitants in the Late period specialized in the production of goods such as shell beads rather than in the procurement of fish or marine mammals, but household-based data are needed to determine whether any households may have specialized in these activities *within* communities.

Examples of environmentally driven subsistence change can be identified on the island. Concentrated lenses of red abalone shell are found in middens dating to about 4500 to 5500 years ago during the Middle Holocene, which may indicate a period dominated by cold waters (Glassow 1993b, 1994). Researchers have also noted well-defined lenses that include numerous specimens of shellfish species linked with local warm water conditions, such as *Astraea undosa* and *Norrisia norrisii* (for example, Arnold 1991a). Davenport et al. (1993) have identified peaks in frequencies of fish species such as swordfish and yellowtail in site deposits possibly associated with warmer water intervals.

SOCIAL ORGANIZATION

Islander social organization has been directly investigated through analyses of historical records and by studies of burial-associated artifact assemblages. As well, recent interhousehold investigations by Arnold (Arnold, Ambos, and Larson 1997) at several island sites are being used to explore links among sociopolitical status, subsistence, and craft production.

Johnson's (1982b, 1988, 1993) analyses of Santa Cruz Island Chumash social geography used mission register documents and ethnographic data to estimate village sizes and reconstruct marriage patterns. Geographic analysis of village locations, population data, and estimated intervillage travel time suggested that the community at Prisoners Harbor (Xaxas) served as the geographically optimal center for the entire northern Channel Islands group. In contrast, Liyam at Coches Prietos served as the primary social center for Santa Cruz Island, based on marriage pattern analysis, ranking it first in terms of "control, frequency, and efficiency of social interaction" (J. Johnson 1993:33). The second-ranked village was Swaxil, located on eastern Santa Cruz Island. Johnson's analysis reflected a location for the Historic village of Shawa that has since been shifted to the vicinity of Morse Point, perhaps necessitating some minor revisions in the interpretations.

Although limitations in the historic records precluded an analysis of the entire northern island group, Johnson (1993) subjected the pan-island marriage data to a hierarchical cluster analysis that revealed two major groupings: Santa Rosa-San Miguel and Santa Cruz. The same technique, performed on the Santa Cruz data alone, segregated the western and southern villages from those on the northern and eastern shores (J. Johnson 1993:36). These results seem to broadly reflect affinities among villages located in comparable, rather than disparate, intertidal resource zones—the northern rocky shores versus the southern sandy or mixed intertidal zones. They also group the northeastern microlith makers together and the primary Santa Cruz Island bead-making communities (elsewhere) together. Islander marriage relationships thus appear not to have been configured principally for purposes of exchange, at least on this single-island level.

The strength of intervillage marriage ties appears to have been most closely linked with canoe travel time rather than land travel time. The combination of canoe travel time *and* the sizes of the interacting populations best explains, however, the observed marriage links (J. Johnson 1993:37-39). Several important exceptions to this overall pattern were observed, including unusually strong ties between Liyam, the social center located on southern Santa Cruz Island, and Siucsiu, the geographic center of the Santa Rosa-San Miguel cluster located on eastern Santa Rosa Island. This arrangement suggests that inter-island sociopolitical considerations promoted a higher than expected number of marriage links between the two villages (J. Johnson 1993:39-40). Finally, in several instances, links between pairs of comparatively close villages were weaker than the analysis predicted, suggesting a spatial range within which the intensity of marriage ties remains unaffected by distance (J. Johnson 1993:39).

HEALTH AND VIOLENCE

Much of the information regarding the changing health of Santa Cruz Islanders is derived from recent analyses of island cemetery populations excavated during the late 1920s by Rogers (1929) and Olson (Hoover 1971). The fieldwork was conducted at roughly 12 of the larger sites along the island's most bountiful coastlines. The excavation methods employed in that era and the subsequent handling of the human remains and associated artifacts at the Lowie Museum (now the Phoebe Hearst Museum) at Berkeley and the Santa Barbara Museum of Natural History in the 1930s through 1960s cannot, of course, be held to today's standards. As a result of field procedures and occasionally muddled field and museum records, there are burials for which a time period cannot be assigned, individuals to whom associated grave goods cannot be linked (making inferences about status and occupation difficult or impossible), and bones in deteriorated condition (eliminating the potential for measurement or trait scoring). Nonetheless, the best-documented skeletal remains from these island communities have been subjected to several detailed osteological studies.

Data compiled by Walker and his colleagues during the 1980s and 1990s indicate that the overall health of island residents was fair to good during the early portion of the Late Holocene through roughly the mid-Middle period (Hollimon 1990; Lambert 1994; Lambert and Walker 1991). Isotopic analyses of human bones verify a strong (and increasing) dietary emphasis on marine foods throughout the Late Holocene (Goldberg 1993; Walker and DeNiro 1986). Indeed, although islanders clearly ate local plant foods, such as seeds, acorns, corms, bulbs, and berries, and secured some of these foods in trade with mainlanders during the Late period, the isotopic signature of the Cruzeño populations resembles that of marine mammals (that is, species that almost exclusively consume fish and shellfish).

During the phases leading up to the terminal Middle period, indicators of chronic illness, such as cribra orbitalia and periosteal lesions, and markers of growth disruption, such as dental hypoplasia, are found in island populations in moderate and slowly rising numbers. Cribra orbitalia is a specific form of porotic hyperostosis attributable to sustained iron deficiency anemia, often associated with chronic diarrhea (Lambert and Walker 1991; Walker 1986). Contaminated sources of drinking water probably account for most cases of this syndrome in the region (Walker 1986). It existed in 15 to 20% of the population on Santa Cruz Island during the Early and early Middle periods (Lambert 1994:167). A distinct peak in porotic hyperostosis occurred during the late Middle period (32%), followed by a decline in the Late period (27%). The enamel hypoplasia data are somewhat equivocal, but the periosteal lesions in long bones show a peak in the terminal Middle period on the islands, with 25 to 33% of people showing signs of the disease (Lambert 1994:183-184). Both pathogens and malnutrition may be responsible for these high numbers. Skeletal features or pathologies (for example, arthritic conditions) derived from repetitive physical actions associated with daily activities or specialized occupations are present in roughly equal proportions throughout the Late Holocene (Hollimon 1990). Male and female stature declined through the Middle period, although the changes are not precipitous and seem to level off in the Late period (Lambert 1994:187-189).

The terminal Middle period and Transitional period data (AD 1000 to 1300) indicate a phase of declining health in island populations. Much higher proportions of the population exhibit cribra orbitalia and lesions on long bones. Poor health is likely associated with stresses caused by a sustained drought that affected coastal California (Raab and Larson 1997), combined with the exacerbating effects of elevated oceanic water temperatures (Arnold 2001; Arnold, Colten, and Pletka 1997; Arnold and Tissot 1993; Lambert 1994). Populations stressed by limited access to fresh water and by reduced or fluctuating productivity in the marine environment appear to have crowded into the best-watered and most productive coastal villages—perhaps just a handful of places such as Prisoners Harbor, Coches Prietos, and Christy Beach. Crowding and competition for resources may both have contributed to diarrheal disease, suboptimal diets, and other problems.

Studies of the exchange and production activities of the Island Chumash demonstrate that several important craft specializations emerged during the Transitional period, and exchange within the Chumash sphere increased (Arnold 1987, 1992a). In part, these new activities helped reduce the impact of environmental stresses by stimulating trade in food goods. By the ensuing Late period, health improved somewhat for much of the population. Surprisingly, higher proportions of the population did not suffer from arthritis related to increasing specialization of activities. Back, arm, and hand problems expected to be most closely linked to repetitive motions such as those associated with fishing and canoe paddling or specialized bead and microlith making, are not present in any greater proportions during this period than in previous periods (Hollimon 1990).

There are subtle indications during the Late period of increasing differentiation in health between the very highest status individuals and all others. Plank canoe fragments in burials, likely representing the highest status people, are associated with excellent health (Hollimon 1990:182-186), but the samples are small and thus not statistically significant. This pattern nonetheless suggests that canoe owners were less likely to have compromised health than all other people. Individuals with other signs of intermediate status, such as ritual paraphernalia or caches of special goods, did not appear as a class to have been healthier than individuals without such items. Gender was linked with health in the late stages of the sequence: Late period women were less healthy than males (Hollimon 1990:206). This condition may suggest that gender-based inequalities were on the upswing at the same time that overall social differentiation (ranking) became much more pronounced in the Transitional and early Late periods.

Patterns of violence mirror many aspects of the health data. Indicators of sublethal violent conflict peaked during the early Middle period and continued at modest levels into the terminal Middle and Transitional periods. Other signs of violence, such as projectile wounds, peaked sharply during the terminal Middle period (Lambert 1994:127-128); wounds due to projectile injuries were found in nearly 10% of the population (including subadults). In the preceding and following years, these kinds of injuries were notably rarer. Lambert (1994:153) argued that the introduction of the bow and arrow during the mid-first millennium AD contributed to the apparent acceleration in violent behavior and a turn toward more lethal forms of aggression during the later Middle period.

Sublethal cranial injuries created by wooden clubs used in face-to-face head bashing encounters (and associated forearm parry fractures) were most common in the early Middle period. Both Lambert (1994) and Walker (1989a) interpreted these injuries as a form of structured, perhaps ritualistic, violence among adult males engaged in public displays. The purpose or meaning of these encounters is unknown. Females are less likely to have suffered all types of violent encounters than males, but more than 3% of adult women over all periods have projectile wounds. More than 10% of adult women from late Middle period samples have these wounds, about half the rates reported for adult males (Lambert 1994:136-137). Lambert (1994:202) described the decline in violence from the Middle/Transitional periods (she did not explicitly partition the Transitional) to the Late period as "drastic" and attributed the change to increasing political consolidation, a position with which we concur.

Artifacts from island middens, households, and burials reveal associated information concerning violent activities. Wooden clubs are virtually unknown in island sites. Projectile points made of chert, fused shale, and other materials are present in many island sites, however, and their density appears to peak during the later Middle and Transitional periods. At this stage, samples from the Transitional period are still small enough that we consider this observation provisional. If the pattern holds with further analysis of the data, it may be possible to attribute the high densities of points during this era in part to violent activities and in part to other socioeconomic developments.

The smaller numbers of individuals with projectile wounds found in the Late and Historic periods, the virtual absence of land mammals to hunt on the islands, and the poorly understood role of lithic projectiles in marine mammal hunting suggest that several factors may jointly account for changing frequencies of projectile points over time in these sites. In addition to their roles in conflict or hunting, points may also have been a tool of social negotiation and a means by which to cement trade partnerships across the channel as exchanges became more central to island life. That is, a spike in point densities during the later Middle and Transitional periods may correlate as much with increased intensity of social and exchange relationships across the channel as with heightened violence, and their continued presence on the islands after a significant decline in violence (in the Late period) would seem to be a function of their continuing role in exchange relationships. Scott Pletka has investigated this question in depth by examining the proportions of points found in island sites made from local cherts and from exotic lithic materials; his results are presented in Pletka (2001a). If points were hunting and fighting weapons alone, then most points ought to be made from the perfectly adequate supplies of local island chert. If their social meaning equaled or outweighed their practical uses, then many (and changing percentages of) points through time ought to be made from exotic materials. At contact, animosities were known to exist among Chumash villages on the mainland coast, but the reports are silent regarding mainland-island or inter-island skirmishes. It is worth considering that, as Keeley (1996) points out, exchange and violent conflict are often closely correlated, and groups engaging in frequent trade may also have a record of regular (or past) engagement in violent contacts.

TECHNOLOGICAL INNOVATIONS

The Late Holocene opened with island populations occupying both coastal and higher elevation inland sites, possibly in alternating seasons, focusing on plant foods from an array of species and animal proteins from the rich nearshore areas. Technological innovations associated with exploitation of the marine environment accelerated during the Late

Holocene, although hook-and-line and net technologies were in place by the later Middle Holocene (Glassow 1997a:86). Nets and fishing line (likely fashioned from milkweed fiber, as at contact) were used more intensively and in a wider range of settings through time (whereas much Middle Holocene fishing was apparently shoreline based). New procurement tools were developed during the first half of the Middle period, including circular and J-shaped fishhooks made of shell, bone harpoon points and barbs, thick chert harpoon points, and compound bone fishhooks (C. King 1990). Facilitated by improvements in boating technology (discussed below), these tools permitted more intensive use of nearshore resources and expanded procurement in offshore, mid-water, and open ocean zones. The subsistence and settlement ramifications of these changes included population expansion, more permanent settlement along the coasts, and increased village size. By the Late period, fish from all kinds of microenvironments were of overwhelming importance (Colten 2001; Glassow 1993a; Pletka 2001b), supplemented by shellfish and marine mammals.

The technological innovation that had perhaps the greatest impact on Chumash life was the *tomol*, or plank canoe. Admired at contact by Cabrillo and later explorers, and still in use during the Mission period, this swift oceangoing watercraft was possibly the most sophisticated boat developed in the New World. Hudson et al. (1978) have published detailed discussions of the engineering, materials, and construction phases of the tomol, outlining the complexities of its design. Typically six to seven m long and with a two-ton capacity, the tomol allowed the Chumash on both sides of the channel to become truly maritime adapted. Lyman (1991) defined a group as "maritime" if it made regular use of open ocean areas with reliable oceangoing watercraft. Clearly, the Makah and Nuu-chahnulth (Nootka) whale hunters of the Northwest Coast, for instance, were maritime, using their large, impressive dugout canoes to exploit many massive deep-water species. In places where less stable boats or rafts were used occasionally to venture into open waters only on calm days, or boats were not used at all and resource collection occurred from the shore, Lyman prefers to use the term "littoral" to describe a group's primary use of marine resources. We subscribe to these same definitions here, with the implication that the pre-tomol coastal Chumash in the channel area (and those in the northern reaches of Chumash territory who did not use the plank canoe) were principally littoral.

Prior to this engineering tour de force, the Chumash may have relied on rather simple rafts or balsas of bundled tule reeds (*Scirpus* sp.) to skirt the islands, move along the mainland coast, and cross the channel (Arnold 1995a, 2001). Such reed boats were still in use at contact. The Chumash on the mainland also had a third type of watercraft, the dugout canoe, but these were round bottomed and too unstable to use in open waters, according to Hudson and Blackburn (1982). These craft were reliable only for estuary or nearshore travels and thus are not considered a direct antecedent to the channel-crossing plank canoe (Arnold 1995a). Certainly, though, if they were being used around mainland estuaries during the earlier Holocene, their shape and size may have helped to inspire the development of the tomol. Unfortunately, archaeological data are virtually absent for these very early (pre-AD 500) watercraft.

The timing of the development of the plank canoe remains somewhat unclear. There is little doubt that it was being heavily used in essentially its modern form by about AD 1000. By this juncture, canoe effigies and canoe planks were being placed in small numbers of burials (C. King 1990), and quite a few different kinds of goods with origins on only one side of the channel appeared on the opposite shores, indicating more regular movement across the 30 to 40 km of frequently turbulent seas. Arnold (1995a) has suggested that tomol development occurred in the second half of the first millennium AD, likely by AD 800, while Davenport et al. (1993) suggest that the presence of swordfish and swordfish-associated paraphernalia in Chumash middens means that the tomol must have been in use by the BC/AD transition (or perhaps earlier). Using burial data, others position this innovation rather broadly in the mid-first millennium (perhaps AD 200 to 800) (L. King 1982; C. King 1990). Arnold (1995a) has suggested that the ramifications of the tomol were far-reaching, once it achieved its final form, affecting many domains of life: people's ability to attend social and ceremonial events, the intensity of exchange, the potential for specialized craft products to be distributed systematically and in large quantities, status and power relations, and symbolic aspects of Chumash life. In short, the tomol facilitated power building, aggregation, large ceremonial gatherings, intensive production and exchange, and improved marine resource exploitation, all of which certainly contributed in some way to the major sociopolitical changes that occurred circa AD 1150 to 1300. We suggest that the development and refinement of the canoe probably did not precede the major changes of the Transitional period by more than a few hundred years. If so, this means that this important technology was developed and improved relatively rapidly as canoe makers and users realized its tremendous potential, even though experimentation with its form and materials was undoubtedly a complex process. Johnson's (1982b) research clearly shows that cross-channel social and marriage ties with some genealogical depth characterized the contact-era Chumash. Regular canoe travel would have greatly facilitated such relationships, and all indications are that these watercraft had been fully functional in the region for at least 500 years when the explorer Cabrillo first saw them in AD 1542.

Jones and Hildebrandt (1995) asserted that the invention of the Chumash plank canoe was directly stimulated by a drive to hunt marine mammals in the waters around the offshore islands. Because most of the marine mammals consumed by the Chumash were much more easily procured on the beach by clubbing rather than in the water (Glassow 1993a; Hanan 1996; Landberg 1965), and for several other reasons that we do not have the space to explore here, Colten and Arnold (1998) suggested that this claim is unlikely to find much support in the data. Certainly, local island hunters would have used the tomol to haul pinniped carcasses and cuts of meat, but this vessel was not an ideal staging platform for hunting these animals. Importantly, moderate exploitation of sea mammals around the islands also appears to have preceded the invention of the canoe by thousands of years (Glassow 1993a).

EXCHANGE AND PRODUCTION

Island Chumash participation in long-distance trade—that is, with groups outside Chumash territory—was clearly of some importance during parts of the Late Holocene. The ebb and flow of both external longer distance trade and localized cross-channel trade within the Chumash sphere provide interesting contrasts with other areas of California, and these patterns merit a more extended discussion than we can provide here. During the Early period, goods clearly circulated into Chumash territory from distant sources. Obsidian tools and flakes probably originating in the Sierra (Ericson 1977) or the Coso Range (far beyond Chumash territory) are found at several Early and Middle period sites, demonstrating that islanders were tied into long-distance obsidian distribution networks. Bennyhoff and Hughes (1987) indicate that long-distance trade in the Great Basin area also increased during the Early period. Islanders and mainland Chumash alike were apparently exporting modest amounts of shell beads and other goods to the Great Basin and possibly the Sierra Nevada during this time via either direct or down-the-line exchange.

In the Middle period, particularly during the latter half, goods originating within the territory of the mainland Chumash appear with some frequency in island sites. For example, mainland lithic materials, such as Franciscan chert, fused shale, Temblor Range chert, and Vandenberg chert, appear routinely in Middle period components, such as at SCRI-474 (Posa) and SCRI-191 (Christy). In some site strata, these materials combine to outweigh or outnumber the specimens of Santa Cruz Island chert. These exotic lithic materials primarily originate within the lands of various subgroups of the mainland Chumash and suggest an intensification of localized cross-channel exchange and travel within the greater south coastal region. Moreover, distinctive Santa Cruz Island chert cores and microblades appear at several mainland sites in the later Middle period (Arnold 1987), suggesting that trade involved the movement of durable goods in both directions. These data indicate that regionally oriented trade and travel across the channel increased during the terminal Middle period. The plank canoe was likely integral in this process.

Obsidian appeared less frequently at Chumash sites during the Middle period, indicating some diminution of longer distance trade in lithic goods. Bennyhoff and Hughes (1987) suggested that, likewise, relatively few items were exported *from* the Chumash region to the Great Basin during the first part of the Middle period. The subsequent appearance of *Olivella* disk, saucer, and split-punched beads in sites in the Southwest, the Great Basin, the San Joaquin Valley, and possibly the Bay Area (C. King 1990:150-151) suggests that some Chumash goods were again being transported over great distances before the Middle period closed. The absence of durable goods in Chumash sites from such places as the Great Basin or the Southwest region suggests two possibilities: (1) some Chumash goods worked their way to these destinations—perhaps via down-the-line trade—with little or no direct return of "exotic" items to the Chumash; or (2) only perishable goods, such as maize, cotton, or baskets, were imported into the Chumash region. Based on available evidence, it does not appear that aspiring Chumash elites of the early second millennium used control over external (long-distance) goods to any significant degree to build or consolidate power. By the Transitional and Late periods, the Chumash area again seems to have become less important in supplying beads to the Great Basin (Bennyhoff and Hughes 1987:158). Northern Californian suppliers (perhaps the Pomo) had become the major players in California-Great Basin exchange. From an islands perspective, we see this as a process by which the Chumash increasingly shifted their production and exchange focus toward the regional and local political economy.

The Transitional period witnessed greatly expanded production and exchange *within* the Chumash sphere. Several theses and long-term projects have focused on the large-scale enterprises of microlithic and bead manufacturing centered on the islands from this period through the early Historic period (Arnold 1987, 1990b, 1992a, 1992b; Arnold and Graesch 2001; Arnold and Munns 1994; Graesch 2001; Munns N.D.; Preziosi 2001). Here, we characterize the overall geographic scope and scale of these industries without presenting many of the supporting details regarding morphological changes, chronological reconstructions, the specific evidence for specialized production, and the like.

By about AD 1150 to 1200, the Island Chumash appear to have secured exclusive access to the large chert quarries along the El Montañon range and at nearby outcrops on the eastern portion of Santa Cruz Island (Arnold 1987, 1990b). There is no evidence that this process required overt defensive action or was a contentious process, but changing distributions of island chert debitage, microliths, and cores from numerous island and mainland sites indicate that few external communities had access to the material after this time. The blocky chert from these quarries is well suited for making microblades and had been used for the preceding 200 to 300 years by both mainland and island residents for the low-intensity manufacture of microblades (Arnold 1987). In that late Middle period era, microlithic cores and microdrills made of island chert, sometimes accompanied by shell bead detritus, were found in modest numbers at several dozen coastal Chumash sites on both sides of the channel.

As the Transitional period progressed, the communities participating in microblade and bead manufacturing became confined almost exclusively to the northern Channel Islands. Specialists at sites within about 8 km of the chert-bearing zone, including China Harbor, Prisoners Harbor, a few sites on the eastern tip of Santa Cruz Island, and several quarries, manufactured millions of microblades over the next 500 to 600 years (Arnold 1987). Most of these microblades were shipped to a number of specialized bead-making communities elsewhere on this island, as well as to Santa Rosa and San Miguel Islands.

On Santa Cruz Island, we have investigated and documented intensive production at 10 bead-making villages (Arnold 1992b; Arnold and Graesch 2001; Arnold and Munns 1994; Munns N.D.). While there is important intersite variability in bead-making intensity and bead-type dominance, we can generalize to say that the Island Chumash of the Transitional, Late, and Historic periods developed what appear to have been the most intensive microlithic and shell bead-making industries in North America. This outcome is anthropologically significant considering the much greater political complexity and larger populations of some of the agriculturally based shell bead-making polities of the Mississippian-era American Midwest and Southeast.

Many of these Santa Cruz Island villages and several others on Santa Rosa Island where we have conducted investigations are conservatively estimated to have *each* produced hundreds of thousands of beads over this 600-year period (perhaps far more). Densities of *Olivella biplicata* shell bead-making by-products (detritus, bead blanks, and beads-in-production) are on the order of 150,000 to 250,000 pieces per cubic meter in the deposits at several of the higher density sites. Exceptional *Olivella* bead production is particularly characteristic of sites such as SCRI-192 (Morse Point) and SCRI-328/330 (Forney's Cove); there are several others as well. Beads made of Pismo clam, red abalone, and mussel have also been recorded from multiple sites, particularly SCRI-191 and SCRI-236 (Christy Beach), SCRI-192 (Morse), SCRI-240 (Prisoners Harbor), and a few others (Arnold and Graesch 2001). Large numbers of spent and broken microdrills are found at these sites in direct association with shell bead-making by-products. Use-wear studies have verified that the microdrills were employed to drill shell (Preziosi 2001).

Variations in bead production intensity at Late period sites on southwestern Santa Cruz Island (Arnold 1992b; Arnold and Munns 1994) suggest that village proximity to abundant *Olivella* shell sources was not the sole influence on community participation in this industry. This inference is confirmed by investigations of contemporaneous deposits at several sites on the island's northern shore (Munns N.D.). These villages are adjacent to intertidal and subtidal zones where *Olivella* are scarce or absent, yet the sites have yielded bead detritus densities rivaling those from sites adjacent to prime shell sources. North-shore bead specialists incurred higher costs of shell acquisition as indicated by their more exhaustive use of the shell raw material compared to that of other sites (Munns N.D.). Intensive bead manufacturing at north-shore villages underscores the significance of this specialization in the island economy. Trade among island communities may well have included *Olivella* raw materials.

Large-scale microlith and bead manufacturing specializations persisted throughout the Late period and well into the Historic era. Islanders were the primary suppliers of beads for the entire Chumash sphere and a number of their mainland neighbors such as the Gabrielino/Tongva. Vast quantities of finished beads were deposited in burials and middens during this 600-year period in the broader region. Even after glass beads and iron needles introduced by the Spanish began to circulate in notable numbers (ca. AD 1782) in both mainland and island contexts, islanders continued to make very large quantities of shell beads, some with chert microdrills and some with needles. One bead type, the red abalone disk, actually experienced a significant boom in production during roughly the last 35 years of island occupation, and *Olivella* wall disks resurged strongly during this same time (Arnold and Graesch 2001). Arnold and Graesch explore the possibility that large numbers of lower value shell beads were produced to secure, among other items, newly prized, rare, and probably higher value glass beads.

Many other occupations and general tasks contributed to cross-channel exchange (C. King 1976). "Exotic" materials reaching island sites in the Late and Historic periods included soapstone vessels and comales (from the Tongva island of Santa Catalina), seeds and acorns, baskets, bone tools, high-grade asphaltum, and projectile points, to mention a few (Arnold 1994; Delaney-Rivera 2001; C. King 1976;

Martin and Popper 2001; Pletka 2001a). Mainlanders likely specialized to some degree in processing plant foods, making baskets and wooden bowls, fashioning tools from deer bone, and collecting certain other raw materials. Highly skilled specialists on both sides of the channel, members of the Brotherhood of the Tomol, made plank canoes (Arnold 1995a; Hudson et al. 1978). Beads and fish were exported from the islands in great quantities.

A recent UCLA field project (directed by Arnold) investigated household-level differences in status, diet, and participation in specialized craft production during the Historic period on Santa Cruz Island. This project included testing and systematic, intensive surface collecting at houses within several of the island's contact-era coastal villages, including SCRI-240 (Xaxas), SCRI-192 (Shawa), SCRI-328 and SCRI-330 (L'akayamu), and SCRI-236 (Ch'oloshish). These communities have either multiple well-preserved surface house depressions or buried house structures of Historic age. The buried redwood post house at SCRI-240 has been tested over a seven-year period, tracing both Historic period levels and an underlying Late period structure (Arnold 1994, 2001; Arnold, Ambos, and Larson 1997). Surficial house depressions have been examined through intensive systematic surface collecting, augering, and/or testing by excavation of six to 10 contiguous test units. Arnold, Ambos, and Larson (1997) assessed the potential of ground penetrating radar and other remote sensing techniques to detect buried house floors in the dense shell-bearing deposits at two of these sites. The methods show great potential despite the complications introduced by the thick, complex stratigraphy. Ongoing artifact analyses from 34 sampled island houses indicate considerable variability in household members' access to exotic trade goods and in the nature and intensity of their participation in shell-bead manufacturing during the roughly two generations that marked island occupation during the Historic period.

SOCIOPOLITICAL EVOLUTION

Current data from much of Late Holocene coastal California, including many of the data presented in this volume, seem to indicate that hunter-gatherer societies with quite complex economic and political organization emerged only in some areas of the state and did so relatively late in the sequence. Alternatively, some scholars who define complexity in much more general terms envision a longer and more gradual evolution of cultural complexity in California beginning at an earlier date. This position is certainly valid, and advocates of this view suggest that some groups were "complex" by the start of the Late Holocene, as has also been suggested for the Northwest Coast. There is evidence for large houses, increasingly sedentary lifeways, and possibly hereditary inequality at least 3000 years ago on the Northwest Coast (see discussions in Ames 1994 and Matson and Coupland 1995), although certain investigators suggest that such evidence is not yet definitive and may be subject to other interpretations. Such an early date for complex, centralized economic and political organization does not appear to us to apply to California, although some of the crucial foundations for more complex organizational structures (for example, populations of some size, settled lifeways) can be traced back several millennia.

Most disagreements on this issue can probably be reduced to definitional problems; that is, authors employing different definitions of "complexity" are describing wholly different cultural circumstances. Arnold (1993b, 1996a, 1996b:93, 2001) has explored this definitional problem in some depth and defines complexity in terms of *hierarchical, hereditary leadership* and *leaders' control over non-kin labor and/or products of labor*. That is, a complex society is defined as roughly equivalent politically to a simple chiefdom. We suggest that this definition provides a specific target for empirical examination that other researchers can, of course, choose to apply to their own data sets as they see fit. But it has the advantage of being explicit, and its sociocultural and political meaningfulness has been explored and explained in some depth, invoking theoretical models and using comparative ethnographic data from several areas of North America and Oceania, in addition to being applied to the Chumash case (Arnold 1992a, 1993b, 1996a, 1996b, 2000a, 2001).

Among the archaeologists who have suggested that hereditary inequality is a key hallmark of complexity, C. King (1990) proposed that social complexity arose among the Chumash at the terminus of the Early period, sometime before 600 BC. The evidence for this is rather limited, however, and is based on the presence of clam beads in a small number of burials from one Santa Cruz Island site (Arnold and O'Shea 1993; Glassow 1992b). Other mortuary analysts in the region tend to be skeptical about this early date and largely agree that clear evidence for ascribed inequality and political centralization came much later (L. King 1982; Martz 1984).

Other authors who have grappled with identifying complexity among California's populations use the term "complex" to characterize societies that developed larger populations, increased sedentism, or created more elaborate symbols or tools. Such open-ended definitions can be problematic—not because these traits are irrelevant (they are potentially quite important)—but because critical thresholds are rarely defined or definable. How sedentary or how big must a population be to make a society complex, for instance? Without explicit delineations of thresholds, such uses of the term complexity can generate thorny comparative and interpretive dilemmas (Arnold 1996b:88-95).

Scholars at a few recent conferences have implied that the emergence of complexity in the Chumash region began during the mid-first millennium AD. Arguments supporting this position generally cite the appearance of one or more of the following features during the Middle period: elaborate juvenile burials, year-round residence (sedentism), growing populations, or increased conflict. The emergence of these cultural features is not at all disputed here (indeed, these phenomena probably originated even earlier than suggested), and a focus on the Middle (and Early) period is essential to refining our understanding of their timing and context. What is important to note, as illustrated by extensive cross-cultural data, is that these four traits, together or apart, are not always or necessarily indicators of hereditary inequality or the presence of leaders with sustainable power. Indeed, quite a number of hunter-gatherer tribal and big man societies as well as nonhierarchical horticultural societies throughout the world have been associated with sedentism, conflict, moderate population densities, and/or quite elaborate juvenile mortuary treatment.

We do not wish to belabor these points, but it seems reasonable to suggest that the preponderance of craft production, exchange, health, and burial data from the two larger northern Channel Islands (some of which has been cited in this chapter) points to a later and more punctuated emergence of political and economic complexity in the Chumash region, layered onto the underlying potential for complexity provided by large populations, sedentary life styles, and achieved inequality expressed through competitive displays (Arnold 1992a, 1993b, 1996a, 1996b). We see the Transitional period as the era of major organizational and economic changes (AD 1150 to 1300). These changes, including the abrupt appearance of massive, strongly integrated specialized craft industries, intensified cross-channel exchange, circumscribed access to key resource areas, and well-defined signs of hereditary inequality in burials, point to the rise of hereditary inequality and the emergence of leadership concentrated in the hands of a few.

Although not all mortuary specialists in the region are fully in accord with one another, independent burial data analyzed by L. King (1982), Martz (1984), and Hollimon (1990) indicate that the first unambiguous dates for ascribed inequality in the region correspond to AD 1100 to 1300 and not before. Together with the burial data, there is strong evidence of rapid sociopolitical evolution in: (1) profound changes in labor organization that accompanied the development of the bead, microlithic, and canoe-making crafts (and their counterparts on the mainland); (2) the acceleration in exchange based on reliable oceangoing watercraft; and (3) the probable first use of beads that served as currency (*Olivella* callus beads) at that time. No other period in the last 3000 years of the islands' prehistory exhibits such a closely chronologically linked panoply of deep-rooted changes. Tomol ownership was likely a key to elite emergence, because only regular movement across the channel could account for these patterns.

It is no coincidence that this was also a period of environmental stresses in the region. Arnold suggests that emerging leaders fundamentally restructured the production and exchange systems in ways that both bettered their communities' chances of transcending resource shortages (such as diminished acorn and seed yields during prolonged droughts) and their own odds of getting ahead. It is a model with both opportunistic and cooperative elements. Rising leaders would have had some difficulty in persuading people to accelerate microlithic and bead production without the specialists judging for themselves that they could benefit significantly from returns on their products (Arnold 1993b, 2000b). Specialists depended heavily, however, on the actions of leaders since tomols were so expensive and owned by only a few. There was also cross-channel cooperation among trade partners who needed to regularly find outlets for the goods they sought to distribute. At contact, a system much like this was in place, with regular cross-channel trade and trade fiestas. Many of these same goods were still moving in the same directions, carried by canoe owners who insisted on payments for passage and apparently profited from carrying cargos (Arnold 1995a, 2000b; Blackburn 1975). The punctuated changes that occurred between about AD 1150 and 1300 seem to mark the origins of this form of organization.

Glassow (1997a) presented an ecologically oriented model of cultural evolution that focused on Middle Holocene events. He viewed the potential for intensification as driven by occupation of ecologically marginal zones. More labor-intensive practices necessarily employed in marginal (fringe) areas to make a living would be adopted widely when regional conditions deteriorated. Once conditions improved, these strategies could be retained, allowing overall populations to grow. Whereas Glassow did not suggest that this situation led toward more complex political organization, we would see this as a potential implication of his model for the Late Holocene.

FUTURE WORK

Significant gaps persist in our understanding of prehistoric Santa Cruz Islander life—gaps of interest in their own right that are also relevant to improving our understanding of comparatively well-documented patterns. Several of the most important of these warrant brief discussion here, including settlement pattern data, terrestrial plant use, and a broad range of research questions linked with earlier time periods, particularly those predating AD 700.

Projects awaiting final reporting (including those by Glassow, Peterson, and Williams) should contribute significantly to our knowledge of islander land use patterns throughout prehistory. Each of these investigations includes coverage of hitherto underrepresented interior zones for which site location, function, and chronology remain poorly understood. Although some sites may represent rest areas along overland trails, others contain higher densities of materials that suggest longer-term habitation, perhaps related to exploitation of plant resources. Few investigations to date have included systematic evaluation of local plant use.

As this overview has shown, comparatively coarse-grained data currently exist for island occupations between 1500 BC and AD 700. The reported data on which subsistence and settlement reconstructions are based derive almost exclusively from very small midden samples collected to provide a broad picture of changing islander practices through time rather than larger samples amenable to finer grained analyses addressing a more complete range of research questions. Despite logistical difficulties arising from investigative focus on the lower portions of stratigraphic sequences within dense middens (including ethical considerations that argue against discard of overlying cultural strata), several projects have been geared toward more intensive evaluation of such research questions. The Early and Middle Holocene occupations at the Punta Arena site (SCRI-109) are currently under investigation by Glassow. Work by Wilcoxon (1993) has focused on subsistence and economy prior to AD 1000 and includes SCRI-333, the site C. King used to hypothesize the early emergence of ascribed status. The final analysis of this site should provide data useful in independently evaluating King's proposition. Nonetheless, we need to expand the spatial range of fine-grained comparative samples from these early occupations. More radiocarbon dating of multiple components at sites throughout the Late Holocene is also warranted.

Much more research on Middle period occupations on the northern Channel Islands can greatly enhance our understanding of Chumash cultural evolution. Sites at Prisoners Harbor, Christy Ranch, Posa, Coches Prietos, and Valley Anchorage are among those known to contain occupations dating to this era. Components of this age possess tremendous potential to address questions related to the blossoming of sedentism, periods of accelerated violence, the incipient stage of specialized production, and the development and refinement of the plank canoe.

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Notes

1. The "B-" prefix for Santa Cruz Island sites refers to a UC Berkeley numbering system stemming from an early survey. Sites designated with this prefix alone have not yet been officially re-recorded or assigned a trinomial by the regional Information Center.
2. Peterson's discussion reflects C. King's 1982 chronology, not King's 1990 revisions to the M2-M3 and earlier phase boundaries. Our discussion here uses the 1990 chronology.

Emergence of Late Holocene Sociopolitical Complexity on Santa Rosa and San Miguel Islands

Douglas J. Kennett and Christina A. Conlee

At the time of European contact (AD 1542), the people of Santa Rosa and San Miguel Islands lived in relatively large coastal villages, were heavily dependent on fishing, produced a variety of trade items, and participated in an extensive interregional exchange network (J. Johnson 1982b, 1988, 1993; Kennett 1998). Santa Rosa and San Miguel are two of the four northern Channel Islands that extend east-west for approximately 88 km along the southern margin of the Santa Barbara Channel (figure 9.1). Historically, people on these islands spoke a dialect of the Chumash language (Cruzeño), distinct from the related languages on the mainland coast and interior (Klar, Whistler, and McLendon 1999). Chumash is an ancient language with no affinities with other languages in California (Klar, Whistler, and McLendon 1999). Although mainland and island languages were not mutually intelligible, there is strong evidence for intermarriage throughout Chumash territory and an exchange of resources and ideas within the region and beyond (Arnold 1995a; J. Johnson 1988).

During the early contact period, population densities in the Santa Barbara Channel region were some of the highest in California (Moratto 1984:2) and among the highest for hunter-gatherers worldwide (R. Kelly 1995). Chumash populations were concentrated on the mainland coast, but large numbers of people also lived on the northern Channel Islands. An estimated 3000 people lived on the islands of Santa Cruz, Santa Rosa, and San Miguel (J. Johnson 1982b). Chumash informants in the late 19th and early 20th centuries named ten villages on Santa Rosa and San Miguel Islands (J. Johnson 1982b, 1993; see figure 9.1). Locational information for many of them is clear, and historic artifacts substantiate their existence (Arnold 1990a; J. Johnson 1982b, 1993; Kennett 1998). Baptismal records indicate that intermarriage between these island communities and mainland villages across the Santa Barbara Channel was extensive (J. Johnson 1988). Archaeological evidence for the relative permanence of these villages comes from the large size and depth of midden deposits, the presence of substantial domestic features such as house depressions and cemeteries, and diverse faunal and artifact assemblages (Kennett 1998).

The Chumash are often described as one of the most socially and politically complex hunter-gatherer-fisher societies in North America (e.g., Arnold 1991a, 1992a, 1993b; Colten 1993; Gamble 1991). In recent years there has been considerable disagreement about the timing and nature of the shift toward greater sociopolitical complexity in the Santa Barbara Channel region (Arnold 1991a; Arnold, Colten, and Pletka 1997; C. King 1990; L. King 1969, 1982; Martz 1984; Raab and Larson 1997). Based primarily on burial lots from different parts of the Santa Barbara Channel region, C. King (1990) interpreted Chumash prehistory as a gradual shift of the social system from egalitarian to nonegalitarian form. He argued that gradual intensification of the economic system resulted from maximizing the benefits of exchanging food and nonfood items among different environmental zones (C. King 1976). King (1990) also suggested that hereditary religious and political leaders emerged among the Chumash as early as 600 BC.

Arnold (1987, 1991a, 1992a, chapter 8, this volume) argued that the emergence of hereditary social ranking occurred after AD 1150, much later than C. King suggested. She views this emergence as a punctuated event triggered by environmental deterioration, particularly a significant ocean warming that impacted marine productivity between about AD 1150 and 1300. Arnold (1991a, chapter 8, this volume) suggested that elites emerged to manage economic activities in the region, particularly the production of bead money on the islands and the transport of food and non-

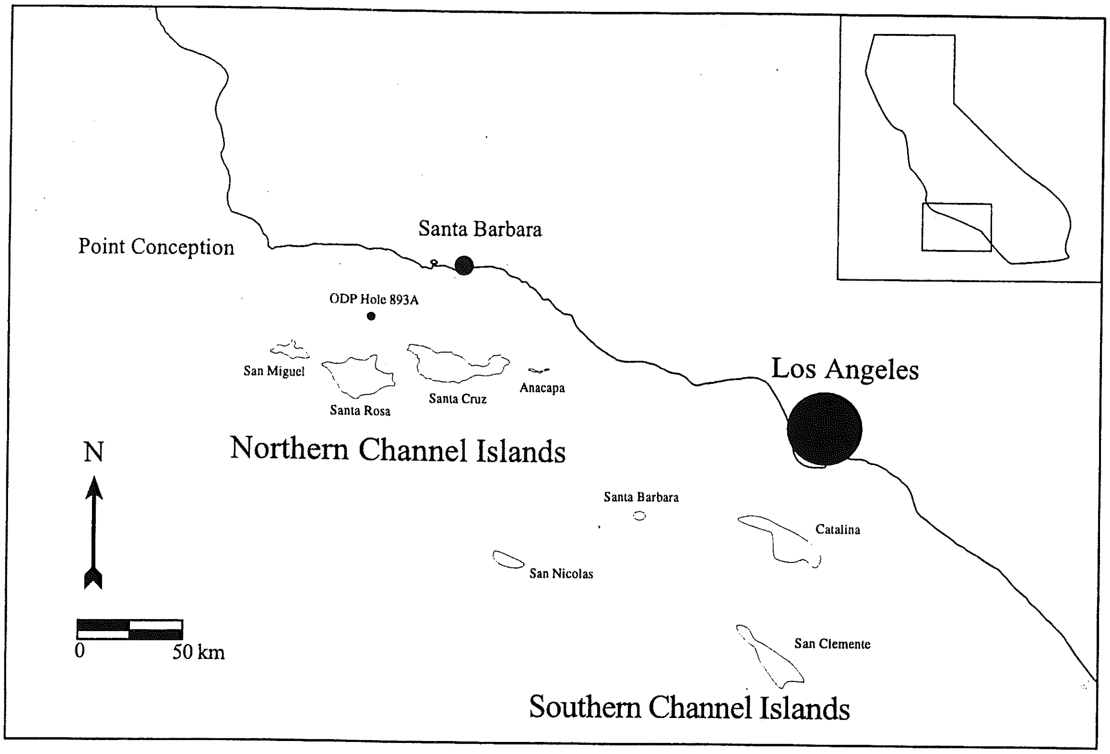

Figure 9.1 The Southern California Bight area, showing the Northern Channel Islands.

food items across the channel. Based on a variety of paleoclimatic indicators (Larson and Michaelson 1989; Pisias 1978, 1979), Arnold (1991a) proposed that elevated sea surface temperatures, reduced marine productivity, and drought enabled elites to control economic activities in the region. Arnold (1992a) argued that the people of Santa Cruz Island increased production of nonfood items, particularly shell beads, as population-resource imbalances increased, ostensibly in exchange for food with people living on the mainland coast.

More recently, Raab (1994; Raab and Larson 1997) argued that diminishing water supplies associated with widespread drought between AD 1150 and 1300 prompted the consolidation of Santa Barbara Channel populations around perennial water sources, solidification of territorial boundaries, increased warfare for scarce resources, and the emergence of a hierarchical social system after AD 1300. Citing evidence from SBA-1731 for a relatively productive marine system (see Erlandson 1993a), Raab (1994; Raab and Larson 1997) argued that marine productivity did not decrease between AD 1150 and 1300 and that settlement shifts evident on Santa Cruz Island during this interval are better explained as a response to fluctuations in the terrestrial, rather than marine, environment. Based on tree ring analysis (Larson and Michaelson 1989), Raab and Larson (1997) linked these changes to widespread cultural change and drought conditions across western North America (see also Jones et al. 1999; Jones and Kennett 1999).

Much of the recent debate regarding the emergence of more complex sociopolitical organization in the Santa Barbara Channel region has focused on the last 800 years of Chumash prehistory. Both Arnold (1991a, 1992a, 1995a, 1997) and Raab (1994; Raab and Larson 1997) have argued for punctuated shifts in sociopolitical organization associated with environmental changes. Arnold emphasized evidence for lowered marine productivity and elite control of labor on Santa Cruz Island, while Raab emphasized lowered terrestrial productivity and competition for limited water supplies. In this paper we explore the emergence of several hallmark Chumash behaviors—sedentism, intensive fishing, production of trade items, and exchange—on Santa Rosa and San Miguel Islands in light of a new paleoclimatic sequence for the region (Kennett 1998; Kennett and Kennett 2000) and new archaeological data from Santa Rosa and San Miguel. Based on these new data, we argue that the social, political, and economic strategies that clearly dominated in the region after AD 1300 emerged earlier, between about AD 650 and 1300, as behavioral responses to climatic and social instabilities in the region. To put the more rapid cultural shifts after AD 650 into a broader context, we consider cultural developments that occurred throughout the Late Holocene.

ENVIRONMENTAL SETTING

Compared with Santa Cruz Island to the east, the outer islands of Santa Rosa and San Miguel are less rugged and topographically variable. Santa Rosa, located 44 km from the mainland, is 217 km² in size. A mountain range runs through the center of the island, but elevations do not exceed 484 m. The northern part of Santa Rosa is dominated by a series of relatively flat, uplifted quaternary terraces (Orr 1968). The distance between the coast and the central range is shorter on the south side of the island, and the terrain is more rugged compared to the north coast. San Miguel Island (37km²) is less topographically variable than Santa Rosa Island. Located 42 km south of Point Conception, it is the most exposed of the northern Channel Islands to the northwesterly winds that blow down the California Coast. Rolling hills and dune fields dominate the landscape. Two small peaks, Green Mountain and San Miguel Hill, neither of which exceeds 255 m in elevation, are located in the center of the island.

Santa Rosa and San Miguel are influenced by a Mediterranean climate with cool, wet winters and warm, dry summers (C. Smith 1952). January through March tend to be the wettest and coolest months, with rainstorms blowing across the island chain from the eastern and northern Pacific. Variable amounts of rainfall occur as these storms cross the islands. As frontal activity dies down in April and May, strong northwest winds blow in the Santa Barbara Channel, impacting areas west of Santa Cruz Island (B. Fagan 1993). Storm fronts are rare between June and September, and there is very little rain during this season. Coastal fog is common during the summer but dissipates starting in October when storm fronts again begin to hit the Southern California bight.

Compared with the mainland coast, fresh drinking water is limited on Santa Rosa and San Miguel Islands. Nonetheless, Santa Rosa Island has a number of streams and springs that provide reliable water throughout the year. The largest and most reliable creeks are found on the north coast where drainages are long and watersheds are laterally extensive (Kennett 1998). Drainages are shorter on the southwestern sides of the island, and fewer reliable streams exist. In addition to streams that flow during the wet season months, a variety of springs, seeps, and vernal pools are available seasonally on various parts of the island (Orr 1968). Only three substantial drainages are present on San Miguel Island (Kennett 1998). Small amounts of water are available in these drainages throughout the year. A number of seeps and springs occur along the north coast of the island (Power 1979). Potable water is more limited on the south side of San Miguel Island.

Other than humans, no large terrestrial animals are native to San Miguel and Santa Rosa Islands. Domesticated dogs and the small island fox (*U. littorallis*) were the largest indigenous land mammals available to humans on the islands during the Late Holocene (Fausett 1993). Plant communities on Santa Rosa and San Miguel are much less diverse relative to mainland communities, and the maritime climate on the islands tends to promote plant species more closely related to Central California (Timbrook 1993). Woodlands, grassland, and coastal sage-scrub communities provided the most economically valuable plant resources to the island Chumash (e.g., seeds, roots, and tubers). These plant communities are patchy, and their productivity varies from island to island. Geological and elevational differences, coupled with ground water availability and wind exposure, create a variety of plant microhabitats (Junak et al. 1995). Santa Rosa supports more diverse floral communities than San Miguel Island. Large stands of trees are absent on San Miguel, but coastal dune, coastal bluff, coastal sagebrush, and native grassland plant communities are interspersed between windswept sand dunes (Hochberg, Junak, and Philbrick 1980; Philbrick and Haller 1977).

The distribution and productivity of plants on the islands is highly dependent on annual rainfall (Junak et al. 1995). Native grasslands and acorn-bearing oak trees are extremely productive during wet years. In general, plants living in grassland and coastal sagebrush communities produce edible seeds, roots, and tubers from May to August. Blue dick bulbs (*Dichelostemma capitatum*) are available throughout the year, but they produce a small purple flower that makes them more visible between March and May. There are ethnohistoric records of people on the islands collecting blue dick bulbs during these months (Timbrook 1993). Acorns and pinenuts are available on Santa Rosa Island between October and December.

Similar to the terrestrial environment, the spatial composition and productivity of marine resources surrounding the northern Channel Islands are not uniform. Each island has a distinct character that results from its geographic position along the California Coast; proximity to the cold, nutrient-rich California current; and physical characteristics unique to each (Engle 1993, 1994). The primary productivity (plankton, etc.) in the Santa Barbara Channel region supporting this rich marine environment is also not uniform and can be linked directly to water temperature variations and regional oceanographic circulation. The cold California current and seasonal upwelling of nutrient-rich waters support the high primary productivity and the rich nearshore fishery in the Santa Barbara Channel. Sea surface temperatures grade from warm to cold between Anacapa and San Miguel Islands, directly affecting the biogeography of different marine organisms around the islands. The distribution and composition of algae, kelp beds, benthic biota, shellfish, and fish for each island also reflect this temperature gradient (Engel 1993, 1994; Murray, Littler, and Abbott 1980; Neushal, Clarke, and Brown 1967; Seapy and Littler 1980).

Geographic proximity to the California current also influences the distribution of sea mammals on the northern

Channel Islands. Harbor seals live and breed along the shores of all the islands (Bartholomew 1967; LeBoeuf and Bonnel 1980; Odell 1971), but the largest number occurs in the cool productive waters surrounding San Miguel Island. The high primary and secondary productivity surrounding San Miguel also supports one of the largest sea mammal colonies on the west coast of North America, with the highest concentrations of animals occurring on the western end of the island at Point Bennett (B. Stewart et al. 1993). Harbor seals (*P. vitulina*), northern fur seals (*C. ursinus*), California sea lions (*Z. californianus*), and elephant seals (*M. angustirostis*) have all established viable breading colonies at Point Bennett. Every year, large numbers of northern fur seals, California sea lions, and elephant seals visit San Miguel at various times to molt and breed (Le Boeuf and Bonnel 1980). Archaeological evidence indicates that southern fur seals (*A. townsendi*) were also common at Point Bennett at certain times during the past (Walker and Snethkamp 1984; Walker et al. 2000). Although there are seasonal fluctuations in species composition at the rookery, incredibly high animal densities occur throughout the year.

Many of the marine resources that were available to people living on the islands are present throughout the year. Mollusks are found in the rocky intertidal zone for much of the year, except for some summers when they are not edible because of "red tide," a small microorganism that makes shellfish meat poisonous. Kelp bed fish are present throughout the year, and fishing would have been impeded only during the worst of winter storms (Landberg 1965). Large numbers of schooling fish (sardines, yellowtail, bonito) enter the channel during summer and fall, sometimes venturing close to shore in search of food. This pulse was of great importance historically to the Chumash who were consummate open ocean fisherpeople (Landberg 1965). Sea mammals are also more readily available between May and August when large concentrations are found at rookeries on San Miguel Island (B. Stewart et al. 1993). Male northern fur seals and California sea lions leave the rookery in September, but the females and pups remain. Harbor seals are present throughout the year but breed in rookeries on San Miguel, Santa Rosa, and Santa Cruz Islands during the summer. Elephant seals visit rookeries on San Miguel Island to breed during January and February. Female elephant seals also revisit San Miguel Island during summer months to molt.

In addition to seasonal fluctuations in resource availability, there are significant interannual, decadal, and century scale climatic changes that impact the marine and terrestrial resource base of the northern Channel Islands. The dynamic interplay between atmospheric and oceanographic phenomena makes short-and-long term climatic patterns incredibly variable. Fluctuations in rainfall directly affect the distribution and productivity of native grasses and oak woodland (Junak et al. 1995). Changes in upwelling, or more intense influences from warm equatorial water associated with El Niño/southern oscillation (ENSO) events, periodically affect marine productivity (Ambrose et al. 1993; Dayton et al. 1992; Tegner and Dayton 1987, 1991). Atmospheric responses to ENSO events are extremely complex. In the Santa Barbara Channel area, increased precipitation often occurs during strong El Niños, because equatorial storms have a tendency to track farther north as water temperatures increase in the eastern Pacific. Weak and moderate El Niño events are not as clearly linked to increased precipitation levels in Southern California. For instance, the moderate El Niño of 1976–1977 was associated with one of the driest periods of the last 50 years (Ramage 1986).

PALEOCLIMATIC CHANGE

New palaeoclimatic data for the Santa Barbara channel area provide a proxy for fluctuations in marine and terrestrial productivity during the Late Holocene (1050 BC to present) (Kennett and Kennett 2000). The most reliable precipitation record for the Central California Coast is based on tree ring sequences (*Pseudotsugo macrocarpa*) from the transverse ranges of central Santa Barbara County and Santa Gorgonia Peak, located 75 km to the south (Larson and Michaelson 1989; Michaelson et al. 1987). Due to the absence of long-lived trees along the Central California Coast, the tree ring sequence spans only the last 1500 years. Fluctuations in precipitation across California during this period also are suggested by a number of other proxy climate records (Graumlich 1993; LaMarche 1974; Scuderi 1984; Stine 1994) that generally agree with the results obtained locally.

The new marine record, derived from a 200 m long core, is based on oxygen and carbon isotopic data for two foraminifera species, *N. pachyderma* and *G. bulloides*. The upper 17 m of the core, taken from deep sea sediments in the Santa Barbara basin just north of Santa Rosa Island (Behl and Kennett 1996; Kennett and Ingram 1995a, 1995b; Kennett and Kennett 2000), contains Holocene sediments. The last 3000 years are represented in the top 5 m of finely laminated sediment. The climate record spans the Holocene at a 50 year resolution from 12,000 to 3000 years ago and 25 year increments for the rest of the Holocene. Sea surface temperatures were inferred from the oxygen isotopic composition of *G. bulloides* (surface dwelling foraminifera) based on the experimental work of Bemis et al. (1998). This new record does not agree with the marine climate sequence produced by Pisias (1978, 1979), which archaeologists in the region have used for the last 20 years (e.g., Arnold 1987, 1991a, 1992a; Glassow, Wilcoxon, and Erlandson 1988).

The new marine record indicates that climatic conditions during the Holocene were not stable but cyclical. In general, the Early Holocene was more stable than the Late Holocene, and the last 1500 years appear to have been particularly unstable (50 year intervals). Based on current data (25 year intervals), average sea surface temperatures during the Late Holocene fluctuated ~6°C between 9 and 15°C. Three general climatic phases are discernable during this interval (Kennett and Kennett 2000). Between 1050 BC and AD 450, sea surface temperatures were relatively warm and stable, fluctuating from 11 and 15°C around the Holocene median of 12.5°C. This was followed by one of the coldest and unstable marine intervals during the Holocene (AD 450 to 1350). Surface water temperatures during this interval ranged between 9 and 13.5°C and were, on average, 1.5°C colder than the Holocene median. Water temperatures were warmer and more stable after AD 1350. The greatest climatic instability occurred between AD 350 and 650 and again between AD 950 and 1550 (Kennett 1998; Kennett and Kennett 2000). Although the impact of climatic changes on the marine resource base around the islands during this interval is not straightforward, it appears that the most productive interval for marine resources was between AD 450 and 1350 (see Kennett and Kennett 2000 for details). Warmer marine conditions, less favorable for high productivity, occurred between 1050 BC and AD 450 and again after AD 1350, with the possible exception of a short interval centered around AD 1700 (Little Ice Age).

The relationship between marine and terrestrial conditions is complex, but historical data for the California Coast suggest that these two climate systems are interrelated (Jones and Kennett 1999). Based on the available data, cool and highly variable marine conditions between AD 450 and 1350 generally correlate with greater terrestrial climatic variability and regional decreases in precipitation (Larson and Michaelson 1989; Stine 1994). Three dry intervals (<17 inches) are broadly defined based on these data: AD 500 to 800, AD 1000 to 1250, and AD 1650 to 1750. Each of these intervals is punctuated temporally by greater precipitation levels (>17 inches). Based on lake level fluctuations in the southern Sierra Nevada, Stine (1994) also defined two primary intervals of extended drought during the last 3000 years, occurring between AD 900 to 1100 and AD 1200 to 1350. Interestingly, the earliest part of Stine's (1994) first drought conflicts with Larson and Michaelson's (1989) interpretation of climatic conditions as wet in the Santa Barbara Channel region. This conflict may be due to slight chronological differences between the two records. In general, however, Stine's (1994) data correlate fairly well with the inferred dry interval between AD 1000 and 1250 in the Santa Barbara Channel record (Larson and Michaelson 1989) and with tree ring studies from elsewhere in California (Graumlich 1993). The implication is that, when marine conditions were cold and productive between AD 450 and 1350, the terrestrial environment was generally dry and less productive. Fresh water was probably limited during this interval, particularly on the islands where watersheds are small relative to the mainland. The interval between AD 800 and 1000 is interesting because it appears that both marine and terrestrial realms were more productive and less variable, favorable conditions for increases in human population on the islands.

HISTORY OF RESEARCH

The earliest archaeological interest in the northern Channel Islands was initiated by the US Coastal Survey during the 1870s (e.g., Bowers 1878; Dall 1874; Rau 1884; Yarrow 1879). Accounts of well-preserved archaeological material prompted expeditions sponsored by the Smithsonian Institution (Bowers 1878), the California Academy of Sciences (Eisen 1904), and what was then the Robert H. Lowie Museum of Anthropology at the University of California, Berkeley (Heizer and Elsasser 1956). The primary objective of these early expeditions was to obtain museum-quality skeletal and artifact collections for study and display. Artifacts and skeletal material were collected from Santa Rosa and San Miguel Islands during this time through casual surface collection or undocumented excavation of burials (Dall 1874; Heye 1921; Schumacher 1875a; Yarrow 1879). Jones' cemetery excavations on Santa Rosa Island are noteworthy owing to the field records and artifact collections made available for study at the Phoebe Hearst Museum at the University of California, Berkeley (Heizer and Elsasser 1956). Most of the burials Jones excavated date to the Late Holocene (Kennett 1998; C. King 1990).

Archaeological investigations on Santa Rosa and San Miguel Islands in the early half of this century are better documented than those of the 19th century, and extensive artifact collections are available in museums for study (Orr 1968; D. Rogers 1929). Prior to World War II, there was a flurry of archaeological activity on the outer islands (Comstock 1939; Edwards 1956; D. Rogers 1929; Von Bloeker 1939; Woodward 1940a, 1940b). In the 1920s, Rogers made several trips to Santa Rosa and San Miguel looking for intact deposits to conduct more extensive archaeological excavations (Glassow 1977). In the summer of 1927, Rogers excavated 12 sites on Santa Rosa Island, including three villages dating to the Late Holocene (SRI-60, SRI-62, and SRI-84). Rogers (1929) used material from the islands to create a cultural chronology comparable to that established for the coastal mainland (Glassow 1977). The Los Angeles Natural History Museum also sponsored several expeditions to Santa Rosa Island just before and after World War II (Comstock 1946).

The most extensive work on the outer islands during this century was conducted by Phil Orr on Santa Rosa Island between 1946 and 1967. Orr's (1968) primary interest was in the Pleistocene occupation of the island, but he was also interested in prehistoric land use during the Holocene and how settlement locations changed through time (Orr 1951, 1967, 1968). Over a 21-year period, Orr recorded 182 sites on the island and excavated 23 locations. Many of Orr's excavations focused on cemeteries associated with residential sites. His primary focus was on three large cemeteries on the north coast dating to the Early Holocene (SRI-3), the Middle Holocene (SRI-41), and the Late Holocene (SRI-2) (Erlandson 1994; Kennett 1998; Orr 1968). At SRI-2, Orr also excavated large sections of shell middens and nine different houses, exposed several house floors, and used radiocarbon dates to establish chronological controls (Orr 1968:217)

The formation of Channel Islands National Monument and ultimately Channel Islands National Park has stimulated numerous field and laboratory studies over the last 30 years. Much of the recent work done on Santa Rosa and San Miguel Islands has focused on documenting the number and type of archaeological sites through systematic archaeological surveys (e.g., Greenwood 1978a; Kennett 1996, 1998; Rozaire 1965, 1993; York 1996). Rozaire (1965) conducted several large-scale excavations on San Miguel Island (SMI-1, SMI-261, SMI-525), but most sampling was restricted to smaller scale excavation (e.g., Erlandson, et al. 1996; Erlandson, et al. 2000; Erlandson, et al. 1997; Kennett 1998; Vellanoweth, Rick, and Erlandson 2000; Walker and Snethkamp 1984). These studies were designed to maximize the amount of information obtained from small samples through detailed laboratory analyses while preserving the integrity of archaeological deposits for future research. Researchers have centered on the earliest occupants of Santa Rosa and San Miguel Islands (Erlandson 1994; Erlandson et al. 1996; Erlandson et al. 2000), the distinct ecology of the islands (Kennett 1998; Walker and Snethkamp 1984) and the emergence of sedentary villages and more complex sociopolitical organization (Kennett 1998). Radiocarbon-based cultural chronologies for Santa Rosa and San Miguel Islands have improved greatly during this period (Erlandson 1994; Erlandson et al. 1996; Kennett 1998; Walker and Snethkamp 1984).

PREHISTORIC CONTEXT

Archaeological deposits on the northern Channel Islands provide some of the best evidence for human occupation along the west coast of North America during the terminal Pleistocene and Early Holocene (9017 to 5550 BC) (Erlandson 1993b, 1994; Erlandson et al. 1996; Erlandson et al. 1997; Erlandson et al. 2000; J. Johnson et al. 2000; Orr 1968). The earliest evidence for occupation of the Santa Barbara Channel region is a terminal Pleistocene deposit in Daisy Cave on San Miguel Island (Erlandson et al. 1996) and the human skeletal material from Arlington Springs on northern Santa Rosa Island (J. Johnson et al. 2000). Daisy Cave also contains some of the best-preserved Early Holocene material on the islands (Erlandson et al. 1996). Beyond Daisy Cave, the number of sites dating to the Early Holocene is relatively small and the dominant settlement and subsistence strategies are difficult to define (Kennett 1998). Many of the earliest sites are located on the outer islands of San Miguel and Santa Rosa (Erlandson 1994; Kennett 1998). It is possible that people used the outer islands sporadically, rather than permanently, during much of this time period.

Except for Daisy Cave, where fishing appears to have been relatively intensive (Rick, Erlandson, and Vellanoweth 2001), all Early Holocene shell middens on Santa Rosa and San Miguel islands contain a limited array of shellfish and fish species. Relatively large mussels (*Mytilus californianus*) and black and red abalones are common in these early deposits. Fish and sea mammal remains are often present, but not dominant. This pattern is supported by quantitative data from midden deposits on Santa Rosa Island (Erlandson et al. 2000; Kennett 1998) and is consistent with a site on Santa Cruz Island (SCrI-109; Glassow 1993a) dating to this time. Future studies may document greater variation in diet on the northern Channel Islands during the Early Holocene.

Human settlements proliferated on Santa Rosa and San Miguel Islands after 5550 BC, and they appear to have been permanently occupied after this time (Kennett 1998). The earliest evidence for permanent settlement on the islands is SRI-3, a large cemetery located at the mouth of Arlington Canyon on the north coast of Santa Rosa Island (Erlandson 1994; Orr 1968). The dominant settlement strategy to emerge on Santa Rosa and San Miguel Islands after ~5550 BC appears to be semisedentary in nature, with periodic movement between the coast and the interior of the islands (Kennett 1998). Large coastal sites appear to have served as primary residential loci, continually occupied and reoccupied through the Middle Holocene. Substantial interior middens dating to this interval also appear to be semipermanent residential bases used periodically during the year, probably on a regular seasonal cycle. A large number of temporary camps appear to have been used to extract and process shellfish (Kennett 1998).

A small number of large coastal middens dating to the Middle Holocene have been identified on Santa Rosa and San Miguel Islands (Kennett 1998). The lateral extent of many of these sites and relatively diverse tool and faunal assemblages suggest a certain degree of sedentism, as do large cemeteries at SRI-3, SRI-4, SRI-5, and SRI-41 (Kennett 1998; C. King 1990; Orr 1968). On Santa Rosa Island these residential bases occur in large dune fields, and the laterally extensive nature of the deposits does not indicate permanent habitation but rather persistent and regular reoccupation. Residential bases were situated on long stretches of rocky coast, and the presence of large red abalone and California mussel shells indicate that this habitat was extremely productive. Proximity to fresh water was also an important determinant of settlement location. On Santa Rosa Island, the four known large residential settlement loci were established near some of the largest perennial streams on the island. Systematic surveys along the coast of the island suggest that this pattern is real and not an artifact of sampling bias (Kennett 1998). Middle Holocene sites were located on the south side of the island, but they appear to be more temporary in nature.

Large residential bases on the coast appear to be the primary settlement loci during the Middle Holocene, but all or segments of the population periodically occupied sites in the interior, probably seasonally (Kennett 1998). People may have aggregated together on the coast part of the year and then splintered into smaller family units to exploit resources in the interior of Santa Rosa Island. A large number of more temporary encampments also appear to have been occupied seasonally. Some of these temporary camps were used to extract and process large quantities of red abalone for transport to more permanent settlements on the coast or in the interior. Although inter island variability exists, these subsistence-settlement strategies appear to have dominated on Santa Rosa and San Miguel Islands throughout the Middle Holocene (5550 to 1050 BC) in the face of large-scale climatic variations.

LATE HOLOCENE SETTLEMENT PATTERNS

Significant changes in the distribution of settlements and cemeteries occurred on the northern Channel Islands after about 1050 BC. The available chronological and typological information for archaeological sites on San Miguel and Santa Rosa Islands that have been securely dated to the Late Holocene are presented in Tables 9.1 a–d (see Kennett 1998). Chronological information is based on radiocarbon dates and time-sensitive artifacts. All these sites appear to be residential bases occupied (or reoccupied) long enough to develop substantial midden deposits. Sites have been divided into four primary chronological occupation phases; 1050 BC to AD 650, AD 650 to 1150, AD 1150 to 1300, and AD 1300 to 1750. These chronological categories generally correspond to the Late Early/Early Middle period, the Late Middle period, the Middle to Late period Transition, and the Late period of Santa Barbara Channel prehistory (Arnold 1992a; Kennett 1998; C. King 1990; Erlandson and Colten 1991b). All radiocarbon dates are presented in table 9.1 as calendar years (BC/AD), with the intercept or most likely age within a one-sigma range shown in parentheses.

Compared to the Middle Holocene, one of the most striking differences in Late Holocene settlement patterns is the absence of substantial interior residences. Very few substantial interior midden deposits on Santa Rosa and San Miguel Islands have been ^{14}C dated after 1050 BC (Kennett 1998). Peterson (1994) reported "residential bases" in the interior of Santa Cruz Island dating after this time, but these appear to have been occupied for short episodes. Similar sites occur on Santa Rosa and San Miguel Islands, but they are much more ephemeral than Middle Holocene interior residences. The absence of substantial interior middens dating after 1050 BC suggests that people were becoming more tethered to coastal locations. Short-term (i.e., daily) logistical forays to collect and process plants are suggested by the presence of globular mortars at certain interior locations (Kennett 1998).

The character of coastal settlements on the outer islands from 1050 BC to AD 650 did not change substantially compared with the Middle Holocene (Kennett 1998). No domestic features, such as house depressions or floors, have been documented at coastal sites dating to this interval. Artifact assemblages at these locations are no more diverse than in middens dating to the Middle Holocene. In fact, settlements along the coast dating to between 1050 BC and AD 650 are difficult to identify because formal artifacts are rare and faunal assemblages are not diverse (Kennett 1998). Radiocarbon dating is the only way to securely identify sites dating to this interval. Consequently, we suspect that sites dating to this time are underrepresented in the archaeological record. Based on the available data, it appears that most of the coastal villages occupied during the Middle Holocene (SRI-5, SRI-40, SRI-116) continued to be used well into the Late Holocene (until AD 650). Cemeteries at some of these sites also indicate a certain degree of settlement continuity (Kennett 1998; C. King 1990). Residential middens and cemeteries were also established at other locations, however, in association with small drainages and more varied coastal habitats. Burials at interior locations began during this interval, a pattern that became much more dominant after AD 650 (Kennett 1998).

The first evidence for settled villages, comparable to that recorded by the Spanish at historic contact, dates to after AD 650 (table 9.1b). Indeed, some of these village locations appear to have been occupied continuously until historic contact (Kennett 1998). Evidence for relatively stable settlements after this time includes more substantial domestic features, large and deep midden deposits, and greater faunal and artifact diversity. This shift did not occur abruptly, but more stable settlements became predominant on Santa Rosa and San Miguel after AD 650. Compared to the Middle Holocene, village locations varied greatly with respect to proximity to rocky coastlines (Kennett 1998), but access to at least a small section of beach was an important

Table 9.1a Available data for archaeological deposits on Santa Rosa and San Miguel islands dating to between 1050 BC and AD 650

SITE #	LOCATION	RADIOCARBON (1 SIGMA)	REFERENCE
SRI-41	Cañada Verde	1230(1070)917 BC	Orr (1968)
		240(200)130 BC	Kennett (1998)
SRI-62	Johnson's Lee	200(110)10 BC	Orr (site record)
		720(530)410 BC	Kennett (1998)
SRI-96	China Camp	AD 120(190)260	Orr (site record)
			Kennett (1998)
SRI-1	Garanon	360(240)160 BC	Erlandson and Morris (1990)
SRI-2	Skull Gulch	AD 260(390)480	Orr (1968)
SRI-3	Tecolote/Arlington	930(800)410 BC	Orr (1968)
			Erlandson (1994)
SRI-4	Tecolote/Arlington	400(370)190 BC	Orr (1968)
		1160(800)260 BC	
SRI-19	Dry Canyon	1010(920)840 BC	Orr (site record)
			Kennett (1998)
SRI-28	China Camp	AD 470(570)640	Orr (site record)
			Morris (site record)
			Kennett (1998)
SRI-31	Bee Canyon	1250(1110)970 BC	Orr (site record)
			Morris (site record)
			Kennett (1998)
SRI-173	Arlington Canyon	60 BC (AD 70) AD 180	Orr (1968)
SRI-432	Ford Point	AD 240(350)440	Morris (site record)
			Kennett (1998)
SRI-587	Cañada Verde	800(760)610 BC	Kennett (1998)
SMI-488	NW San Miguel Is.	760(700)510 BC	Walker and Snethkamp (1984)
SMI-492	NW San Miguel Is.	AD 590(670)710	Walker and Snethkamp (1984)
SMI-503	NW San Miguel Is.	480(380)340 BC	Walker and Snethkamp (1984)
		730(550)430 BC	Conlee n.d.
SMI-504	NW San Miguel Is	1090(990)900 BC	Walker and Snethkamp (1984)
SMI-525	Point Bennett	1190(1070)960 BC	Walker and Snethkamp (1984)
		1260(1160)1040 BC	
SMI-528	Point Bennett	AD 450(560)640	Walker et al. (2000)
		AD 400(490)610	
		AD 490(590)660	
SMI-536?	Cuyler Harbor?	210 BC (AD 30) AD 205	Hubbs
		AD 80(290)540	Kennett (1998)

determinant of settlement location. Arnold (1991a) suggested that beaches were critical for landing plank canoes, the primary watercraft used starting about AD 500. Proximity to sandy beaches may also have been important for acquiring *Olivella biplicata*, the primary shellfish species used to make beads.

Some notable shifts in cemetery locations also occurred after AD 650. The large burial grounds that predominated during earlier periods were not used extensively after AD 650. After this time, cemeteries were associated with coastal villages and occurred more frequently at interior cave and hilltop locations, a pattern that appears to have developed some time after 1050 BC. C. King also noted interesting differences in burial patterns after this period:

> The phases and subphases so far described (6000 BC to AD 650) are mainly defined on the basis of cemeteries from which burial lots cannot be sorted into more than one time period. Beginning with phase M3 burials (after AD 650), the burials found in island cemeteries in the sample I studied are from a number of phases (calendar years added) (1990:35).

In other words, after AD 650 some cemeteries may have been used more or less continuously into the Historic period, supporting the settlement data that suggest continuity at certain locations after this time.

Although some coastal communities were relatively stable on Santa Rosa and San Miguel after AD 650, settlement at

Table 9.1b Available data for archaeological deposits on Santa Rosa and San Miguel islands dating to between AD 650 and 1150.

		DOMESTIC FEATURES		ASSOCIATED ARTIFACTS					
SITE #	SIZE (M^2)	PITS	BERMS	WB	TRP	JF	LP	RADIOCARBON (1 σ)	REFERENCE
SRI-2	50,000	p	p	p	p	p	p	AD 710(790)890	Orr (1968) Kennett (1998)
SRI-6		*	-	p	p	-	-		Orr (1968) Kennett (1998)
SRI-15	28,000	-	p	p	p	-	p	AD 790(970)1030	Orr (site record) Morris (site record) Kennett (1998)
SRI-28	9,200	-	p	p	-	-	-	AD 470(570)640	Orr (site record) Morris (site record) Kennett (1998)
SRI-31		p	p	p	p	-	-	AD 540(610)670 AD 640(690)770	Kennett (1998)
SRI-40	17,500	p	p	p	p	p	p		Orr (1968) Kennett (1998)
SRI-41	105000	-	p	-	-	p	-	AD 690(760)820	Orr (1998) King (1990) Kennett (1998)
SRI-60	12000	p	p	p	p	p	p		Heizer and Elsasser (1956) Rogers (1929) Orr (1968) Kennett (1998)
SRI-77	10000	p	p	p	-	-	-	AD 670(890)1030	Kennett (1998) Kennett (1998)
SRI-85	6612	-	p	p	p	-	-	AD 790(1040)1290	Orr (1968) Kennett (1998)
SRI-130/131	14177	p	p	p	p	-	-	AD 640(690)770 AD 680(730)810	Orr (site record) Morris (site record) Kennett (1998)
SRI-116		-	-	p	p	-	-		Kennett (1998)
SMI-468	5250	-	p	p	p	-	-	AD 1050(1160)1250	Greenwood (site record) Kennett (1998)
SMI-503/504	20425	-	-	p	-	p	p	AD 710(810)920	Walker and Snethkamp (1984) Conlee n.d. Bowser (1993)
SMI-510	65,000	-	-	-	-	p	-	AD 700(770)850	Walker and Snethkamp (1984)
SMI-525	54,000	-	-	-	-	-	-	AD 670(730)820	Walker and Snethkamp (1984) Bowser (1993)
SMI-528	55,000	-	-	p	-	p	p	AD 690(770)860 AD 490(590)660	Walker et al. (2000) Kennett (1998)

WB=Wall Bead; TRP=Trapezoidal Microblade; JF=J-Shaped Fishhook; LP=Leaf-Shaped Arrow Point; *Identified by Orr (1968), but not visible today.

some locations appears to have been disrupted between AD 1150 and 1300 (table 9.1c) (Erlandson, Kennett, and Walker 1997; Kennett 1998). A limited number of villages were definitely inhabited during this interval, but the outer islands seem to have been partially abandoned. Arnold (1991a) noted a similar pattern on Santa Cruz Island and argued that some sites ^{14}C dated to this period could have been occupied intermittently. Paleoclimatic reconstructions for the region suggest that the years leading up to this interval were particularly dry and severe droughts could have occurred more frequently, possibly accounting for the hiatus in settlement. Indeed, the most stable coastal communities were positioned on the largest drainages on San Miguel and Santa Rosa Islands (Kennett 1998).

Sedentary communities solidified on Santa Rosa and San Miguel Islands after this apparent settlement disruption (table 9.1d). Substantial coastal villages were evenly spaced around these islands between AD 1300 and 1750. Many of them were occupied between AD 650 and 1150, then abandoned between AD 1150 and 1300, and reoccupied. Most villages were established near perennial streams, but this does not appear to be a necessary determinant of location (Kennett 1998). Beach access also appears to have been important for some communities. Residential middens in the interior portions of the islands are rare, but burials in caves and on hilltops became much more common, at least on Santa Rosa Island (Kennett 1998). Shell lenses exposed in river cuts and in small rockshelters dating to this period

Table 9.1c Archaeological deposits on Santa Rosa and San Miguel Islands that clearly date to between AD 1150 and 1300

SITE #	LOCATION	RADIOCARBON DATES	CLOSEST PERENNIAL STREAM	REFERENCE
SRI-2	Skull Gulch	AD 1300(1340)1420	Tecolote	Orr (1968)
		AD 1220(1300)1400		Kennett (1998)
SRI-15	Abalone Point	AD 1300(1330)1410	Garanon Canyon	Orr (site record)
		AD 1190(1280)1320		Morris (site reocrd)
		AD 1130(1220)1280		Kennett (1998)
SRI-97	China Camp	AD 1190(1250)1290	unnamed	Morris (site record)
		AD 1160(1230)1290		Kennett (1998)
SRI-85	Old Ranch Canyon	AD 1300(1330)1410	Old Ranch Canyon	Morris (site record)
	(mouth)	AD 1270(1320)1400		Kennett (1998)
SMI-468	Otter Canyon	AD 1310(1350)1420	Otter Canyon	Rozaire (site record)
		AD 1070(1190)1270		Greenwood (site record)
		AD 1050(1160)1250		Kennett (1998)

Table 9.1d Archaeological sites on Santa Rosa and San Miguel islands dating to between AD 1300 and 1750

		FEATURES		ASSOCIATED ARTIFACTS						
SITE #	SIZE (M²)	PITS	BERMS	TM	CC	LB	CF	CB	RADIOCARBON	PRIMARY REFERENCES
SRI-2 Skull Gulch	50,000	p	p	p	p	p	p	p	AD 1490(1560)1650 AD 1440(1480)1640 AD 1300(1340)1420 AD 1220(1300)1400	Orr (1968) King (1990) Kennett (1998)
SRI-15 Abalone Point	28,000	p	p	p	p	-	p	p	AD 1400(1440)1480 AD 1300(1330)1410 AD 1190(1280)1320	Orr (site record) Morris (site record) Kennett (1998)
SRI-40 Cañada Verde	17,500	p	p	p	p	p	p	p	AD 1660(1690)1800	Jones (1901) Orr (1968) Kennett (1998)
SRI-60 Beecher's Bay	6000	p	p	p	p	p	p	p	AD 1650(1690)1800	Jones (1901) Rogers (1929) Kennett (1998)
SRI-62 Johnson's Lee	62,500	p	-	p	p	p	p	p		Rogers (1929) Orr (1968)
SRI-84 Old Ranch Canyon	12,240	p	p	p	p	p	p	p		Orr (site record) Morris (site record) Kennett (1998)
SRI-85 Old Ranch Canyon	1,875	-	p	p	p	-	p	-	AD 1450(1490)1540 AD 1300(1330)1410 AD 1270(1320)1400	Orr (1968) Kennett (1998)
SRI-87 Old Ranch Canyon	24,000	-	-	p	p	p	p	p		Orr (site record) Morris (site record) Kennett (1998)
SRI-88 Old Ranch Canyon	625	-	-	p	p	-	-	-		Orr (site record) Morris (site record) Kennett (1998)
SRI-97 China Camp	9,100	p	p	p	p	p	-	-	AD 1680(1720)1850	Orr (1968) Morris (site record) Kennett (1998)
SRI-98 China Camp	8,840	p	p	p	p	-	-	-		Orr (1968) Morris (site record) Kennett (1998)
SRI-130/131 Jolla Vieja	1,200	p	p	p	p	-	-	-		Orr (site record) Morris (site record) Kennett (1998)
SRI-427 San Augustine	34,000	p	p	p	p	p	-	-		Morris (site record) Kennett (1998)
SRI-432 Ford Point	6,600	p	p	p	p	-	-	-		Morris (site record) Kennett (1998)
SMI-161/163 Cuyler Harbor	4,000	p	p	p	p	-	-	-	AD 1490(1640)1660	Rozaire (site record) Greenwood (site record) Kennett (1998)
SMI-470 Otter Point	7373	p	p	p	p	p	p	-	AD 1710(1830)1950 AD 1700(1830)1950	Rozaire (site record) Greenwood (site record) Kennett (1998)
SMI-602 Point Bennett		p	-	p	p	p	p	p	AD 1420(1460)1510 AD 1430(1460)1510 AD 1560(1660)1690 AD 1710(1840)1950	Kennett (site record) Walker et al. (2000) Kennett (1998)

Notes: TM=Triangular Microblade (w/retouch), CC=Olivella Callus-Cup Bead, LB=Olivella Lipped Bead, CF=Circular Fishhook (grooved shank), CB=Concave Base Arrow Point suggest temporary rather than permanent occupation of the interior (Kennett 1996; York 1996).

LATE HOLOCENE SUBSISTENCE STRATEGIES

Radiocarbon dated column samples from residential middens on San Miguel and Santa Rosa Islands indicate that significant dietary shifts and changes in subsistence took place between 1050 BC and AD 1750 (table 9.2; Kennett 1998). Though these column samples are small (25 x 25 x 10 cm), they present the best available evidence for long-term stability and change in subsistence strategies on the islands. We focus on the relative importance of fish and shellfish because bird bone is generally scarce in these deposits, and the sea mammal remains may be either over or under represented. Recent larger scale excavations on the west end of San Miguel Island near Point Bennett suggest that the exploitation of sea mammals increased after AD 500 (Walker et al. 2000). Settlement focus on the coast in the Late Holocene (see above) also suggests that plant foods decreased in importance or that islanders were obtaining these foods from the mainland.

During the Middle Holocene, the available data suggest that shellfish were the dominant source of meat for many people living on Santa Rosa and San Miguel Islands (Kennett 1998). Column sample data indicate that shellfish remained a prominent meat source during the Late Holocene (table 9.2), but its importance relative to fish decreased through time. Shellfish continued to be a dominant meat source at some locations between 1050 BC and AD 650, indicating some continuity with Middle Holocene subsistence strategies. Compared with most Middle Holocene faunal assemblages, however, the diversity of shellfish types in middens dating after 1050 BC is much greater and the average size of most important species (abalone and mussel) tends to be much smaller. It appears that after 1050 BC people were spending more time foraging for shellfish in the intertidal zone for less return.

It is in this context that some individuals appear to have experimented with more sophisticated fishing technology and going offshore to catch fish. Fish bone is relatively uncommon in most Middle Holocene deposits, and fishing technology was not sophisticated (Glassow 1980; Kennett 1998). After about 1050 BC, fish and fishing became generally more important to people living on the islands, especially after about AD 650 (Kennett 1998). The column sample data in table 9.2 show that the dietary importance of shellfish and fish varied greatly between 1050 BC and AD 650. At some locations, however, fish became a much more important dietary component; fish and fishing steadily increased on Santa Cruz Island (Glassow 1980, 1993a). It was during this interval that more sophisticated fishing technology was developed regionally, including the J-shaped fishhook (Erlandson and Rick, chapter 10, this volume; Glassow 1996c) and the ocean going plank canoe that augmented existing types of watercraft (Arnold 1995a; Davenport, Timbrook and Johnson 1993; Hudson, Timbrook, and Rempe 1978; C. King 1990).

These column sample data also suggest that after AD 950 fish were consistently the most dominant meat source. Other studies corroborate the importance of fish after AD 1300 (Glassow 1980, 1993a; Bowser 1993; Colten 1993, 1995; Pletka 1996), and the Santa Rosa Island data suggest that the importance of fish and fishing increased substantially between AD 950 and 1300 (Kennett 1998; Kennett and Kennett 2000). Increased importance of fishing is supported by an exponential increase in fish bone density in middens dating to this interval (Kennett and Kennett 2000).

TECHNOLOGY AND TRADE

The diversity of formal artifacts increased markedly in residential middens on Santa Rosa and San Miguel Islands after about AD 650 (Kennett 1998). There is also more evidence for intense production of certain types of trade items. Here, we focus on the production of beads, microblades, and ground stone artifacts (mortars and pestles), the most visible specialized industries on the northern Channel Islands.

Various bead types were produced on the northern Channel Islands during the Holocene, but the most intensive production of beads for trade occurred between AD 1300 and 1750 (Arnold 1987; C. King 1990). These highly standardized beads were produced from the callus portion of the *Olivella* shell, a small gastropod found along sandy beaches on the islands. Strands of beads served as a medium of exchange, and most of the beads found throughout the Santa Barbara Channel area were produced on the northern Channel Islands (C. King 1990). Sites on certain parts of the islands are literally covered with *Olivella* bead manufacturing detritus.

The production of callus-cup beads varied spatially on the islands (table 9.3, figure 9.2a). The manufacturing workshops at large coastal villages and smaller sites in the interior appear to be more logistical types of encampments (Kennett 1998; R. Peterson 1994). Bladelet manufacturing has even been identified on the small island of Anacapa during this period (Rozaire 1993). Arnold (1987; Arnold and Munns 1994) documented the most intensive production of callus-cup beads at sites on the west end of Santa Cruz Island. Large-scale bead manufacturing also occured on the east end of Santa Rosa Island (Kennett 1998), where bead making detritus is particularly concentrated at several sites at the mouth of Old Ranch Canyon (SRI-84, SRI-85, SRI-87, SRI-88).

Although the most intensive bead manufacturing occurred between AD 1300 and 1750, *Olivella* bead making

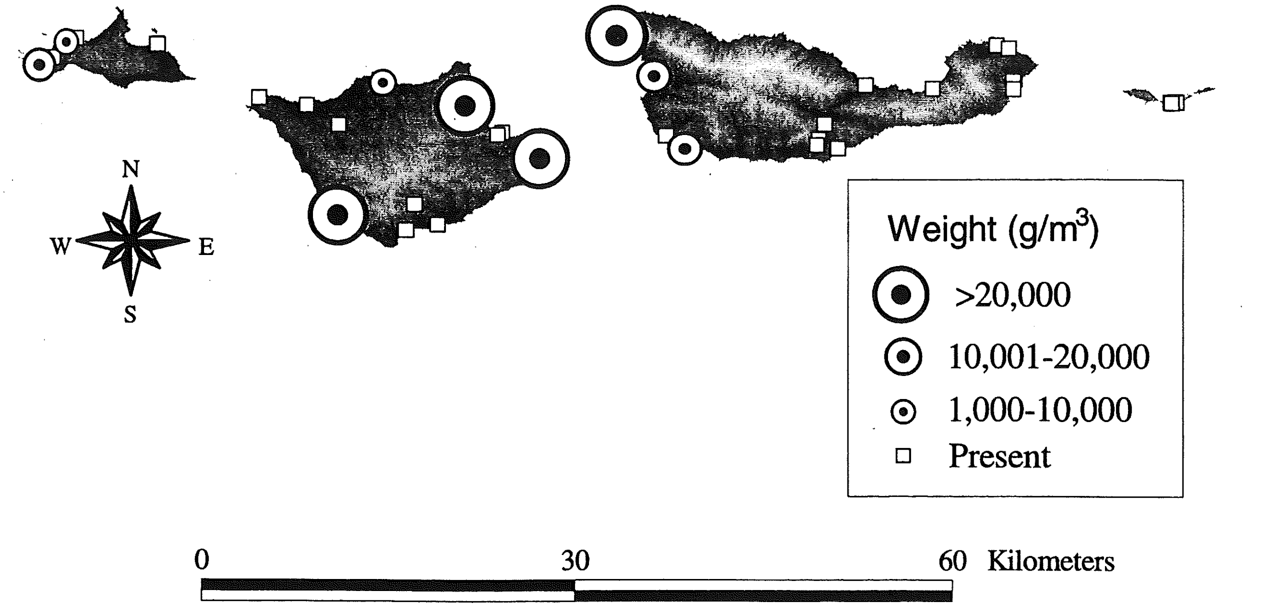

Figure 9.2a Distribution and intensity of *Olivella* bead manufacturing at sites on the Northern Channel Islands, AD 1300-1750. White squares are locations where bead-making detritus was found associated with prepared triangular microblades.

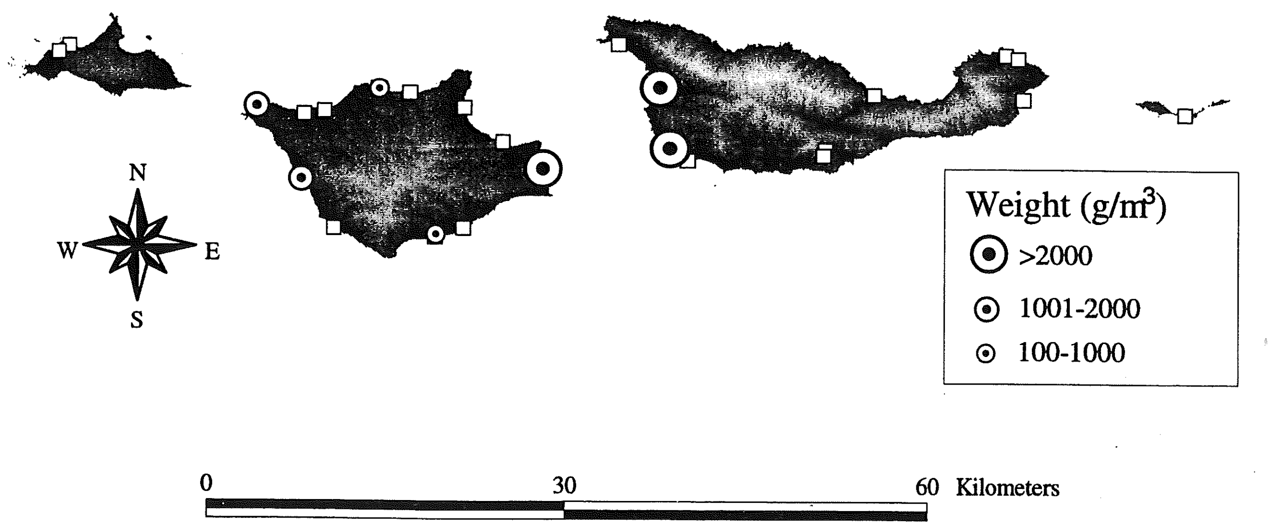

Figure 9.2b Distribution and intensity of *Olivella* bead manufacturing at sites on the Northern Channel Islands, AD 650-1300. White squares are locations where bead-making detritus was found associated with trapezoidal microblades.

increased at some locations between AD 650 and 1300, at least compared to the rest of the Holocene (table 9.3, figure 9.2b). We calculated *Olivella* bead detritus densities for all the ^{14}C dated column samples on Santa Rosa and San Miguel Islands (Kennett 1998; Walker and Snethkamp 1984). Little evidence for bead manufacturing exists in levels dating to the Middle Holocene, although finished beads found at sites and in burial lots show beads were being produced (C. King 1990). Trace amounts of *Olivella* bead detritus were found in column samples dating between 1050 BC and AD 650. A slight increase is evident between AD 650 and 1150, followed by a dramatic increase in production after AD 1150. The highest densities of *Olivella* detritus between AD 650 and 1300 are at sites on western Santa Cruz (Arnold and Munns 1994). This production increase may be more pronounced when additional levels dating to this interval are examined from eastern Santa Rosa and western Santa Cruz.

The slight increase in bead manufacturing between AD 650 and 1150 is contemporary with the first evidence for microblade production on eastern Santa Cruz Island (Arnold

Table 9.2 Faunal data (fish and shellfish) from radiocarbon dated column samples from Santa Rosa and San Miguel islands

				FISH			SHELLFISH			
NO.	SITE #	PROVENIENCE	AGE (1 σ)	WEIGHT	MEAT	%	WEIGHT	MEAT	%	REFERENCE
1	CA-SRI-31	Unit 2, 10-25	1250(1110)970 BC	57.10	1582	77.82	1358	450.90	22.18	Kennett (1998)
2	CA-SMI-525	Prof. D, Strat. 27, 227-235cm	1190(1060)960 BC	47.00	1301.90	86.59	607.30	201.62	13.41	Walker and Snethkamp (1984)
3	CA-SMI-504	Prof. N, Strat. 12, 200-230cm	1090(980)900 BC	0.00	0.00	0.00	55.30	18.36	100.00	Walker and Snethkamp (1984)
4	CA-SRI-19	Unit 1, 10-20cm	1010(920)840 BC	6.23	172.57	54.82	428.41	142.23	45.18	Kennett (1998)
5	CA-SMI-488	Profile N, Strat. 4, 45-60cm	760(690)510 BC	37.00	1024.90	93.57	212.00	70.38	6.43	Walker and Snethkamp (1984)
6	CA-SMI-503	Profile N, Strat. 8, 30-52cm	730(540)420 BC	125	3462.25	96.65	361.70	120.08	3.35	Walker and Snethkamp (1984)
7	CA-SRI-62	Unit 1, 40-50cm	720(530)410 BC	8.20	227.14	43.88	875.10	290.53	56.12	Kennett (1998)
8	CA-SRI-41	Unit 1, 20-30cm	340(200)130 BC	69.46	1924.04	81.3454	1329.3	441.23	18.65	Kennett (1998)
9	CA-SRI-62	Unit 1, 20-30cm	200(110)10 BC	7.50	181.50	41.21	779.99	258.96	58.79	Kennett (1998)
10	CA-SRI-96	Unit 1, 0-10cm	AD 120(190)260	80.90	2240.93	90.78	685.94	227.73	9.22	Kennett (1998)
11	CA-SRI-432	Unit 1, 0-10cm	AD 250(360)450	13.20	365.64	62.06	673.23	223.51	37.94	Kennett (1998)
12	CA-SRI-31	Unit 1, 28-40cm	AD 540(610)670	65.96	1827.09	74.99	1835.02	609.22	25.01	Kennett (1998)
13	CA-SMI-492	Prof. N, Strat. 9, 48-64cm	AD 590(670)700	300.00	8310.00	94.89	1349.30	447.97	5.1150	Walker and Snethkamp (1984)
14	CA-SRI-31	Unit 1, 12-20cm	AD 640(690)790	27.72	755.92	69.55	996.98	331.00	30.45	Kennett (1998)
15	CA-SRI-130	Unit 1, 7-20cm	AD 640(690)770	11.60	321.32	36.59	1677.60	556.96	63.41	Kennett (1998)
16	CA-SRI-130	Unit 1, 40-44cm	AD 680(730)810	6.25	173.12	76.70	158.45	52.60	23.30	Kennett (1998)
17	CA-SMI-525	Prof. D, Strat. 9, 70-79cm	AD 680(730)820	196	5429.20	97.68	389.80	129.11	2.32	Walker and Snethkamp (1984)
18	CA-SRI-41	Unit 1, 0-10cm	AD 690(760)820	18.79	520.48	60.65	1017.20	337.71	39.35	Kennett (1998)
19	CA-SMI-510	Prof. N, Strat. 6, 89-97cm	AD 700(770)850	38.00	1052.60	66.49	1598.00	530.54	33.51	Walker and Snethkamp (1984)
20	CA-SRI-15	Unit 1, 126-135cm	AD 780(890)1000	21.23	588.07	87.84	245.28	81.43	12.16	Kennett (1998)
21	CA-SRI-15	Unit 1, 117-126cm	AD 880(970)1030	74.40	2061.40	94.89	333.97	110.90	5.11	Kennett (1998)
22	CA-SRI-15	Unit 1, 80-95cm	AD 880(970)1030	124.00	3443.50	90.19	1127.60	374.40	9.81	Kennett (1998)
23	CA-SRI-15	Unit 1, 65-75cm	AD 880(970)1030	165.10	4573.27	89.66	1588.61	527.41	10.34	Kennett (1998)
24	CA-SRI-15	Unit 1, 19-30cm	AD 1140(1230)1270	80.70	2234.70	94.33	404.51	134.30	5.67	Kennett (1998)
25	CA-SRI-97	Unit 1, 60-70cm	AD 1200(1250)1300	78.40	2172.30	90.10	718.90	238.70	9.90	Kennett (1998)
26	CA-SRI-97	Unit 1, 40-50cm	AD 1200(1230)1290	88.60	2454.20	92.15	629.80	209.10	7.85	Kennett (1998)
27	CA-SRI-15	Unit 1, 0-10cm	AD 1190(1280)1320	75.86	2101.32	81.45	1414.17	478.47	18.55	Kennett (1998)
28	CA-SRI-85	Unit 1, 70-80cm	AD 1300(1330)1410	115.92	3210.98	88.55	1250.91	415.30	11.45	Kennett (1998)
29	CA-SRI-15	Unit 2, 40-50cm	AD 1300(1340)1410	81.80	2265.00	99.29	509.00	16.29	0.71	Kennett (1998)
30	CA-SMI-525	Prof. D, Strat. 3, 30-37cm	AD 1340(1410)1450	31.00	858.70	66.49	1303.30	432.69	33.51	Walker and Snethkamp (1984)
31	CA-SMI-485	Prof. S, 10-20cm	AD 1380(1440)1490	103.00	2853.10	93.20	626.60	208.03	6.80	Walker and Snethkamp (1984)
32	CA-SRI-15	Unit 2, 20-29cm	AD 1410(1450)1480	79.20	2194.00	99.01	682.90	21.85	0.99	Kennett (1998)
33	CA-SMI-602	Unit 5, 40-50cm	AD 1430(1460)1510	137.29	3802.93	94.50	667.18	221.50	5.50	Jones et al. (1998)
34	CA-SMI-602	Unit 5, 0-10cm	AD 1420(1460)1510	57.87	1603.00	96.71	164.12	54.49	3.29	Jones et al. (1998)
35	CA-SRI-85	Unit 1, 0-10cm	AD 1450(1490)1540	40.84	1131.27	86.08	551.20	183.00	13.92	Kennett (1998)
36	CA-SMI-602	Unit 2, Strat. B	AD 1560(1660)1690	16.73	463.42	89.53	163.20	54.18	10.47	Jones et al. (1998)
37	CA-SRI-60	Unit 1, 40-50cm	AD 1660(1690)1800	35.37	979.75	64.02	1658.22	550.53	35.98	Kennett (1998)
38	CA-SRI-40	Unit 1, 60-70cm	AD 1660(1690)1800	347.81	9634.34	90.35	3099.41	1029.00	9.65	Kennett (1998)
39	CA-SRI-97	Unit 1, 10-26cm	AD 1680(1710)1850	414.40	11478.00	98.22	626.18	207.89	1.78	Kennett (1998)
40	CA-SMI-602	Unit 2, Strat. A	AD 1710(1840)1950	43.82	1213.81	95.21	183.97	61.08	4.79	Jones et al. (1998)

See Kennett (1998) for meat weight multipliers.

Table 9.3 *Olivella* bead manufacturing densities in radiocarbon dated (1 σ) column samples from the Northern Channel Islands

#	SITE #	PROVENIENCE	AGE RANGE	OLIVELLA DETRITUS (G/M³)	REFERENCE
1	SRI-31	Unit 2, 10-25	1250(1110)970 BC	0	Kennett (1998)
2	SRI-19	Unit 1, 10-20cm	1010(920)840 BC	194	Kennett (1998)
3	SMI-488	Profile N, 0-10 cm	760(700)510 BC	275	Walker and Snethkamp (1984)
4	SRI-62	Unit 1, 40-50cm	720(530)410 BC	54	Kennett (1998)
5	SMI-503	Profile N, 0-35 cm	730(550)430 BC	375	Walker and Snethkamp (1984)
6	SRI-41	Unit 1, 20-30cm	340(200)130 BC	368	Kennett (1998)
7	SRI-62	Unit 1, 20-30cm	200(110)10 BC	454	Kennett (1998)
8	SRI-96	Unit 1, 0-10cm	AD 120(190)260	373	Kennett (1998)
9	SCrI-474	Unit 1S,11W, 70-75cm	(M2) AD 160-660	572	Arnold and Munns (1994)
10	SCrI-474	Unit 1S, 11W, 55-60cm	(M3) AD 660-980	1970	Arnold and Munns (1994)
11	SRI-31	Unit 1, 28-40cm	AD 540(610)670	507	Kennett (1998)
12	SRI-130	Unit 1, 7-20cm	AD 640(690)770	148	Kennett (1998)
13	SRI-130	Unit 1, 40-44cm	AD 680(730)810	417	Kennett (1998)
14	SRI-41	Unit 1, 0-10cm	AD 690(760)820	432	Kennett (1998)
15	SCrI-191	Unit 35S, 3W, 75-80	(M4) AD 980-1170	778	Arnold and Munns (1994)
16	SRI-31	Unit 1, 12-20cm	AD 640(690)790	1068	Kennett (1998)
17	SRI-15	Unit 1, 0-10cm	AD 1190(1280)1320	1402	Kennett (1998)
18	SCrI-474	Unit 1S, 11W, 10-15cm	(MLT) AD 1150-1300	6176	Arnold and Munns (1994)
19	SCrI-474	Unit 1S, 11W, 35-40cm	(MLT) AD 1150-1300	6176	Arnold and Munns (1994)
20	SCrI-191	Unit 35S, 3W	(MLT) AD 1150-1300	3000	Arnold and Munns (1994)
21	SRI-85	Unit 1, 70-80cm	AD 1300(1330)1410	6907	Kennett (1998)
22	SCrI-330	Unit 3S, 28W, 105-110cm	(L) AD 1300-1750	8428	Arnold and Munns (1994)
23	SCrI-191	Unit 35S, 3W, 35-40cm	(L) AD 1300-1750	11836	Arnold and Munns (1994)
24	SCrI-330	Unit 3S, 28W, 65-70cm	(L) AD 1300-1750	23036	Arnold and Munns (1994)
25	SCrI-330	Unit 3S, 28W, 40-45cm	(L) AD 1300-1750	13702	Arnold and Munns (1994)
26	SCrI-192	Unit 2N, 23E, 65-70	(L) AD 1300-1750	15794	Arnold and Munns (1994)
27	SCrI-192	Unit 2N, 23E, 40-45cm	(L) AD 1300-1750	14942	Arnold and Munns (1994)
28	SMI-485	Profile S, 0-40cm	AD 1380(1440)1490	5100	Walker and Snethkamp (1984)
29	SMI-602	Unit 5, 40-50cm	AD 1430(1460)1510	3576	Walker and Snethkamp (1984)
30	SMI-602	Unit 5, 0-10cm	AD 1420(1460)1510	3741	Walker and Snethkamp (1984)
31	SRI-85	Unit 1, 0-10cm	AD 1450(1490)1540	44118	Kennett (1998)
32	SMI-602	Unit 2, Strat. B	AD 1560(1660)1690	10425	Walker and Snethkamp (1984)
33	SRI-60	Unit 1, 40-50cm	AD 1660(1690)1800	33088	Kennett (1998)
34	SRI-40	Unit 1, 60-70cm	AD 1660(1690)1800	1701	Kennett (1998)
35	SRI-97	Unit 1, 10-26cm	AD 1680(1710)1850	48700	Kennett (1998)
36	SMI-602	Unit 2, Strat. A	AD 1710(1840)1950	11875	Walker and Snethkamp (1984)

1987, 1990b; Kennett 1998). On the northern Channel Islands, microblades were fashioned into drills for perforating shell beads, an integral part of the industry. Three types of microblades were produced on the islands: trapezoidal, triangular without retouch, and triangular with retouch (figure 9.3). Trapezoidal microblades were dominant between about AD 900 and 1150, while triangular microblades with retouch dominated after AD 1150 (Arnold 1987, 1990b). Triangular microblades without retouch are associated with assemblages dominated by both of these forms and appear to be temporally undiagnostic (Arnold 1987).

Microblade production always appears to have been focused on the east end of Santa Cruz Island, where quality chert outcrops and subsurface chert beds occur naturally (Arnold 1987; Kennett 1998). Smaller concentrations of chert are present elsewhere on the islands, and there is some evidence that these sources were used to produce microblades during this period (Erlandson et al. 1997). It is unlikely, however, that production on other parts of the northern Channel Islands ever reached the scale visible on eastern Santa Cruz Island. Microblade cores are rare at archaeological sites on Santa Rosa and San Miguel, but trapezoidal microblades and drills are common at coastal village sites on these islands, and triangular forms are dominant after AD 1300 (Kennett 1998). Microblades and drills are always associated with *Olivella* bead manufacturing detritus.

Mortar and pestle production has been documented at 16 sites on San Miguel Island (Conlee 2000; Rozaire 1993; Walker and Snethkamp 1984). Radiocarbon dates on levels with small amounts of manufacturing debris suggest that the industry extends back to at least 550 BC but was limited until about AD 650 (Conlee 2000). Based on the density of manufacturing debris, mortar and pestle production appears to have been most intense on San Miguel Island between about

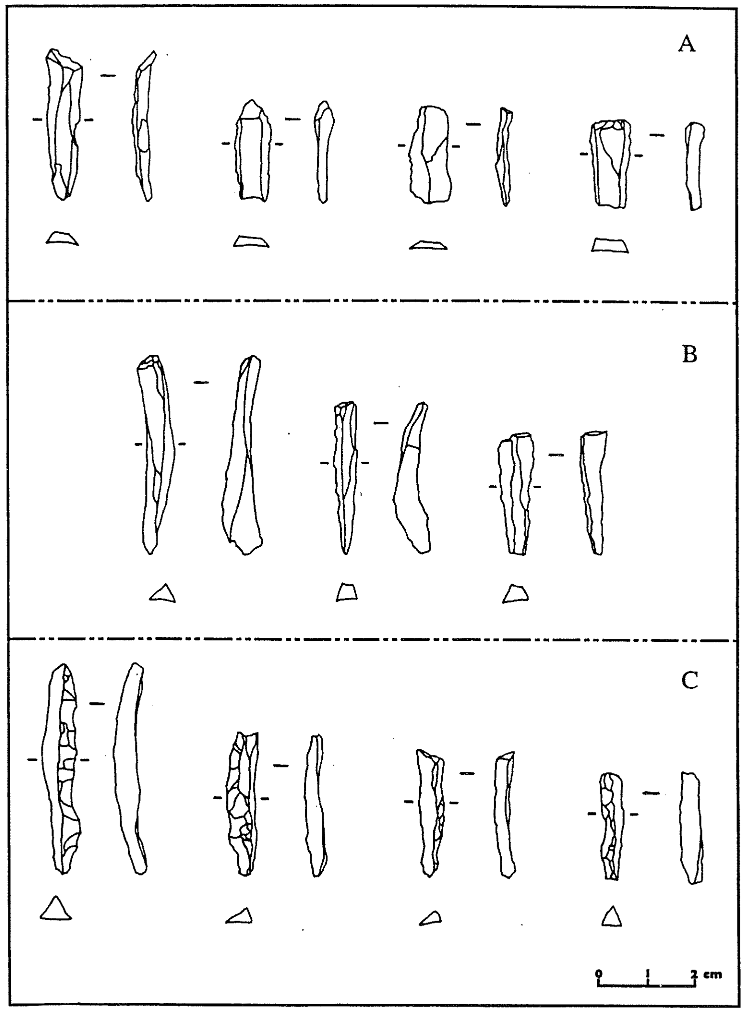

Figure 9.3 Three microblade types manufactured and used on the Northern Channel Islands in the Late Holocene: (A) trapezoidal, used primarily from AD 900 to 1150; (B) triangular without retouch, produced between AD 900 and 1750; and (C) prepared triangular microblades (note retouch) made between AD 1300 and 1750. *Drawings by J. Toohey, layout by C. Kantner*

AD 650 and 950, continuing after this time at a much lower level.

Ground stone quarrying and production activities were centered at SMI-503 and SMI-504, adjacent sites on the northwest coast of San Miguel Island. These sites are located directly above an Eocene conglomerate formation exposed in the sea cliff (Bremner 1932; Weaver and Doerner 1969). Spherical boulders of volcanic porphyry from this formation, graded from gray to red, provided the raw material for mortar and pestle manufacturing. Chipping waste litters the surface of these sites, along with mortars and pestles in all stages of production (Walker and Snethkamp 1984). The upper stratum at SMI-504 dates between about AD 700 and 950 and contains the highest densities of manufacturing debris relative to earlier and later strata (Conlee 2000). Habitation debris at these locations suggests at least temporary occupation during mining and quarrying activities. Levels at four other sites in the vicinity of SMI-503 also have high concentrations of chipping debris that date to this same interval. The intense production of ground stone on San Miguel Island is somewhat paradoxical given the current lack of oak trees and other plant foods. Mortars and pestles in the Santa Barbara Channel area were used primarily to grind acorns (Glassow 1980). Other California groups used them to process rodents, fish, insects, and large mammals, but on San Miguel Island they were probably manufactured to process plant foods (Conlee 2000). Although plant foods were probably more plentiful than today, it seems likely that mortars and pestles were being manufactured for export or that acorns (or other plant foods) were being imported to the islands. Regardless, increased production of ground stone represents an increase in intervillage exchange and integration among groups in the region.

SUMMARY AND DISCUSSION

Major changes in settlement, subsistence, and socioeconomic organization are evident in the Late Holocene archaeological record for Santa Rosa and San Miguel Islands. Although a great deal of local variability is evident, the dominant settlement and subsistence strategies employed by islanders changed after 1050 BC. The primary coastal settlements occupied during the Middle Holocene continued to be used into the Late Holocene. Many Middle Holocene cemeteries also have burial lots that date between 1050 BC and AD 650, suggesting a certain degree of continuity with Middle Holocene settlement practices. Other residential bases were established, however, in association with more diverse coastal habitats and secondary drainages. The most economically valuable species of shellfish (mussel and abalone) are smaller in deposits dating after 1050 BC, and shellfish assemblages in general are more diverse compared to the Middle Holocene. Fish bone is slightly more common in midden deposits between 1050 BC and AD 650, but formal tools are rare, and it is likely that these types of sites are underrepresented archaeologically.

The apparent absence of substantial residential middens in the interior of the islands after 1050 BC suggests a shift in focus towards marine resources (shellfish and fish). Globular mortars found at some interior locations provide evidence that plant resources were being collected logistically from coastal residences. Geographic positioning, combined with midden constituent data, indicates that shellfish exploitation remained a prominent activity. However, fishing became more important at certain locations during the Late Holocene, and more sophisticated fishing technology was developed regionally.

Changes in subsistence and settlement on Santa Rosa and San Miguel Islands between 1050 BC and AD 650 did not occur abruptly. Larger numbers of residential bases on the coast suggest that population levels on the islands increased compared to the Middle Holocene. The absence of substantial interior middens indicates that people became more tethered to coastal locations. No domestic features are evident at coastal locations, suggesting a certain degree of residential mobility. Shellfish harvesting profiles suggest that people occupied a series of coastal villages in different locations throughout the year, probably within a more restricted range than previously (Kennett 1998). A decrease in mussel and abalone size and an increase in shellfish diversity indicate that people were working harder for less, while others used alternative strategies, such as intensified fishing, to supplement their diets. Changes in intertidal resources were probably related to a combination of unfavorable marine conditions and population-dependent increases in human predation.

More sedentary village communities appear to have emerged on the northern Channel Islands between AD 650 and 1150. These villages were distributed evenly around the coastlines of the islands, many associated with perennial streams and relatively long sections of beach. Village locations varied greatly but tended to be atop sea cliffs or at headlands. Domestic features, particularly faint house depressions and berms, are evident at many of these villages. The extent and depth of these middens, coupled with the presence of domestic features and diverse faunal and artifact assemblages, suggest that these communities were relatively stable. Faunal and artifact assemblages are more diverse compared with earlier sites, and fish remains increased exponentially at many of these locations. Shellfish harvesting profiles are also comparable to contact period deposits, suggesting a certain degree of settlement stability (Kennett 1998). The shift towards more sedentary living did not occur abruptly, nor does the timing appear to be the same on all the islands. Rather, more stable settlements became predominant on the outer islands after AD 650.

Arnold (1991a) suggested that beaches were critical for landing plank canoes, the primary watercraft used in the Santa Barbara Channel region after AD 500 (Arnold 1995a; Davenport, Timbrook, and Johnson 1993). This view is interesting given the exponential increase in fish bone at coastal villages dating to this period and the clear and temporally consistent dietary importance of fish. New paleoclimatic data for the region suggest that exponential increases in fishing occurred during an interval when marine productivity was relatively high and terrestrial productivity was generally low (Kennett 1998; Kennett and Kennett 2000). Therefore, intense use of marine resources may be related, at least in part, to decreasing productivity of the terrestrial environment.

The close proximity of settlements to sandy beaches may also be related to acquiring the *Olivella* shells found in these habitats. Bead manufacturing intensified at certain locations on eastern Santa Rosa and western Santa Cruz Islands after AD 650, about the same time that the production of trapezoidal microblades became more visible on the east end of Santa Cruz Island and mortar and pestle manufacturing intensified on San Miguel Island (Arnold 1987; Conlee 2000; Kennett 1998; Walker and Snethkamp 1984). Increased production of nonfood trade items after AD 650 suggests that people began to establish more exchange relationships with inhabitants of other island and mainland villages. Trapezoidal microblades and drills from sources on eastern Santa Cruz Island are found at villages on western Santa Cruz and Santa Rosa (Arnold 1987; Kennett 1998). Increased production of mortars and pestles suggests these items were being exported, that plant foods were being imported, or both (Conlee 2000). This production level constitutes more evidence that exchange relationships among individuals were becoming more important during this interval and possibly reflects increased integration among communities and greater sociopolitical complexity.

The emergence of more sedentary villages, intensified fishing, and increased production of nonfood trade items coincides with increases in territoriality. Greater territorial behavior is suggested by the even distribution of coastal villages around Santa Rosa and San Miguel after AD 650 and the lack of intervisibility between these communities (Kennett 1998). This situation is similar to the historically known settlement distribution; indeed, some of these locations were occupied continuously until the Historic period. The strategic position of these communities afforded commanding views along the coast and out to sea.

Settled village living, intensive fishing, and production of nonfood trade items that emerged between AD 650 and 1150 became dominant strategies on the northern Channel Islands after AD 1300. Following severe settlement disruption between about AD 1150 and 1300. Arnold (1992a) first documented such a disruption on Santa Cruz Island and referred to this interval as the Transitional period. Many sites on the island appear to have been abandoned during this period (Arnold 1991a). A similar pattern is evident on San Miguel and Santa Rosa Islands (Erlandson, Kennett, and Walker 1997; Kennett 1998). Based on Pisias's (1978, 1979) sea temperature curve, Arnold (1991a; Arnold and Tissot 1993), Colten (1993, 1995), Pletka (1996), and others have argued that unusually high sea surface temperatures (some exceeding 24°C) damaged the kelp beds surrounding the northern Channel Islands during this interval. Evidence of warm sea surface temperatures is supported by growth patterns in black abalone collected from sites dating to this interval (Arnold and Tissot 1993). Arnold (1991a, 1992a) argued that reduced marine productivity and coeval droughts resulted in subsistence stress and partial abandonment of some sites for a short time during the Transitional period. A new marine climate sequence suggests, however, that marine conditions were cold, not warm, and marine productivity was quite high. This premise is supported by oxygen isotopic measurements on mussel shells from ^{14}C dated archaeological levels on Santa Rosa Island (Kennett 1998). More work is needed to determine why these new data do not correspond with the black abalone data from Santa Cruz Island, but we suspect chronological inconsistencies between the two records may be responsible.

We argue here that settlement disruption during this interval is better explained by a series of severe droughts registered in paleoclimatic records across California (Jones and Kennett 1999; Kennett and Kennett 2000; Larson and Michaelson 1989; Raab and Larson 1997; Stine 1994). On the islands, the best sequences spanning this interval are associated with large watersheds that provide perennial water supplies even during extended droughts. Radiocarbon dated archaeological levels from Santa Rosa Island that fall within this period also have high densities of fish remains, and shellfish assemblages indicate that marine productivity was relatively high. Based on the available data, we propose that people living in well-watered areas had a competitive advantage over people who did not. These people began to intensively fish to compensate for shortfalls in terrestrial resources associated with drought conditions. It is likely that individuals developed new strategies for obtaining carbohydrate-rich plant foods, including the establishment of more exchange relationships with people from mainland villages. People living at poorly watered locations probably used a variety of strategies to deal with their predicament. Some undoubtedly chose to eke out a living at marginal locations, suffering the health and reproductive consequences of their decision. Others probably sought refuge with relatives living in villages near well-watered locations elsewhere in the Santa Barbara Channel region.

A cultural resurgence occurred on the northern Channel Islands after drought conditions ameliorated around AD 1300. People reestablished settlements occupied prior to AD 1150, and new villages appeared. Large house depressions are evident at virtually all of these villages, and faunal assemblages are extremely diverse. Bead manufacturing exploded, particularly at settlements on western Santa Cruz and eastern Santa Rosa Islands (Arnold 1991a; Kennett 1998). Subsurface mining for chert on eastern Santa Cruz intensified as the demand for microblades and drills increased (Kennett 1998). Exchange relationships with mainland villagers were also well established (C. King 1990), and the plank canoe provided the primary mode of transportation across the channel (Arnold 1995a).

Most island settlements established after AD 1300 appear to have been occupied well into the Mission period. Similar to settlements dating between AD 650 and 1150, villages were evenly spaced around San Miguel and Santa Rosa Islands. More villages were occupied between AD 1300 and 1750 than are documented ethnohistorically, however, suggesting that protohistoric disease may have affected islanders before the Mission period (Erlandson and Bartoy 1995, Erlandson, Kennett, and Walker 1997). After Spanish colonization of the mainland in the late 1700s, many people left the islands because populations had been decimated by disease, their exchange networks had collapsed, and climatic instabilities during the early 19th century had taken their toll (J. Johnson 1982b; Larson et al. 1994).

All the behavioral strategies that dominated the northern Channel Islands after AD 1300—sedentism, intensive fishing, and intensive production of nonfood items—have earlier incipient origins, between AD 650 and 1150 (or earlier). A variety of long-and short-term processes are undoubtedly responsible for the emergence of these behavioral strategies. There is evidence of gradual population growth, expanded diet breadth, and intensified fishing (Kennett 1998). Settlement mobility decreased as many of available stretches of coast were increasingly occupied. The interval when sedentary villages were established, fishing intensified, and the production of nonfood trade items increased was one of great climatic and social instability. Osteological data suggest that these developments occurred as diseases spread to island populations, when health problems were on the rise, and as lethal violence increased exponentially (Lambert 1994, 1997; Lambert and Walker 1991; Walker 1989a, 1989b). Gradual decreases in health and stature and increases in violence prior to this time are probably best explained by population-dependent demands on resources, but the sudden increase between AD 650 and 1150 requires an alternative explanation, as do the interrelated behavioral responses.

Marine conditions now appear to have been generally cool and unstable between AD 450 and 1350. Even with highly variable conditions during this interval it is unlikely that decreased marine productivity caused subsistence stress. Cool and unstable marine conditions could have had a tremendous impact on regional rainfall patterns, because it appears that cool water conditions correlate well with relatively dry conditions. On the islands water is one of the most limited resources. Plant resources are also limited, and decreased rainfall may have significantly affected their productivity. Competition for terrestrial resources, particularly access to perennial water, could account for reduced mobility and increased violence. Because one of the wettest intervals in the last 1500 years appears to have occurred between AD 800 and 1000, alternative hypotheses should be considered, however.

Violence increased after AD 650 when the bow and arrow was becoming the weapon of choice on the northern Channel Islands (Lambert 1994). The bow and arrow spread rapidly across North American between AD 150 and 600 due to intergroup contact, conflict, and competition (Blitz 1988). Its introduction into California after about AD 500 is suggested by the replacement of large atlatl dart points with small arrow points and the simultaneous appearance of arrow shaft straighteners (Moratto 1984). In the Santa Barbara Channel area, the bow and arrow is marked by the appearance of small leaf-shaped projectile points between AD 500 and 800 (Glassow 1996c). The introduction of this technology parallels exponential increases in violence regionally, although many of the projectile point wounds between AD 500 and 800 appear to have resulted from atlatl darts or spear points (Lambert 1994, 1997), an expected pattern when new technology is introduced into a region. The bow and arrow was in full use by AD 800 (Lambert 1994).

The bow and arrow was introduced into the Santa Barbara Channel region when terrestrial conditions appear to have been generally poor. This introduction was a phenomenon that undoubtedly opened new possibilities for resource exploitation and territorial expansion. Extremely accurate within a 20 m range, this technology would have provided greater hunting efficiency than the atlatl (Blitz 1988). The flatter trajectory and higher velocity, coupled with the ability to shoot projectiles at a faster rate, would have significantly altered individual and group interaction, particularly during times of local resource stress or competition for limited resources.

Greater chronological precision is needed in both paleoclimatic and archaeological records to assess why people on the northern Channel Islands became more violent after AD 650 and more information is needed regarding the introduction of the bow and arrow and its effect on local politics. Alternative proxies of terrestrial climatic conditions are also needed to extend the paleoclimatic record back in time. In addition, Lambert's (1994) chronology is based on C. King's (1990) seriation of burial lots and is tied to a limited number of ^{14}C dates. Each burial (or clearly associated objects) needs to be ^{14}C dated directly to compare the timing and nature of health problems and violence with the new climatic reconstructions becoming available for the region.

Our current working hypothesis is that the climatic instability and resource stress associated with persistent drought stimulated greater conflict and competition for access to perennial water sources on the islands starting about AD 500. This situation promoted greater sedentism near perennial water sources and territorial behavior. Violent interaction and competition were exacerbated by the introduction of the bow and arrow between AD 500 and 800. Competition for resources continued between AD 650 and 800, even when both marine and terrestrial conditions were favorable. Favorable water availability undoubtedly promoted population increases at certain locations and the establishment of sedentary villages in more marginal locations. More intensive fishing, production of non-food trade items, and increased trade emerged in this context as new behavioral strategies to deal with subsistence problems associated with decreased mobility. Decreased settlement mobility and territorial behavior would have exacerbated resource stress for some groups of people when perturbations in the terrestrial environment occurred between AD 1150 and 1300, a problem dealt with previously in the Holocene by periodic movement. Drought conditions served to fix, in an evolutionary sense, certain behavioral strategies—sedentism, intensive fishing, exchange, and the production of trade items—some of the hallmarks of island Chumash society after AD 1300.

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Notes

1. Hole 893a (Ocean Drilling Project) is plotted relative to the northern Channel Islands and the mainland coast. The core provides the newest marine paleoclimatic data for the region (Kennett 1998; Kennett and Kennett 2000).

CHAPTER 10

Late Holocene Cultural Developments Along the Santa Barbara Coast

Jon M. Erlandson and Torben C. Rick

The maritime Chumash, who occupied the Santa Barbara Channel area of the Southern California Coast, were among the most populous and sophisticated of California's Indian tribes. The Chumash impressed Spanish explorers with their elaborate technology, extensive trade networks, craft guilds, seafaring abilities, and artistry. The elaborate nature of Chumash society is well illustrated by Hudson and Blackburn's (1982, 1983, 1985, 1986, 1987) monumental summary of Chumash material culture, which fills five volumes and roughly 2000 pages. Since the Spanish first settled Alta California 230 years ago, the richness and diversity of Chumash culture has captivated antiquarians and art collectors, historians, ethnographers, archaeologists, and others. For decades, archaeologists have strived to understand how, when, and why this complex culture developed.

Within Chumash territory, extending from Malibu to Morro Bay along the coast and inland to the Cuyama River Valley and Castaic areas (figure 10.1), the highest population densities were found among the maritime Chumash of the mainland coast (Brown 1967; Glassow and Wilcoxon 1988; Grant 1978a:506, 1978b). Along the Santa Barbara Coast, extending for roughly 100 km (60 miles) from Point Conception to Rincon Point and from the nearshore waters of the Santa Barbara Channel to the southern slopes of the Santa Ynez Mountains, the Chumash lived in numerous villages and towns (some with as many as 800 to 1000 residents) clustered around several large estuaries. With a central role in regional exchange and interaction networks (C. King 1971), it can be argued that the Santa Barbara Coast was the demographic, political, and economic center of the Chumash world.

Since the late 1800s, the Santa Barbara Channel area has played a key role in the archaeology of California. D. Rogers' (1929) culture history of the Santa Barbara Coast laid a foundation upon which many broader and still widely used regional chronologies are based (e.g., Wallace 1955; Warren 1968). In recent years, however, much of the progress made in understanding the evolution of Chumash society has come from work on the northern Channel Islands, where the Chumash had relatively limited access to terrestrial resources, population densities were lower, and cultural developments may have taken a somewhat unique trajectory.

In this chapter, we examine the development of Chumash culture along the Santa Barbara Coast during the Late Holocene, from about 3500 years ago to the time of European contact. We discuss a series of key sites that span this time period, along with evidence for changes in technology, subsistence, demography, social organization, and other aspects of Chumash society. We also examine the fundamental processes that stimulated the maritime Chumash to develop complex economic, social, and political mechanisms for survival. In most discussions of Chumash cultural evolution, the development of maritime adaptations, intensive fishing, and cultural complexity are inextricably linked, a linkage we reexamine here.

ENVIRONMENTAL SETTING

Modern Setting

Unlike most of the California Coast, which faces west and is fully exposed to the weather and storm tracks of the North Pacific, the Santa Barbara Coast faces south towards the more protected and productive waters of the Santa Barbara Channel. To the north, the Santa Ynez Mountains rise rapidly from the sea, creating a variety of closely spaced terrestrial habitats. To the south, the northern Channel Islands further shelter the Santa Barbara Channel. Although this geography "circumscribes" the Santa Barbara Coast, framing a relatively

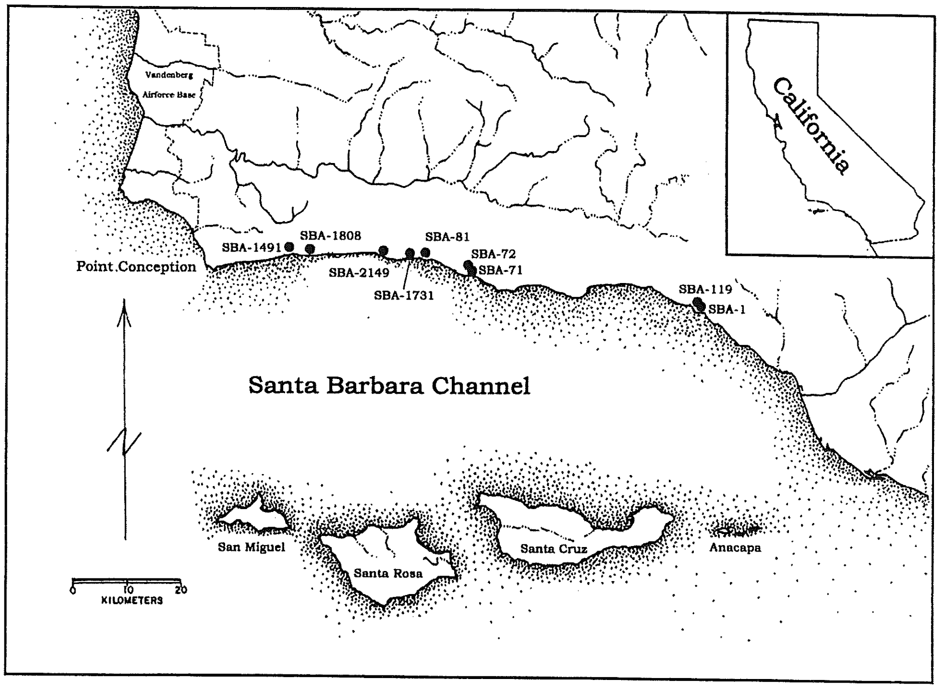

Figure 10.1 The Santa Barbara Channel and location of key sites discussed in text

narrow stretch of land between the mountains and the sea, a diversity of marine and terrestrial habitats provided a wealth of resources that nurtured the Chumash people for millennia. Local variation in resource availability also encouraged commerce between social groups desiring to diversify their economies, even out inequities in resource distributions, build wealth and obtain exotic goods, or establish reciprocal and cooperative relations.

The Santa Barbara Coast has a Mediterranean climate with cool, wet winters and warm, dry summers. Local climate is ameliorated by the cool waters of the Pacific and by the barrier the Santa Ynez Mountains pose to the more extreme temperatures of the interior. Annual rainfall averages about 45 cm at sea level and about 75 cm at the crest of the mountains, which rise steeply to maximum elevations of over 1000 m. The long dry season limits access to fresh water, and the area is susceptible to more severe drought cycles. Between Point Conception and Rincon Point, a relatively narrow coastal plain is dissected by scores of canyons in which small streams flow southward from the coastal foothills into the sea.

Much of the eastern Santa Barbara Coast, from Goleta to Rincon Point, is characterized by a relatively broad coastal plain (approximately 2 to 5 km wide) and extensive riparian and woodland habitats that rise gradually into the coastal foothills and Santa Ynez Mountains. Many coastal canyons have relatively large catchments and permanent water sources. The relatively wide coastal plain and larger canyons provided extensive habitat for hunting deer and other land mammals, or for collecting acorns, seeds, and other plant foods. Prior to historic sedimentation and filling of wetlands, this stretch of coast was broken by four substantial estuaries: Goleta Slough, El Estero, Las Salinas, and Carpinteria Slough. These estuaries supported a diverse array of medium and large land mammals, sea mammals, fish, shellfish, birds, and plant foods. Outer coast habitats include a mosaic of sandy and rocky intertidal and subtidal habitats, extensive nearshore kelp beds, and pelagic zones with a diversity of shellfish, fish, sea mammals, and seabirds. Overall, the diversity and productivity of terrestrial and aquatic food resources were probably unsurpassed along the eastern Santa Barbara Coast, where population densities were among the highest recorded in aboriginal California. West of the Goleta Valley, the coastal plain is generally narrower (0 to 2 km wide), and the foothills rise more rapidly to the higher slopes of the Santa Ynez Mountains. This scenario results in relatively small drainages, and many coastal streams flow intermittently, drying up or retreating underground during the dry season. This situation encouraged settlement around larger canyons with perennial streams, especially sites occupied during the summer or fall. No sizable estuaries existed in historic times along the western Santa Barbara Coast, with its steeper topography and smaller canyons.

Paleogeography

About 9000 years ago, the geography of the Santa Barbara Coast was quite different. Sea levels were probably 15 to 30 m lower than today and rising rapidly, extending the coastal plain by a kilometer or more and forming estuaries at the mouths of many coastal canyons (Erlandson 1994). During the Early Holocene, many of the stream terraces that today support oak woodlands and other productive terrestrial habitats probably did not exist or were much less stable landforms. In the Middle Holocene, sea level rise slowed dramatically and essentially stabilized (Inman 1983:9). As a result, the estuaries of the Santa Barbara Coast filled with sediments, leading to their disappearance along the western coast (Erlandson 1997b) and the shrinking of the larger lagoons of the eastern coast (Colten 1989). Coastal erosion and slow sea level rise continued to gradually reduce the width of the coastal plain, forming high sea cliffs along much of the coast and cutting broad nearshore platforms that may have encouraged the growth of kelp beds and increased marine productivity. These trends probably continued into the Late Holocene, as the geography of the Santa Barbara Coast gradually evolved into the landscapes and seascapes occupied by the historic Chumash.

These environmental changes affected the distribution and productivity of terrestrial and marine resources, but most of the major food sources available to the Chumash probably were present throughout the Holocene. Pollen studies from the Santa Barbara area suggest that similar plant communities have been present in the area for 10,000 or more years, although their distribution and abundance have changed through time. Pollen data suggest that conditions were warmer and dryer during much of the Middle Holocene, but these general patterns were almost certainly interrupted by numerous climatic fluctuations of shorter duration (Glassow, Wilcoxon, and Erlandson 1988; Kennett and Kennett 2000). Sea surface temperatures fluctuated over the past 8000 years, for instance, and such shifts probably were linked to changes in local marine productivity and climatic patterns.

In recent years, research in the Santa Barbara Channel area has focused on Late Holocene environmental changes as important stimulants to developments in Chumash society, especially during what Arnold (1992a) defined as the Middle-to-Late period transition, between about AD 1150 and 1300. The ability of archaeologists to address such problems has rested on two fortuitous yet unrelated circumstances: (1) the recovery of cores from varved sediments in the offshore Santa Barbara Basin, which provide relatively detailed paleoecological data spanning the Late Pleistocene and Holocene (e.g., Kennett and Ingram 1995a, 1995b; Pisias 1978), and (2) the presence of numerous finely stratified and well-preserved shell middens on the Channel Islands. These two data sets encourage Santa Barbara Channel archaeologists to seek direct correlations and causal relationships between environmental fluctuations documented in the paleoecological record and cultural changes observed in the archaeological record. Until recently, such efforts focused on linking cultural changes to an 8000 year sea surface temperature curve published by Pisias (1978), with the knowledge that fluctuations in oceanic temperatures are related to the intensity of marine upwelling, marine productivity, and other environmental changes (Kennett and Kennett 2000).

New studies have raised questions about such correlations. They query key aspects of Pisias' (1978) chronology and suggest that his curve exaggerated the extent of Holocene fluctuations in Santa Barbara Channel water temperatures. Analyses of a new high-resolution core spanning the last 124,000 years (Kennett and Ingram 1995a, 1995b) are changing our notions of environmental and cultural changes in the Santa Barbara Channel area, but the current sampling interval of 25 years for most of the Late Holocene and the precision limits of radiocarbon dating still hinder correlations between environmental and archaeological records. Recent environmental data suggest that the Middle-to-Late period transition was highly variable and unstable, but not a period of uniformly low marine productivity (see D. Kennett 1998; Kennett and Kennett 2000). Consequently, most recent analyses of Chumash cultural changes during the Transitional period have shifted from changes in marine circulation to the potential for a prolonged drought (e.g., Kennett and Kennett 2000; Raab and Larson 1997; see also Jones et al. 1999). Arnold and Tissot's (1993) identification of growth anomalies in black abalone shells from Santa Cruz Island middens dated to the Transitional period suggest, however, that El Niño cycles or other warm water events may still have played a role in the important cultural changes associated with this time period.

ARCHAEOLOGY AND ETHNOHISTORY OF THE BARBAREÑO CHUMASH

Evidence for a Pleistocene occupation of the Santa Barbara Coast is limited to a single fluted point fragment (Erlandson, Cooley, and Carrico 1987), but the island sites of Daisy Cave and Arlington Springs have also produced evidence for terminal Pleistocene occupations (Erlandson et al. 1996; Johnson et al. 2000; Rick, Erlandson, and Vellanoweth 2001). Early Holocene sites are much more numerous in the area, with at least 16 mainland sites ^{14}C dated between about 7500 and 10,000 years ago (see Erlandson 1994; Erlandson and Moss 1996). Most of these sites were located around estuaries, and lagoonal shellfish dominate most faunal assemblages. Milling stones are the most conspicuous tools in most early sites, and tools associated with hunting and fishing are rare, as are the bones of fish, birds, and mammals (Erlandson 1994; Rick and Erlandson 2000a). Both artifact and faunal assemblages suggest that shellfish and seeds were the most important foods for the Early Holocene people of the mainland coast (Erlandson 1991a).

Large estuaries persisted along the eastern Santa Barbara Coast into historic times, but most smaller estuaries in the area disappeared by about 6000 to 5000 years ago. The reduction in estuarine habitat contributed to Middle

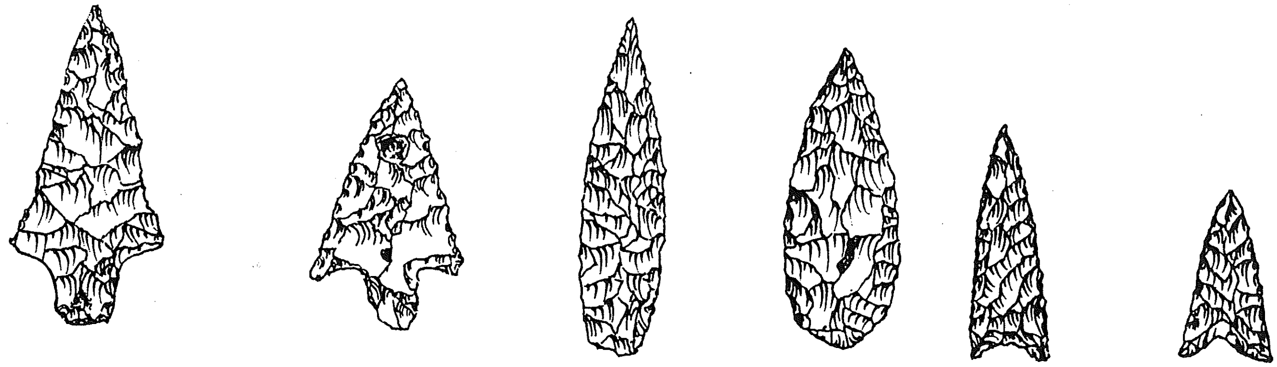

Figure 10.2 Late Holocene projectile points from the Santa Barbara Channel area. *Drawn by Deana Dartt*

Holocene shifts in settlement and subsistence, including the development of higher residential mobility along the western Santa Barbara Coast (Erlandson 1997b), an increased emphasis on outer coast shellfish and fish, and an intensification of land and sea mammal hunting (D. Rogers 1929). Between 6500 and 4000 years ago, for instance, the first mortars and pestles appear in the area, and large side-notched and contracting stem dart points become relatively common (Erlandson 1997b; Glassow 1997b). These changes suggest a broadening of subsistence related to population growth, environmental changes, and resource stress, but Erlandson (1997a) cautioned that similar and roughly contemporary technological shifts occur across much of California and that such changes may result from diffusion of ideas rather than local responses to demographic or environmental change.

Between about 4000 and 3000 years ago, an elaboration of material culture similar to aspects of classic Chumash society is evident in the Santa Barbara Channel area (Harrison 1964; Hoover 1971; Orr 1968). This elaboration is accompanied by a general trend towards larger and more numerous archaeological sites through time (C. King 1990). When Cabrillo's ships sailed into the Santa Barbara Channel in AD 1542, the first known contact between Europeans and the Chumash, dozens of Chumash towns were noted along the Santa Barbara Coast (Paez 1968). In AD 1769 when Spanish settlement of Alta California began, 5000 or more Chumash may have lived in the area (Brown 1967; Glassow and Wilcoxon 1988:39).

Along the Santa Barbara Coast, the Chumash lived in villages and towns, including capital towns where most social, political, and religious leaders resided (Gibson 1991:48; J. R. Johnson 1988). Such leaders came from the ranks of the nobility and reportedly administered the use of resource areas, the accumulation and distribution of food stores and other goods, and ceremonial feasts and regional councils, as well as organizing people for warfare and defense. Access to the nobility and leadership was governed by rules of heredity, but *wots*, or captains (male or female), reportedly were approved by the people they governed (Landberg 1965:33). Well-organized Chumash communities contained streets, rows of houses, communal work, play or dance areas, cemeteries, and sweathouses. The Chumash lived in large multifamily semisubterranean dwellings that Pedro Font (Priestley 1972) described as the finest houses the Spaniards saw during the De Anza expedition in AD 1775–76:

> The form is round, very spacious, large and high, the shape of half an orange. In the center of the top the hut has an opening for the admission of light. It also serves for a chimney, through which the smoke escapes from the fire they make in the center of the habitation. In some of these huts there are, along the sides two or three apertures, like small windows. The frameworks of all are strong poles bent towards the center of the top. The walls are of coarse, dried grass or tules, which is woven in between the poles.

The coastal Chumash also built plank boats called *tomols* that facilitated ocean fishing, maritime trade, and travel to the Channel Islands (Arnold 1995a; Hudson, Timbrook, and Rempe 1978). Chumash commerce and occupational specialization were also described by Fages in AD 1775:

> The occupations and ordinary pursuits of these people is limited; some of them follow fishing, others engage in their small carpentry jobs; some make strings of beads, others grind red, white and blue paint clays. They make variously shaped plates from the roots of the oak and the alder trees, and also mortars, crocks, and plates of black stone, all of which they cut out with flint, certainly with great skill and dexterity. They make an infinite number of arrows. The women go about their seed-sowing, bringing the wood for the use of the house, the water and other provisions. They skillfully weave trays, baskets and pitchers for various purposes.... (Priestley 1972:34-35)

Figure 10.3 Late Holocene single-piece shell fishhooks from the Santa Barbara Channel area. *Drawn by Deana Dartt*

Chumash assemblages also include a variety of artistically wrought projectile points, fishing and sea mammal hunting tackle, bowls and pestles, soapstone comals and ollas (cooking slabs and pots), ornaments, charmstones, effigies, hairpins, whistles, and many other artifacts (figures 10.2, 10.3). The elaboration of Chumash society is evident, in part, by the numbers and variety of beads and ornaments used (C. King 1990). A diverse array of ornaments was made from *Olivella*, abalone, mussel, limpet, clam, cowrie, and other shell types, as well as stone and bone. Some of these items were decorated with elaborately serrated edges, punctate designs, or shell bead inlay. Beads and ornaments were used for personal adornment, as status or ethnic markers, and as a currency used in trade (C. King 1990). In 1792, the early Spanish chronicler, Longinos Martinez, noted that:

> ...these Indians are fond of traffic and commerce. They trade frequently with those of the mountains, bringing them fish and bead-work, which they exchange for seeds and shawls of foxskin, and a kind of blanket made from the fibers of a plant which resembles cotton.... When they trade for profit, beads circulate among them as if they were money, being strung on long threads. (Simpson 1939:44-45)

The numbers of money beads, made primarily by the island Chumash from the callus portion of *Olivella biplicata* shells (C. King 1971; Arnold 1992b) increased dramatically in the archaeological record about AD 1300.

DEVELOPMENT OF LATE HOLOCENE CULTURAL COMPLEXITY

D. Rogers (1929) first developed the concept of a Canaliño culture to refer to the elaborated maritime societies that developed among the Chumash in the millennia just prior to European contact. Over the years, some California archaeologists used the term Canaliño to refer collectively to both the maritime Chumash and their southern neighbors, the coastal Gabrieliño or Tongva (see Glassow, Johnson, and Erlandson 1986; Orr 1943, 1952, 1968:101; Wallace 1955:224). No consensus developed, however, about when a recognizably Canaliño cultural pattern first appeared: Wallace (1955) placed their emergence at about 1000 years ago, Orr (1968:100-101) about 2500 to 3000 years ago, and Harrison (1964:364) about 4000 years ago. When did the elaboration of Chumash culture occur along the Santa Barbara Coast? When did key attributes of the Canaliño or Chumash way of life first appear? Finally, why did this elaboration and presumably increased cultural complexity develop among the Chumash and what were its consequences?

Ultimately, the answers to such questions depend on what constitutes "elaboration" or "complexity" and what are considered to be the key aspects of Chumash culture. Most archaeologists would probably agree that the elaboration of material culture among Southern California's coastal tribes reflects the general diversification of local economies and the development of sociopolitical complexity along the California Coast. Problems remain, however, in classifying cultural elaboration or complexity using traits that develop on continuous scales of variation. In recent years, considerable emphasis has been placed on determining when key components of a "chiefdom" level of social organization (ascribed status, craft specialization, formation of sizable towns and confederated alliances, etc.) first appeared, leading to considerable debate about the antiquity of cultural complexity among the Chumash.

Numerous scholars have identified archaeological correlates for chiefdom levels of complexity (e.g., Arnold 1996b; Carneiro 1981; Johnson and Earle 1987; Price and Brown 1985), but many of these have anthropological signatures such as ascribed status that are difficult to determine from a fragmentary archaeological record hindered by a variety of taphonomic problems and limited chronological resolution. To avoid such complications, we focus on the development of aspects of historically documented Chumash society, including the elaboration of material culture and the appearance of a suite of cultural traits, such as village layout, architecture, burial practices, and other elements represented at key sites on the Santa Barbara Coast. In this sense, we do not seek to identify specific organizational shifts in Chumash society, such as when the Chumash first organized themselves into chiefdoms, but to explore the development of the general underpinnings of Chumash cultural complexity.

Although the problems associated with such a "direct historical approach" are well known, especially for drawing analogies rooted deeper in time, this avenue should be useful for tracing the development of distinctive aspects of Late Holocene Chumash society. It should also be noted that an elaboration of material culture does not always represent increases in sociopolitical complexity. We believe that the two are inextricably linked, however, and that through the analysis of changes and elaboration in material culture we can elucidate general patterns of complexity.

In the following sections, we discuss key sites from the Santa Barbara Coast that span the last 4000 years and seem to illustrate the gradual emergence of a variety of traits typical of historic Chumash culture. Our point is not to argue against the notion of periods of "punctuated" or relatively rapid cultural changes among the maritime Chumash, which appear to be well documented. We believe that cultural change among the Chumash was both gradual and punctuated, and that a trans-Holocene view of Chumash cultural evolution suggests that debating which process was most important unnecessarily polarizes the variation found in the archaeological record.

Eakins Site (SBA-119 or SBA-1C)

About 3500 years ago, two young men—warriors killed in battle judging from their wounds—were buried with a wealth of grave goods in a cemetery near Rincon Point (Erlandson 1999a). Harrison (1964) noted that the flexed bodies were dusted with red ochre and surrounded by baskets, stone bowls, atlatls, flake tools, abalone pendants, deer legs, and utilized beach stones. One man was also buried with two pebbles encircled with asphalt bands, a grooved stone, a glob of asphaltum with two rows of inset shark teeth, a bird bone tube, a large bone bodkin or point, a stone disk with asphalt around the edge, sandals, and a turtle shell. The second man also had four bone awls (one with an ochre-painted asphalt handle), a dart point, a palette, a quartz crystal, two cakes of red ochre, four eagle claws, two abalone dishes, a bone scraper, a turtle shell containing two cores and 67 whole *Olivella* shells, and another turtle shell containing four fish gorges and five phalanges from a large bird wing. Portions of this same cemetery were excavated in the late 1800s by Bowers (1884:373-374), who found numerous charmstones, stone pipes, mortars, pestles, manos, and other artifacts (C. King 1980:20).

As Harrison recognized almost 40 years ago, aspects of this assemblage are characteristic of the Canaliño (Chumash) cultural pattern: flexed burials with a wealth of grave goods, evidence for an elaborated ritual or ceremonial life, a relatively diverse array of beads and other ornaments, an increasing emphasis on artistry in the production of functional tools such as mortars and pestles, and evidence of injury or violent death among a sizable portion of the population. What is remarkable about this cemetery is its age (between about 3300 and 3800 years old [table 10.1]), the elaboration of material culture and ritual behavior, the apparent evidence of warfare, the context of these associations, and some of the things not found in the cemetery. The context of the finds is a Milling Stone assemblage in which manos and metates outnumber mortars and pestles 10 to 1. Yet, as Harrison (1964:346) recognized, other aspects of the assemblage, from the flexed burials to the elaborate and finely crafted grave offerings, seem typically Canaliño. What is missing from the assemblage is any evidence of intensified maritime subsistence: no circular shell fishhooks or other specialized marine hunting technology and relatively few fish or sea mammal bones, despite Harrison's use of 1/8 inch screen in excavating the deposits. Interpretation of this assemblage is complicated by the fact that the people buried in this cemetery appear to have been interred in older midden deposits (C. King 1980), but Harrison's discoveries at SBA-119 suggest a relatively great antiquity for some of the foundations of Chumash culture. They also suggest that the economic underpinnings of the high population densities and cultural complexity along the Santa Barbara Coast were not strictly maritime; they were based on the combined diversity and productivity of marine and terrestrial resources available to the Chumash.

Las Llagas (SBA-81)

D. Rogers (1929:219) excavated extensively at this village site located at the mouth of Las Llagas Canyon on the western Santa Barbara Coast. The central portions of the site are L-shaped, following the sea cliff on the south and the canyon rim on the west, and extend for over 100 m east to west and just under 100 m north to south. Rogers considered the people of SBA-81 to be transitional between his Hunting People and the Canaliño. The presence of occasional manos and metates found in the hard subsoil were suggestive of an Oak Grove occupation, probably from a 5750-year-old occupation documented for the northern site area (Erlandson 1997b). Rogers' work at SBA-81 included extensive excavation of a large residential area, where he identified the remnants of 12 to 16

Table 10.1 ^{14}C dates from Late Holocene sites of the Santa Barbara Coast

SITE	^{14}C DATE	CALENDAR AGE (1 σ)	LAB NO.	MATERIAL	REFERENCE
SBA-1	2920 ± 100	1090 (930) 820 BC	Beta-33993	Pismo clam	Erlandson 1991b
SBA-71	1590 ± 60	AD 550 (630) 680	–	Marine shell	J.R. Johnson 1998
	1610 ± 90	AD 480 (610) 680	Beta-5320	Abalone shell	Davenport et al. 1993
	1790 ± 90	AD 270 (410) 520	UCR-1120	Marine shell	Breschini et al. 1996
	2110 ± 90	BC 90 (AD 30) AD 130	UCR-1119	Marine shell	Breschini et al. 1996
SBA-72	740 ± 50	AD 1350 (1420) 1450	–	Marine shell	J.R. Johnson 1998
	780 ± 80	AD 1310 (1400) 1440	UCR-1115	Marine shell	Breschini et al. 1996
	970 ± 60	AD 1170 (1250) 1300	–	Marine shell	J.R. Johnson 1998
	1060 ± 80	AD 1040 (1160) 1240	UCR-1117	Marine shell	Breschini et al. 1996
	1080 ± 60	AD 1040 (1120) 1210	–	Marine shell	J.R. Johnson 1998
	1200 ± 90	AD 900 (1010) 1070	–	Marine shell	J.R. Johnson 1998
	1270 ± 80	AD 830 (940) 1020	UCR-1118	*Olivella* beads	Breschini et al. 1996
	1540 ± 70	AD 600 (660) 720)	–	Marine shell	J.R. Johnson 1998
	1710 ± 90	AD 390 (480) 610	UCR-1114	Marine shell	Breschini et al. 1996
	2060 ± 70	AD 1 (80) 160	Beta-28031	Marine shell	This volume
SBA-73N	2090 ± 70	BC 40 (AD 50) AD 130	Beta-8938	Marine shell	Breschini et al. 1996
SBA-73S	1000 ± 60	AD 1130 (1220) 1280	Beta-19723	Marine shell	Breschini et al. 1996
	1210 ± 70	AD 910 (1000) 1050	Beta-8939	Marine shell	Breschini et al. 1996
	1320 ± 60	AD 790 (890) 970	Beta-19724	Marine shell	Breschini et al. 1999
SBA-81	2580 ± 60	730 (540) 410 BC	Beta-33934	Marine shell	This volume
	2660 ± 90	790 (740) 520 BC	BCta-33935	Marine shell	This volume
SBA-119	3270 ± 250	1690 (1400) 1080 BC	A-323	Abalone shell	Harrison 1964
	3420 ± 130	1730 (1570) 1410 BC	A-324	Abalone shell	Harrison 1964
	3530 ± 60	1780 (1690) 1620 BC	A-340	Pismo clam	Harrison 1964
	3730 ± 70	2060 (1960) 1870 BC	–	Marine shell	J.R. Johnson 1998
SBA-1491B	260 ± 80	AD 1720 (1890) 1950*	Beta-17212	Marine Shell	Erlandson 1988a
	310 ± 90	AD 1680 (1820) 1950	Beta-17213	Marine shell	Erlandson 1988a
	400 ± 80	AD 1640 (1680) 1820	Beta-17211	Marine shell	Erlandson 1988a
	500 ± 60	AD 1520 (1630) 1670	Beta-12946	Marine shell	Erlandson 1988a
	670 ± 70	AD 1400 (1450) 1500	Beta-17210	Marine shell	Erlandson 1988a
SBA-1491C	Modern	Modern	Beta-15050	Marine shell	Erlandson 1988a
	220 ± 70	AD 1910 (1910) 1950	Beta-10225	Marine shell	Erlandson 1988a
	300 ± 80	AD 1690 (1820) 1950	Beta-15046	Marine shell	Erlandson 1988a
	430 ± 80	AD 1580 (1670) 1720	Beta-15049	Marine shell	Erlandson 1988a
	470 ± 60	AD 1540 (1650) 1680	Beta-12948	Marine shell	Erlandson 1988a
	470 ± 80	AD 1530 (1650) 1690	Beta-15047	Marine shell	Erlandson 1988a
	640 ± 60	AD 1430 (1470) 1520	Beta-15048	Marine shell	Erlandson 1988a
	760 ± 80	AD 1320 (1410) 1450	BCta-12947	Marine shell	Erlandson 1988a
SBA-1731	190 ± 50	AD 1660 (1830) 1950*	Beta-4389	Charcoal	Erlandson and Gerber 1993
	560 ± 70	AD 1470 (1530) 1640	Beta-4934	Marine shell	Erlandson and Gerber 1993
	560 ± 80	AD 1460 (1530) 1650	Beta-5058	Marine shell	Erlandson and Gerber 1993
	800 ± 80	AD 1300 (1360) 1430	Beta-33549	Marine shell	Erlandson and Gerber 1993
	820 ± 60	AD 1300 (1330) 1410	Beta-4391	Marine shell	Erlandson and Gerber 1993
	965 ± 65	AD 1180 (1250) 1300	Beta-4935	Marine shell	Erlandson and Gerber 1993
	990 ± 90	AD 1110 (1230) 1300	Beta-33821	Marine shell	Erlandson and Gerber 1993
	1060 ± 60	AD 1050 (1160) 1230	Beta-33822	Marine shell	Erlandson and Gerber 1993
	1720 ± 70	AD 400 (470) 570	Beta-4390	Marine shell	Erlandson and Gerber 1993
SBA-1808	3100 ± 70	1300 (1210) 1080 BC	Beta-13595	Mussel shell	Erlandson 1988a
	3300 ± 70	1510 (1430) 1370 BC	Beta-13596	Mussel shell	Erlandson 1988a
	3310 ± 90	1530 (1440) 1360 BC	Beta-13594	Mussel shell	Erlandson 1988a
SBA-2149	650 ± 60	AD 1480 (1530) 1640	Beta-60997	Marine shell	Santoro et al. 1993
	2110 ± 60	200 (140) 50 BC*	Beta-44071	Soil organics	Santoro et al. 1993
	2470 ± 60	770 (660) 410 BC*	Beta-42814	Soil organics	Santoro et al. 1993
	2650 ± 80	890 (810) 790 BC	Beta-42813	Soil organics	Santoro et al, 1993

* Dates with multiple intercepts

Note: All shell dates are in uncorrected ^{14}C years without $^{13}C/^{12}C$ corrections; 430 years were subtracted from AMS dates—an average value for $^{13}C/^{12}C$ adjustments for shell samples from the Santa Barbara Coast. All dates were calibrated using Calib 4.3 (Stuiver and Reimer 1993). Calendar age midpoints shown in parentheses.

semisubterranean houses about 9 m (30 ft) in diameter. He noted that:

> The circular formation of the refuse heaps was easily traced, after I penetrated below the cultivated stratum. These circular heaps were not in perfect alignment, but were, nevertheless, confined to a single row that bent to conform to the contour of the village. In each example investigated, the outer parts of the circle, some thirty feet in diameter, were built up almost entirely of quantities of shell and bone refuse, the component parts of which were in a more or less entire condition. As we approached the center of the circle, the debris became more broken and was mixed with ashes, while the center was occupied throughout the entire depth by a bed of almost pure ash. (D. Rogers 1929:217)

Among the structures excavated was a possible sweathouse (*temescal*) or shrine about 6 m wide surrounded by a "low barricade of boulders" (D. Rogers 1929:217). On the floor of this structure, Rogers (1929:388, 418) found two clusters of 10 cigar-shaped charmstones, each reportedly arranged in radiating starburst patterns around a circular stone "encircled by a band of asphaltum and resting in a small cup-shaped boulder." He interpreted this as a "sacred chamber" and "medicine man's shrine." Also found in the structure were many more charmstones "disarranged by subsequent burials, . . . four crudely made, stone effigies of whales, a few pipes and two of the strange, so-called 'snake heads,' in which I believe there is phallic suggestion" and "a unique 'gambling top' or die made of milky translucent calcitic stone" (Rogers 1929:388). Because this ceremonial structure had been encroached on by later burials from an expanding cemetery, Rogers concluded that the shrine was associated with the early phases of village occupation.

Rogers also worked extensively in a large (12 x 30 meter) bilobate cemetery at SBA-81 in which he found the skeletal remains of over 300 individuals. He interpreted the cemetery as two separate plots that coalesced over time and found that many earlier burials had been disturbed by later interments. Except for a few more ancient extended burials found in the subsoil (probably Middle Holocene in age), the vast majority of burials were interred in flexed position, "mostly with the faces down" (D. Rogers 1929:219). Hundreds of fragments of broken stone bowls and pestles were found in the cemetery, along with weaponry described as being "of large, businesslike proportions" but lacking "the finish usually expected in flint products" in this area (D. Rogers 1929:220).

Rogers provided little other description of this cemetery, but C. King (1990:34) described it as the most important assemblage he used in defining Phase 2a of his Middle period. According to King, Rogers excavated at least 364 burials in the cemetery and recovered a wide variety of artifacts consistent with an early Middle period occupation, including charmstones and charmstone blanks, effigies, stone pipes, shell beads, *Megathura* (keyhole limpet) rings and abalone ornaments, and pins (some incised) made from bird and mammal bones, and dolphin and porpoise jaws. King (1990:287-288) classified over 12,000 beads from this cemetery, including 5030 *Olivella* saucers, 3375 *Trivia californiana* (coffee bean shell) beads, 1377 abalone disks, 1235 *Olivella* disks, 621 *Megathura* rings, 357 spire-ground *Olivella* shells, 9 soapstone disks, 7 bird bone cylinders, 4 large mammal bone cylinders, 3 *Fissurella volcano* (limpet) rings, and 1 abalone rectangle. Based on the differential distribution of artifacts he associated with ritual versus wealth in this cemetery—bone pins, pipes, effigies, and charmstones predominantly in the eastern half, and beads and ornaments almost exclusively in the western half—King (1990:99) concluded that the people of SBA-81 were "divided into two groups of which one was in control of the political and economic subsystems and the other of ritual." Although Rogers (1929:388) attributed most of the ritual objects in the eastern part of this cemetery to the fact that burials had encroached on a portion of the ceremonial enclosure he had excavated, the concentration of beads and ornaments in the western part of the cemetery suggests that wealth and economic power may have been differentially distributed among the villagers.

At SBA-81, a number of characteristics similar to classic Chumash society appear to be found: sedentism marked by substantial semisubterranean houses; a ceremonial enclosure, a large cemetery containing closely packed and flexed burials, and the linear organization of houses facing the ocean; a diverse and elaborated material culture that includes a wide range of beads and ornaments; ritual objects such as charmstones, pipes, and effigies similar to ethnohistoric Chumash specimens; and possibly the differential distribution of wealth and power within the village. Apparently absent is evidence of circular shell fishhooks, the bow and arrow, the highly finished implements typical of later times, or specialized trade in steatite from Santa Catalina Island. Although the midden was described as having a "fairly prominent content of broken sea shells and fragmentary bones from larger mammals," Rogers (1929:220) claimed the absence of fish bones "was very marked." While some fish bone is undoubtedly present (small fish bones tend to be nearly invisible in the types of excavations Rogers conducted), fishing probably was not the dominant economic activity at SBA-81, or fish bones and fishing equipment would have been more prominent.

In 1989, Erlandson had two shell samples from the SBA-81 cemetery dated. King's (1981) estimate that Phase 2a of his Middle period dated between about 2750 and 2250 RYBP provided a general chronological framework for use of the cemetery. Single-shell ornaments associated with two separate burials were ^{14}C dated to 2660 ± 90 RYBP and 2580 ± 70 RYBP, closely matching King's estimate. After calibration, these dates place the use of the cemetery between about 800 and 400 BC, although further dating may expand this range somewhat. Like the even older assemblage from SBA-119, the SBA-81 data suggest that recognizable aspects of Chumash society emerged relatively early in the Late Holocene. As Rogers (1929:221) concluded, "the site was abandoned centuries before it attained the climax of Canaliño culture, but it had nevertheless advanced markedly."

Tecolote Canyon (CA-SBA-71 and CA-SBA-72)

This complex of archaeological sites at the mouth of Tecolote Canyon, located on the open coast about 7.5 km west of the Goleta Slough mouth, was occupied between about 2100 and 500 years ago. Tecolote Canyon contains a perennial stream and offers access to extensive kelp bed, nearshore, pelagic, and terrestrial habitats. Three sites here, two of which also contain evidence of occupation during the Early or Middle Holocene (Erlandson 1994:178-179; Erlandson 1997a:103), appear to hold the remnants of five separate (but overlapping) village occupations. The area has been investigated by archaeologists since at least the early 1900s, with additional work in the 1960s and 1970s (see DuBarton 1991; C. King 1980; D. Rogers 1929). Archaeological teams directed by Erlandson and Vellanoweth have worked on the sites periodically since 1986. Although much of the material recovered in recent years is still being analyzed, a general chronology for the sites has been established, with C. King's (1980) study of cemetery and other artifact collections from SBA-71 and SBA-72 providing valuable data concerning the nature of Late Holocene technology, subsistence, and social organization at Tecolote Canyon.

SBA-71. Late Holocene occupation of the Tecolote site complex appears to have begun a little over 2000 years ago on the high terrace that forms the eastern canyon rim. SBA-71 is a large multicomponent site that encompasses an area about 240 m north to south by 110 m east to west. In 1926, Rogers excavated a discrete cemetery plot in the southern site area, where he reported finding 75 closely packed burials, including at least 69 articulated burials and four reburials (C. King 1980:40). Almost all the articulated burials were flexed. Two or three extended burials in the southern part of the cemetery or scattered about the periphery may be associated with a Middle Holocene site occupation (see D. Rogers 1929:182). In the central part of the main cemetery, a large cobble and boulder platform covered numerous burials, including the remains of five individuals with whom most of the wealth goods were buried. These five individuals included the skeleton of the famous "Swordfish Man" buried with a ceremonial headdress made from a swordfish skull and bill, with abalone inlay around the eye sockets and a cape of abalone shell ornaments (Davenport et al. 1993; DuBarton 1991:158-159). Numerous abalone shells and beads, red ochre, and bone hairpins were also found with this burial (C. King 1980:Table 3-6). Davenport et al. (1993) summarized the importance of swordfish to the Chumash, who regarded them as "people of the ocean." King (1990:66) also noted ethnographic accounts that describe similar headdresses worn by Chumash chiefs as insignia of power. Nearby was the skeleton of a woman, buried with numerous abalone ornaments, whose body had been placed in a heavily burned pit dug into the clay subsoil. Outside this central area, people were buried with relatively few artifacts that were mostly utilitarian in nature (C. King 1980).

King believed the Chumash used this cemetery between about 1950 and 1550 RYBP and that much of the midden refuse in the southern site area was deposited during the same period. A sample of Pismo clam shell from near the base of the shell midden produced an uncorrected ^{14}C date of 2110 ± 90 RYBP. Three dates are available for marine shell samples from Rogers' cemetery area, including 1610 ± 90 RYBP on abalone ornaments from the "Swordfish Man" headdress. The calibrated ages for these dates, ranging from about 100 BC to AD 500, are consistent with King's chronology.

Warren's 1971 excavation of SBA-71 produced a diverse artifact assemblage that includes materials from multiple site components. Much of the assemblage appears to be consistent with an occupation contemporaneous with the cemetery discussed above, but materials from the Early Holocene, Middle Holocene, and Late period are also present. The projectile technology, dominated by large dart points (and two probable bone atlatl spurs), includes a few small triangular arrow points (DuBarton 1991). Fragments of at least four shell fishhooks, some with grooved shanks, are also present. AMS radiocarbon dates recently obtained for two of these hooks suggest they were manufactured about 2000 years ago (Rick, et al. 2002).

In 1979, testing of the midden in the southern part of SBA-71 by University of California, Santa Barbara (UCSB) archaeologists produced a small sample of faunal remains recovered by wet-screening excavated sediments over 1/8 inch screen. A faunal sample from three 10 cm levels (0 to 10 cm, 20 to 30 cm, and 40 to 50 cm) in Unit N52/E732, relatively undisturbed and apparently consisting primarily of Late Holocene materials, produced about 616 g of shell, 55 g of mammal or bird bone, and only 1.9 g of fish bone. The shellfish assemblage included the remains of at least 23 taxa, but it was dominated by California mussel (*Mytilus californianus*) at 74.3%, Venus clams (*Chione* sp.) at 5.4%, Washington clam (*Saxidomus nuttalli*) at 3.5%, Pismo clam at 3.0%, littleneck clam (*Protothaca staminea*) at 2.9%, and undifferentiated pelecypod at 7.3%. Among the vertebrate remains, almost 31% of the mammal and bird bone was burned, suggesting that much of the assemblage was of cultural origin. The small assemblage of fish remains included rockfish, surfperches, what may be the remains of Pacific mackerel and sardine, and an unidentified elasmobranch. The apparent dearth of fish remains and fishing tackle at the site once again suggests that fishing was not always central to the economy of the maritime Chumash.

SBA-72. At this large site located on a low terrace on the east side of Tecolote Creek below SBA-71, Rogers excavated two cemeteries, one in the northern area and one in the southern. The site also contains two discrete, but partly overlapping, residential areas. In the northern cemetery, partly disturbed by previous excavators and attributed by King to between about 1550 and 1350 RYBP, Rogers (1929) reported finding 53 articulated burials and nine reburials. Among these individuals were several victims of violence. Among 17 skeletons studied by Lambert (1994), four had projectile point wounds, and one had a perimortem cranial fracture, an almost 30% rate of violent injury or death.

Between this and the southern cemetery, Rogers (1929) reported finding an ovate ceremonial dance area largely cleared of stone or midden refuse but surrounded by a "moraine" of rocks. Similar features described for Chumash villages during the contact period were also noted in the other Tecolote Canyon sites. Also found in the southern area, which King (1980) dated to between about 1050 and 800 RYBP, were the remnants of a semisubterranean sweat lodge about 6 m wide, with the perimeter lined with a row of boulders and the interior containing thick deposits of charcoal and ash.

In the southern cemetery, Rogers excavated the remains of 103 flexed burials and over 70 reburials. With these burials he found more than 1500 keyhole limpet (*Megathura crenulata*) ornaments of several types. In his analysis, King separated this cemetery into several areas, including a central area where most reburials were concentrated and most of the beads, ornaments, and other artifacts were found. According to King, the central portion of this cemetery could be divided into three areas based on burial associations: a northern half, a southwest quarter, and a southeast quarter. Within these areas, wealth and ceremonial items reportedly were differentially distributed:

> The southwest quarter contained the largest amount of wealth...and bone whistles were found exclusively in this area.... Many of these were made from deer tibia. Similar bone whistles were associated historically with the elite Antap society (Hudson et al. 1977). Also concentrated in the southwest quarter of the cemetery were shell beads, bone hairpins, and quartz crystals (C. King 1980:52).

Shellfish remains from contemporaneous midden deposits at SBA-72S are dominated by mussels (*Mytilus californianus*, *Septifer bifurcatus*), Pismo clam, littleneck clam, and small amounts of calm water taxa (e.g., *Argopecten*, *Chione*, *Ostrea*, *Polinices*) that may have been obtained from the Goleta Slough or small estuaries in the site vicinity (Serena 1980). J. Johnson (1980) identified a variety of nearshore and pelagic fish remains from the site, but mammal and bird remains were heavily fragmented and burned, so the vast majority could only be identified to general taxonomic classes (Lawson et al. 1980). A dietary reconstruction based on the preliminary study of vertebrate and shellfish remains from 1/8 inch screen samples suggests that land and sea mammals were the dominant animals taken, together contributing over 75% of the edible meat represented, while fish provided less than 15%. Shellfish and birds seem to have been minor resources at SBA-72S, contributing less than 5 and 1%, respectively, of the estimated edible meat yields.

Corral Canyon (SBA-1731)

Located at the mouth of Corral Canyon on the western Santa Barbara Coast, SBA-1731 offers an unusually well stratified record of cultural changes between about 1500 and 400 years ago. First investigated by archaeologists from UCSB in 1982 (Moore and Luce 1983), the site contains two areas. The western area is located on a low alluvial terrace just above Corral Creek and the beach, where several discrete archaeological strata are well preserved between successive layers of alluvium. To the east, these strata rise onto a gently sloping canyon wall, where they merge into a single surficial soil that contains mixed archaeological materials deposited throughout the site occupation. Altogether, the site extends for about 100 m east to west and at least 20 m north to south. An unknown amount of the southern site area has been lost to erosion, and the northern site area is obscured by fill on which the Southern Pacific Railroad and US Highway 101 were built. In 1988, investigations by Dames and Moore archaeologists in the western site area focused on obtaining a relatively high-resolution record of cultural and environmental changes spanning the Middle-to-Late period transition (Erlandson and Gerber 1993). The main occupations of SBA-1731 appear to span a period of about 400 years, ending about AD 1550. The function of SBA-1731 probably varied through time, but it appears to have served primarily as a seasonal camp. Near the end of the Middle period (ca. AD 1100 to 1350), when densities of most site constituents peak, site occupation may have been more sustained.

The stratified sequence at SBA-1731 is especially significant because the major occupational strata (3, 7, 8, and 8+) appear to span the time Arnold (1992a; Arnold and Tissot 1993) and Colten (1991, 1993:4) proposed as an extended period of warm ocean temperatures and low marine productivity crucial to the development of complexity among the maritime Chumash. Faunal assemblages show little evidence of unusually warm water temperatures or any serious degra-

Table 10.2 Dietary reconstructions for Late Holocene sites of the Santa Barbara Coast

PROTEIN YIELDS/OTHER VARIABLES	SBA-1808	SBA-1	SBA-2149	SBA-72S	SBA-1731	SBA-1731	SBA-1491
Approximate site age (AD/BC)	1200-1450 BC	850 BC	AD 400-750	AD 750-1150	AD 1200	AD 1350	AD 1450-1820
SITE TYPE	SEASONAL	VILLAGE?	SEASONAL	VILLAGE	VILLAGE?	SEASONAL	VILLAGE
Shellfish (%)	53	55	7	4	2	1	13
Fish (%)	12	12	57	17	33	43	75
Sea mammals (%)	14	10	–	38	47	31	4
Land mammals (%)	–	–	–	–	5	5	–
Undifferentiated vertebrates (%)	22	23	36	41	14	17	8
All vertebrates (%)	47	45	93	96	98	99	87
Marine component (%)	>79	>77	>64	>59	>82	>75	>92

Sources: Erlandson (1991a, 1993, 1994:277); Erlandson et al. (1993a); Peterson (1984); Santoro et al. (1993)

dation of the marine environment, however, with especially high densities of fish and sea mammal bone in levels dating to the Transitional period (Erlandson 1993a).

In fact, the floral and faunal remains recovered from the site are remarkably diverse: 47 plant taxa, at least 64 types of fish, 60 shellfish taxa, and a minimum of 27 different mammals, birds, reptiles, and amphibians. While some of the plants and animals identified may be natural or nondietary site constituents, the diversity of the assemblage demonstrates the intensified nature of Chumash subsistence and resource use. Dietary reconstructions based on the recovered fauna suggest, however, that fishing, sea mammal hunting, and to a lesser extent land mammal hunting were the primary sources of meat (table 10.2; see also Erlandson 1993). In the terminal Middle period levels, fish and sea mammals together comprise 75 to 80% of the animal meat represented by the recovered faunal remains (Erlandson 1993:196). Both shellfish and birds appear to have been minor resources throughout the site occupation, never contributing more than 2% and 0.4%, respectively, of the meat represented.

The artifacts from SBA-1731 are also diverse. Chipped stone artifacts include 20 bifaces, 9 leaf-shaped points, 4 contracting stem points, 4 triangular arrow points, 4 drills, 5 notched tools, 51 flake tools, 13 cores, and over 7000 pieces of debitage. The vast majority of chipped stone artifacts were made from local or perilocal raw materials, especially Monterey chert (77%) and Franciscan chert (17%), but 22 artifacts of obsidian and 9 of fused shale indicate that the site occupants participated in regional exchange networks. The ground stone tool assemblage includes nine manos and two metates, six pestles and one mortar, a net weight, and an abrader. Of the 31 identifiable bone tools, 25 were pointed awl, pin, or needle fragments; four appear to have been fish gorges; and two were probably barbs hafted on fishing or hunting spears (Carbone et al. 1993). Also recovered were three asphaltum basketry impressions, probably fragments of twined water bottles; 13 tarring pebbles; and 7 angular rock fragments splashed with asphaltum. Shell artifacts from SBA-1731 include 32 fishhook or fishhook blank fragments, including 15 fragments of grooved-shank circular style hooks. Twelve of these circular hooks came from the Middle period strata (Munns and Erlandson 1993).

Some of the most interesting artifacts from SBA-1731 are the beads and bead detritus. These include 154 *Olivella* beads (including 126 cup, 16 wall disk, and 8 spire-removed specimens), 1460 pieces of *Olivella* bead refuse, 13 other shell (*Mytilus*, *Tivela*, *Haliotis*, and undifferentiated pelecypod) beads, 7 stone beads, and 3 bone beads. The relatively large amount of *Olivella* detritus suggests that the Chumash were making beads on site. Analysis of the refuse suggests that *Olivella* callus cup (money) beads were the primary product of this manufacturing effort (Munns and Erlandson 1993). Bead detritus has been found in a number of mainland Chumash sites (e.g., Erlandson 1988b), but none have produced *Olivella* detritus in the densities encountered at SBA-1731. In the Middle period Stratum 7, for instance, detritus densities reached a high of roughly 10,500/m^3, overlapping the lower range of densities found in some specialized Santa Cruz Island bead-making sites (Arnold 1987). The bead assemblage is also unique because the bulk of the cup beads and cup bead-making refuse traditionally seen as Late period markers in the Santa Barbara Channel region come from strata tentatively dated to the Middle period, between about 100 and 250 years before the beginning of the Late period.

To explain this apparent chronological anomaly, Glassow (personal communication 1999) suggested that upstream erosion of an archaeological site might have led to the deposition of a mix of artifacts in the fluvial strata at the mouth of Corral Creek. This hypothesis does not account, however, for the presence of numerous apparently intact features in the Middle period site deposits, many of which contain *Olivella* cup beads and associated detritus. It also does not account for the excellent preservation of the assemblage, the fact that several of the fluvial strata are essentially sterile, or the close correlation between the paleosols and high archaeological densities. Finally, it does not explain the seemingly consistent series of ^{14}C dates obtained on carefully selected individual shell fragments from the main occupational strata in the western site area or the fact that this chronology is consistent with an earlier series of dates for materials found on the higher slope where no fluvial sedimentation occurred.

Although dating of additional ^{14}C samples, including direct AMS dating of some of the *Olivella* cup beads, is needed to refine the SBA-1731 chronology, the available data suggest that several key Late period markers (such as *Olivella* cups, Cottonwood triangle arrow points) may have first appeared along the Santa Barbara Coast during the Middle-to-Late period transition. In support of this idea, we note that sites dated to this time period are rare in the Santa Barbara Channel area and that there are currently no known mainland sites dating to this period with the stratigraphic integrity of SBA-1731.

Estait (SBA-1491)

In AD 1769, Spanish chronicles suggested that approximately 200 people lived at the Chumash village of Estait at the mouth of Cañada de la Santa Anita on the western Santa Barbara Coast (A. Brown 1967). These people reportedly lived in as many as 30 houses and owned 3 to 5 tomols. Spanish accounts also suggest that Estait was located between two larger sociopolitical capital villages, Sisolop to the west at Cojo and Nomgio to the east at Gaviota. In 1901, construction of the Southern Pacific Railroad divided the village site into northern (SBA-1491) and southern (SBA-1492) areas. SBA-1492 has seen little archaeological work, but SBA-1491 was intensively investigated in the 1980s (Erlandson et al. 1993). Perennial Santa Anita Creek runs through the center of the site from north to south, separating this site into eastern (C) and western (B and D) loci.

The investigation of Estait provided a wealth of data concerning the structure, age, and contents of SBA-1491, as well as valuable information regarding the nature of Chumash adaptations between about AD 1350 and 1810. Fifty-nine test units and 55 shovel test pits were excavated across an area about 130 m north to south by 250 m east to west. The density of archaeological materials varied considerably across this area, from dense shell and bone midden areas to low-density lithic aprons around the site periphery. Soil pH values varied from mildly acidic to mildly alkaline, resulting in relatively good preservation of artifacts and ecofacts.

As expected from a Late period and historic Chumash village, the large assemblage from SBA-1491 includes a wide variety of artifacts. Chipped stone tools include 222 bifaces, 157 small drills interpreted as bead drills (Santoro 1990), 154 large drills, 115 flake tools, 45 hammerstones, 24 cores, and tens of thousands of pieces of debitage. Projectile points include contracting stem dart tips, a variety of large and small leaf-shaped points, and a number of small triangular arrow points. Ground or pecked stone tools include 20 mortar fragments and 6 pestles, 3 metate fragments and 4 manos, a charmstone, a steatite comal fragment, a net weight, and a sandstone sphere. Also found were 32 tarring pebbles and 6 asphalt applicators. Of the 77 bone tool fragments recovered, most were so badly fragmented that their function could not be identified. Fourteen of these were pointed tool fragments that probably served as awls, pins, barbs, or gorges. The abundant shell artifacts include numerous circular shell fishhooks and a wide variety of beads and other ornaments. Beads and ornaments include 262 items made from *Olivella* shells (120 disk beads, 70 cup beads, and *Olivella* spire-ground beads), and specimens made from clam, mussel, and abalone shell; 31 stone beads; and 44 glass beads. Small numbers of shell and stone bead blanks, and small amounts of *Olivella* bead detritus indicate that some bead making took place on site (Santoro 1990).

Faunal remains from SBA-1491 suggest that residents harvested a diverse range of resources. Analysis of about 2000 fish elements identified at least 22 discrete taxa, an assemblage dominated numerically by clupeids (65%), rockfish (11%), croakers and surfperch (9% each), and Pacific mackerel (8%), with lesser amounts of senorita, jacksmelt, jack mackerel, members of the sole family, midshipman, kelp bass, yellowtail, bonito, barracuda, halibut, and others. Other vertebrate remains are derived from a variety of small, medium, and large land mammals, sea mammals, several birds (cormorant, duck, gull, pelican), snake, and turtle. Except for a variety of small rodents, the bone assemblage is heavily burned and fragmented, suggesting that it is largely cultural in origin. The shellfish assemblage was also quite diverse, with the remains of 39 discrete taxa identified. Several species appear to have been important contributors to the shellfish diet, including *Protothaca staminea* (20%), *Mytilus californianus* (13.6%), chitons (12.3%), abalone (11.1%), sea urchin (5.8 %), *Septifer bifurcatus* (4.6%), *Tegula* sp. (4.3%), crab (2.9%), Pismo clam (2.5%), and rock scallop (2.2%). Despite the recovery of over 32 kg of marine shell, dietary reconstructions derived from meat weight conversions for faunal remains from test units excavated in both Locus C and Locus D suggest that shellfish provided less than 10% of the animal flesh represented. Fish dominate the meat diet, contributing 65% or more of the estimated meat yield—with sea mammals, land mammals, shellfish, birds, and reptiles all appearing to have been secondary resources.

By AD 1796, Old World diseases and movements to the missions had reduced the population of Estait to 68 (J. Johnson 1988:113, 115), and during AD 1804 to 1806 most of these survivors moved to Mission La Purisima. By about AD 1810, the village seems to have been largely abandoned (Erlandson et al. 1993:16-4). At Estait and elsewhere along the Santa Barbara Coast, an elaborate and sophisticated Chumash way of life that had developed over many millennia came rapidly to an end. Their freedom constrained by the Mission system and the encroaching pueblo of Santa Barbara, their land stolen from them, their health sapped by additional disease epidemics and the stresses of living under the yoke of colonial oppression, the surviving Chumash melted into the rapidly transforming economies and multicultural societies of the Spanish, Mexican, and American periods. Only the most ardent optimist of the late 19th or early 20th century could have foreseen the survival and eventual revival of Chumash culture.

DISCUSSION

Archaeologists have long been interested in the processes that led to the development of greater cultural complexity along the California Coast. Changing with the times, archaeologists have proposed a number of scenarios for why such cultural complexity developed. D. Rogers (1929), for instance, viewed the appearance of the Canaliño and their sophisticated maritime lifeways as evidence of migration from another region. Meighan (1959) saw such developments largely as the result of a long and relatively gradual adjustment to marine lifeways, an explanation also favored by Hoover (1971) and others:

> ...the prehistoric sequence in southern California was of the continuous development of a single society, with major changes resulting from ecological adaptations. Thus, the temporal sequence simply represents increasing efficiency in exploiting the local environment (Hoover 1971:257).

For Hoover in 1971, a gradual fine-tuning of maritime adaptations was explanation enough, but C. King (1990) also recognized that growing coastal populations required increasing amounts of energy to sustain themselves, leading to a diversification of subsistence and technology through time. Unlike many of his contemporaries, King (1990:79) explicitly stated that environmental changes had little effect on the development of Chumash culture. Over the past decade, most Santa Barbara Channel scholars have explained the development of cultural complexity as a response to population growth, environmental changes, and increased resource stress (e.g., Colten 1987; Glassow, Wilcoxon, and Erlandson 1988; Lambert 1993; Lambert and Walker 1991). For most researchers, this was a long and cumulative process also marked by periods of relatively rapid cultural change due to shifts in the environment or human population levels.

Consistent with a general shift in evolutionary theory, recent interpretations of Chumash archaeology have often emphasized "punctuated equilibrium" models, where long periods of relative stability are broken by shorter periods of rapid cultural change. The meticulous work of Jeanne Arnold, Roger Colten, and their colleagues on Santa Cruz Island, for instance, focused on the possible effects of an extended period of warm sea surface temperatures on the coastal Chumash between about AD 1150 and 1300 (e.g., Arnold 1987, 1991a, 1992a, 1992b, 1997; Arnold and Tissot 1993; Arnold, Colten, and Pletka 1997). Recent research has raised questions about the duration and intensity of this warm water event, suggesting that the Middle-to-Late period transition was part of a longer period of relative climatic and environmental instability (D. Kennett 1998; Kennett and Kennett 2000; Kennett and Conlee, chapter 9, this volume). Other research has focused on the potential effects of a severe drought during essentially the same time interval (see Arnold, Colten, and Pletka 1997; Jones et al. 1999; Raab and Bradford 1997; Raab and Larson 1997).

Clearly, Native American cultures of the Santa Barbara Channel area changed dramatically through time, and some of the most profound changes took place during the Late Holocene. The pace of cultural change in the area also seems to have accelerated through time, from Early and Middle Holocene changes that seem to have occurred relatively slowly, to Late Holocene changes that occurred much more rapidly and continued to accelerate until European contact. This acceleration of cultural change, along with the lack of detailed knowledge about the timing of certain key developments in the area (the tomol, circular shell fishhook, bow and arrow, etc.) limits our ability to evaluate the nature of Late Holocene culture change, especially after about 2500 years ago. With numerous and relatively rapid cultural changes taking place, it becomes difficult to distinguish gradual versus punctuated events in the somewhat blurred and incomplete archaeological record—especially in bioturbated mainland shell middens. In evaluating the tempo of cultural evolution in the Late Holocene Santa Barbara Channel area, we must be careful not to confuse a general acceleration of culture change with short periods of rapid cultural change. Likewise, we should be cautious when searching for correlations between changes in the archaeological record and patterns identified in even high-resolution paleoecological records. Finally, as archaeologists we are trained primarily to identify changes in the archaeological record and to seek explanations for such developments. In the process, however, we should also consider the evidence for cultural continuity, which may temper conclusions about the significance of some changes and alter our explanations for cultural evolution.

Late Holocene Technological Developments

While considerable evidence for the persistence of earlier technologies argues for cultural continuity along the Santa Barbara Coast during the Early, Middle, and Late Holocene, several significant technological developments appear to have occurred during the last 3000 to 4000 years. Among these was the development of the plank tomol (Arnold 1995a; C. King 1990), although when and how the large ethnographic type of tomol was first developed remains uncertain. Circular shell or bone fishhooks also first appeared along the Santa Barbara Coast during the Late Holocene, probably about 2500 years ago (Rick et al. 2002), and may have significantly increased the productivity of nearshore fishing. The introduction of the bow and arrow about AD 500; the development of a variety of new bead and ornament types (C. King 1990), including *Olivella* callus cup beads probably first used as a form of currency between about AD 1150 to 1300; the development of specialized bladelet and bead-making industries on (primarily) the northern Channel Islands; and the appearance of new cooking vessels (ollas and comals) made from Catalina Island steatite are also Late Holocene developments. The refinement of existing tool types such as mortars and pestles, which become more symmetrical and standardized through time, probably reflects an increase in labor investment, craft specialization, and accumulation of wealth to purchase or commission such items.

While a progressive elaboration of material culture is evident during the Late Holocene, including the appearance of new technologies, it should be noted that many of these "new" artifact forms emerge from earlier analogs. For instance, circular or J-shaped fishhooks probably evolved from composite forms (see C. King 1990:80), the plank tomol emerged from a 12,000 year tradition of maritime channel crossings, the bow and arrow was an improvement or refinement of earlier projectile technologies, and the Late period money bead and bladelet manufacturing traditions emerged from Middle period precursors. We are not suggesting that these technological developments were not significant in the wider array of Late Holocene sociopolitical evolution, only that they are extensions of longstanding trends towards technological diversification and elaboration. From this perspective, where change and continuity are given equal weight, many of the Late Holocene technological developments among the Chumash can be seen as incremental rather than revolutionary, and both gradual and punctuated in nature.

Settlement and Subsistence

Erlandson (1994, 1997a) argued that the people of the Santa Barbara Coast probably had been relatively sedentary since the Early Holocene, although the intensity and nature of that sedentism fluctuated through space and time. By about 3500 years ago, there is no question that the Canaliño were relatively sedentary, with a number of large cemeteries known from the mainland coast and the larger Santa Barbara Channel area. Like the historic Chumash, however, the general sedentism of the mainland Canaliño included the logistical use of a number of smaller campsites, processing localities, or other specialized activity sites (see Glassow 1985). Many of these sites are located away from the coast, although relatively little is known about the nature of inland sites along the Santa Barbara Coast. The use of pericoastal sites may have been more common along the eastern Santa Barbara Coast, where the broader expanse of coastal plain and foothill habitats added travel and search time to inland hunting or collecting forays.

Along the Santa Barbara Coast, the earliest clear evidence of large clusters of semisubterranean houses typical of Chumash architecture and village organization is found at SBA-81 at Las Llagas, dated between about 800 and 400 BC At Las Llagas, D. Rogers (1929) identified the remains of a temescal or other ceremonial structure similar to those described in historical accounts of the Chumash. It seems likely, however, that such architecture, village aggregations, and ceremonialism began earlier in time, with the evidence largely erased or obscured by the effects of bioturbation, plowing, development, looting, and other destructive processes.

Along the Santa Barbara Coast there is also considerable evidence for subsistence variation through space and time. Various evidence suggests that shellfish and plant foods were the most important resources for most Early Holocene peoples of the area (Erlandson 1994), with Middle Holocene patterns more variable and diversified, including generally less emphasis on shellfish. What seems most evident from the data available from Late Holocene sites is that subsistence among the mainland Canaliño or Chumash was quite variable (table 10.2). General Late Holocene patterns include an increased reliance on vertebrates and the decreasing significance of shellfish through time. Overall, the importance of fish seems to increase through time, particularly after about 1000 years ago. It seems likely that these general trends reflect an intensification of resource use through time. As shellfish declined in importance, probably due to harvest pressure from expanding human populations, the use of mammals and later of fish intensified. Although less visible in the archaeological record, plant use probably intensified through time, with the ethnographic Chumash known to have used more than 150 different plant species (Timbrook 1990).

There is still much to be learned about Late Holocene subsistence patterns along the Santa Barbara Coast, including questions about how environmental variations between the eastern and western coasts affected resource use, when and why fishing intensified in various areas, and when intervillage exchange of foods intensified. It seems likely that terrestrial resources were also more significant to emergent Chumash cultural developments along the mainland coast than previously recognized and that intensive fishing may have played a limited role in the appearance of some of the early hallmarks of cultural complexity among the mainland Chumash, especially prior to about 2000 years ago. Fishing, often seen as the foundation upon which high Chumash population densities and cultural complexity were built, does generally appear to have intensified through time, at least at some sites. Fish appear to have been a relatively minor resource at SBA-71, SBA-81, and SBA-119, however, suggesting that fishing was not central to the economy of all maritime Chumash groups of the Santa Barbara Coast. At some sites, the abundance of pelagic or migratory species, such as barracuda, tuna, yellowtail, and swordfish, represents a significant shift from earlier fishing practices, particularly after about 2000 years ago.

Many authors have argued that the intensive use of nearshore and pelagic fish may be a response to growing populations, increased reliance on the plank tomol, and use of harpoons and circular fishhooks. There is undoubtedly some truth to such assertions, but these developments are also an outgrowth of fishing practices present since the Early Holocene. Fish remains from early Santa Barbara Channel sites include yellowtail, barracuda, giant sea bass, sardines and herrings, sharks and rays, surfperch, rockfish, sheephead, and other estuarine and marine taxa (Erlandson 1994; Erlandson et al. 1999; Rick and Erlandson 2000; Rick, Erlandson, and Vellanoweth 2001). Rick and Glassow (1999) also reported swordfish, mackerel, and clupeids at SBA-53, a 5100 to 5500 year old site located on the margin of the Goleta Slough. Thus, it appears that people of the Santa Barbara Coast were capable of capturing a wide range of fish and other resources long before Late Holocene economies intensified. Such evidence for continuity in hunting and fishing raises questions about how revolutionary or rapid some of the developments of Late Holocene Chumash society were.

Warfare, Violence, and Health

As several chapters in this volume have pointed out, analyses of skeletal collections by Walker, Lambert, and others show that indicators of resource stress increased during the Late Holocene. The evidence, derived from both mainland and island cemeteries of the Santa Barbara Channel area, is in the form of increased signs of violence (e.g., cranial injuries, parry fractures, projectile wounds) and deteriorating health (criba orbitalia, Harris lines, enamel hypoplasia, declining stature, etc.). The introduction of the bow and arrow may have exacerbated violence and warfare, but an increase in general violence is found as much as 2000 years earlier, and an increase in projectile wounds also predates this introduction (Lambert 1994). Thus, it is unclear whether the introduction of the bow and arrow was a cause of increased violence or a by-product. Much has been made recently of the sharp increase in evidence for violence and health problems between about AD 1150 to 1300, changes that appear to be associated with an extended drought and fluctuating marine productivity (Arnold 1992a; Colten 1993; Kennett and Kennett 2000; Raab and Larson 1997). This view may be supported by an apparent decline in violence among the Late period Chumash, but a number of indicators suggest that health problems, resource stress, and violence persisted into the Late period. Signs of deteriorating health also significantly predate the Transitional period, suggesting that periods of significant resource stress began earlier in the Late Holocene. The relatively high population densities, resource stress, and violence appear to have been general Late Holocene patterns with roots in the demographic expansions and cultural changes of the Early and Middle Holocene.

The Causes of Culture Change

Along the Santa Barbara Coast, the Late Holocene was a period of profound and sometimes rapid technological, social, and political developments. The evolution of complexity among the maritime Chumash was a multidimensional process that spanned millennia and involved the gradual accumulation of technological adjustments, periods of rapid local innovation, diffusion of ideas or technologies from neighboring groups, and other processes. In our view, the rapid cultural changes of the Late Holocene cannot be understood without reference to more ancient and interrelated processes: increasing population densities and the gradual filling of the Santa Barbara Channel and surrounding landscapes; environmental changes, including sea level rise, changes in the relative productivity of terrestrial versus aquatic resources, El Niño cycles, and periods of severe drought; diffusion of innovative ideas and technologies through local and regional interaction networks; and increasing levels of resource stress and social friction.

Although these are clearly trans-Holocene processes, a key period in the evolution of Chumash complexity may have occurred between about 4000 and 3000 years ago. A variety of data suggest that this transition may have occurred when the Chumash and their neighbors had filled much of the coastal and interior landscape, approaching or exceeding a threshold of territorial circumscription (see Carneiro 1970). Prior to this, population densities appear to have been relatively low, and a number of areas along the mainland coast, islands, or interior valleys were probably underutilized at any given time. These open niches allowed groups of people to move their villages in response to local resource shortages or social stress, to avert the sustained overexploitation of key resources, and to avoid many of the conflicts that result from resource shortages or social crowding. As populations grew and the landscape filled with people, however, open niches became increasingly scarce and group territories converged or eventually overlapped.

After local populations reached territorial circumscription, the balance between human resource needs and fluctuations in environmental productivity would have been increasingly precarious. Groups could no longer move into unoccupied or underused areas in response to social and economic stress. Thus, environmental changes that posed relatively limited challenges during the Early and Middle Holocene had more serious consequences on more densely packed Late Holocene populations. This led to the diversification and intensification of resource use within circumscribed group territories, as well as greater socioeconomic interaction among groups to even out inequities in the distribution of resources. In some cases, greater interaction may have led to increased cooperation and economic exchange, in others to more competition and warfare. The need for greater regulation of such interactions is probably reflected in the increasing diversity of shell beads and ornaments that were markers of ethnic or local group affiliation, social status, and wealth. In such socially and environmentally circumscribed societies, the development of more formal social hierarchies based on wealth and power also provided increased opportunities for coercion or exploitation by elite members of society (Arnold 1992a).

Like population pressure and the effects of environmental change, territorial circumscription is difficult to measure archaeologically. There is little direct evidence for when the Chumash became circumscribed, but there is little doubt that Chumash territories were circumscribed when Cabrillo first sailed into the Santa Barbara Channel in AD 1542. We suspect that an acceleration of cultural change about 3500 years ago may indicate that social groups of the Santa Barbara Coast and surrounding areas approached or reached territorial circumscription near the end of the Middle Holocene. About this time, we see the appearance of a number of traits at SBA-119: flexed burials, an abundance of grave goods that may indicate differential access to wealth, evidence for warfare and violent death, and an elaboration of material culture typical of the Canaliño or Chumash culture. Shortly after this time, physical anthropological data suggest that the health of Santa Barbara Channel populations began to decline significantly as resource stress and social conflict increased (Lambert 1993; Lambert and Walker 1991; Walker 1989a, 1989b). By the Late Holocene, the balance between population size and environmental productivity appears to have become increasingly precarious, setting the stage for the significant and rapid cultural changes of the last 1000 to 1500 years.

SUMMARY AND CONCLUSIONS

In this chapter, we examined Late Holocene cultural developments along the Santa Barbara Coast, focusing on the development of various traits of Canaliño or Chumash society described in historical or ethnographic accounts. Our analysis suggests that a number of traits associated with the ethnohistoric Chumash developed incrementally over the past 3500 to 4000 years. We believe that the general sociopolitical and economic complexity historically evident in Chumash society has relatively ancient roots in the earlier demographic expansions and technological developments of the Early and Middle Holocene. Our review of a variety of data culled from several key Santa Barbara coastal sites has led us to a number of conclusions:

- Evidence of significant levels of violence (and probably warfare), elaborated material culture, and accumulations of grave goods with some individuals dating back at least 3500 years ago was found at SBA-119 and SRI-41.
- At some sites on the mainland coast, including SBA-119 and probably SBA-1900 (Erlandson 1997a), such developments seem to be associated with a Late Milling Stone adaptation in which terrestrial plant and animal resources were as significant as marine resources, and fishing appears to have been of limited economic importance.
- At SBA-81, by about 2600 years ago (ca. 650 BC), we see evidence of Chumash-style sedentism, semisubterranean houses, village layout, ceremonialism, and a large cemetery, again in a context in which fishing appears to have limited significance.
- At Tecolote Canyon (SBA-71 and SBA-72) between about 2000 and 500 years ago, we see additional evidence of sedentism, ceremonialism, and site structure typical of the Chumash pattern, violence and probable status differentiation, and the incremental addition of key technologies, such as the circular hook and the bow and arrow.
- At several cemeteries (SBA-119, SRI-41, SBA-71) between about 4000 and 1500 years old, objects found with burials, including a swordfish headdress, a headband decorated with shell beads, eagle or bear claws, charmstones, pipes, bone tubes, whistles, and quartz crystals, match ethnographic descriptions of burial accompaniments the Chumash often interred with their chiefs, members of the religious 'Antap cult, or high status individuals (Hollimon 1990:128-130). These parallels with ethnographic Chumash practices, along with clear evidence of an elaborate and diversified material culture, suggest that fundamental aspects of Chumash society emerged near the end of the Middle Holocene or early in the Late Holocene.
- At SBA-1731, a stratified multicomponent site occupied primarily between about AD 1150 and 1550, evidence of diversified technology and eclectic subsistence typical of the Chumash was apparent. In occupational strata spanning the Middle-to-Late period transition (Arnold 1992a), there appears to be

no evidence of an extended period of warm water or low marine productivity. In fact, fishing and other marine resources seem to have dominated the site economy. SBA-1731 is one of the few Santa Barbara Channel sites known to have been occupied during the Transitional period, possibly supporting the idea that a prolonged drought resulted in an aggregation of Chumash settlements in the area (Erlandson, Kennett, and Walker 1997).

- At SBA-1731, long and sustained settlement seems to have ceased about the time of Cabrillo's AD 1542–3 maritime expedition, which wintered in the Santa Barbara Channel area. It is possible, but by no means clear, that such abandonments were related to the Protohistoric introduction of Old World disease epidemics and related demographic disruptions (Erlandson and Bartoy 1995, 1996; Erlandson, Kennett, and Walker 1997; Glassow, chapter 11, this volume; Preston 1996).
- If such Protohistoric epidemics did occur, their impact on the Chumash may have been temporary, as ethnohistoric accounts and archaeological evidence from historic villages such as Estait (SBA-1491) suggest that Chumash society was thriving when the Spanish first settled Alta California in AD 1769. Evidence from SBA-1491, similar to SBA-1731, suggests a highly diversified economy focused on the relatively intensive harvest of fish. By about AD 1810, however, Estait and most other Chumash villages of the Santa Barbara Coast were abandoned as traditional Chumash society collapsed under the pressures of Old World diseases and colonial oppression.

These interpretations suggest several more general conclusions about the evolution of Chumash society, of cultural complexity in general, and the nature of culture change. First, the complexity of the maritime Chumash was based on a highly diversified subsistence base, including a variety of terrestrial (plant and animal) and marine resources. It was the combination of marine and terrestrial resources, along with the availability of a wide range of such resources in relatively small mainland catchments, that allowed the Chumash of the Santa Barbara Coast to attain very high population densities and considerable cultural complexity. Second, Chumash adaptations were highly variable, not just among the islands, mainland, and interior or north versus east of Point Conception (Glassow and Wilcoxon 1988), but along the Santa Barbara Coast itself. Third, we stressed the evidence for both continuity and change in Chumash society, arguing that many incremental developments in Chumash technology, settlement, demography, and other traits had their roots in the Middle or Early Holocene. While the Late Holocene was clearly a time of relatively rapid culture change, the development of such changes was both gradual and punctuated. Ultimately, evaluating whether gradual versus punctuated cultural changes were more significant is a polarizing exercise that does not do justice to the variability inherent in the archaeological record. The answer to such questions, moreover, will depend not just on the preconceptions of individual researchers, but on the time period examined and the chronological resolution of the archaeological record itself.

Finally, attempts to identify prime movers, such as migration, population growth, or environmental change, to explain the evolution of Chumash society are likely to encounter similar problems. We proposed a multivariate explanation of culture change in which gradual and punctuated evolutionary mechanisms acted in concert and in which multiple causal mechanisms worked synergistically over time to account for the evolution of Chumash society. An important transition seems to have occurred about 3500 years ago when the Chumash of the Santa Barbara Channel area may have reached a threshold of circumscription leading to smaller territories, increased resources, and social stress; greater susceptibility to environmental perturbations; intensification of subsistence and interaction; and accelerated culture change. Another key transition occurred between about AD 500 and AD 1400 during the end of the Middle, Transitional, and early Late periods when the coastal Chumash made a series of technological, economic, and social adjustments to severe demographic and environmental challenges.

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Late Holocene Prehistory of the Vandenberg Region

MICHAEL A. GLASSOW

Only a few relatively long segments of California's coastline face directly west, these being at the northern and southern extremes of the state and along nearly the full length of Vandenberg Air Force Base in the south-central portion of the state. Because of its west-facing coastal lands, Vandenberg Air Force Base receives prevailing northwesterly winds directly off the ocean, which creates a microclimate that strongly influences the coastal and near-coastal environment. As would be expected, prehistoric people living in this environment developed distinctive means for coping with its unique features, and an underlying objective of archaeological research in this region has been to elucidate these means.

For the purposes of this chapter, the region of concern is somewhat larger than the lands encompassed by Vandenberg Air Force Base. It includes the coastal lands between Point Sal on the north (west of the city of Santa Maria) and Jalama Beach on the south (at the mouth of Jalama Creek), as well as the lands 10 to 15 km inland from the coast (figure 11.1). The Santa Ynez River, a major drainage whose watershed extends 120 km eastward from the coast, divides the northern and southern sectors of the region, and the lands south of the river often are referred to as south Vandenberg while the lands to the north are referred to as north Vandenberg. Three other major drainages cross the region from east to west: Shuman Canyon and San Antonio Creek on north Vandenberg, and Honda Creek on south Vandenberg. Relief within the region is generally moderate, the principal exception being the east-west trending Tranquillon Ridge on south Vandenberg. Burton Mesa and the San Antonio Terrace on north Vandenberg and the Lompoc Terrace on south Vandenberg are relatively flat terrace lands, with semistabilized dune hills near the coast. About 15 km inland from the coast these lands rise into hills bisected by canyons with usually gentle side slopes.

The canyon bottoms and flat terrace lands contain patches of freshwater wetlands that enhance the diversity of the region's flora and fauna. A distinctive feature of the vegetation communities is the near absence of oaks within about 5 to 10 km of the coast. Low, often dense, chaparral and grasslands cover most of the region, although willows and other larger wet-loving shrubs and trees are found in canyon bottoms or in mesa or terrace wetlands. The diversity and complexity of vegetation communities, the availability of fresh water in many coastal and inland locations, and the ease of movement over gentle topography meant that prehistoric people living in the region enjoyed many opportunities to acquire plant and animal resources, and as a result, settlement systems placed a good deal of emphasis on mobility throughout the 9000 years of the region's documented prehistory.

I am concerned with prehistoric cultural development during the Late Holocene, which I arbitrarily define as beginning about 3500 radiocarbon years ago. It was during this interval that Purisimeño Chumash culture developed into the form documented, albeit minimally, in the ethnographic and ethnohistoric literature (Greenwood 1978b). My objectives are to survey what is known about cultural change during the Late Holocene, and in doing so, give attention to the issues that have been guiding archaeological research in the region over the past couple decades. As well, I explore explanations for culture change in the region and differences between the region's cultural development and that of neighboring regions.[1]

The Vandenberg region offers unique opportunities for studying Late Holocene prehistory. The most obvious of these is the large number of sites dating to this period. As a result of recent

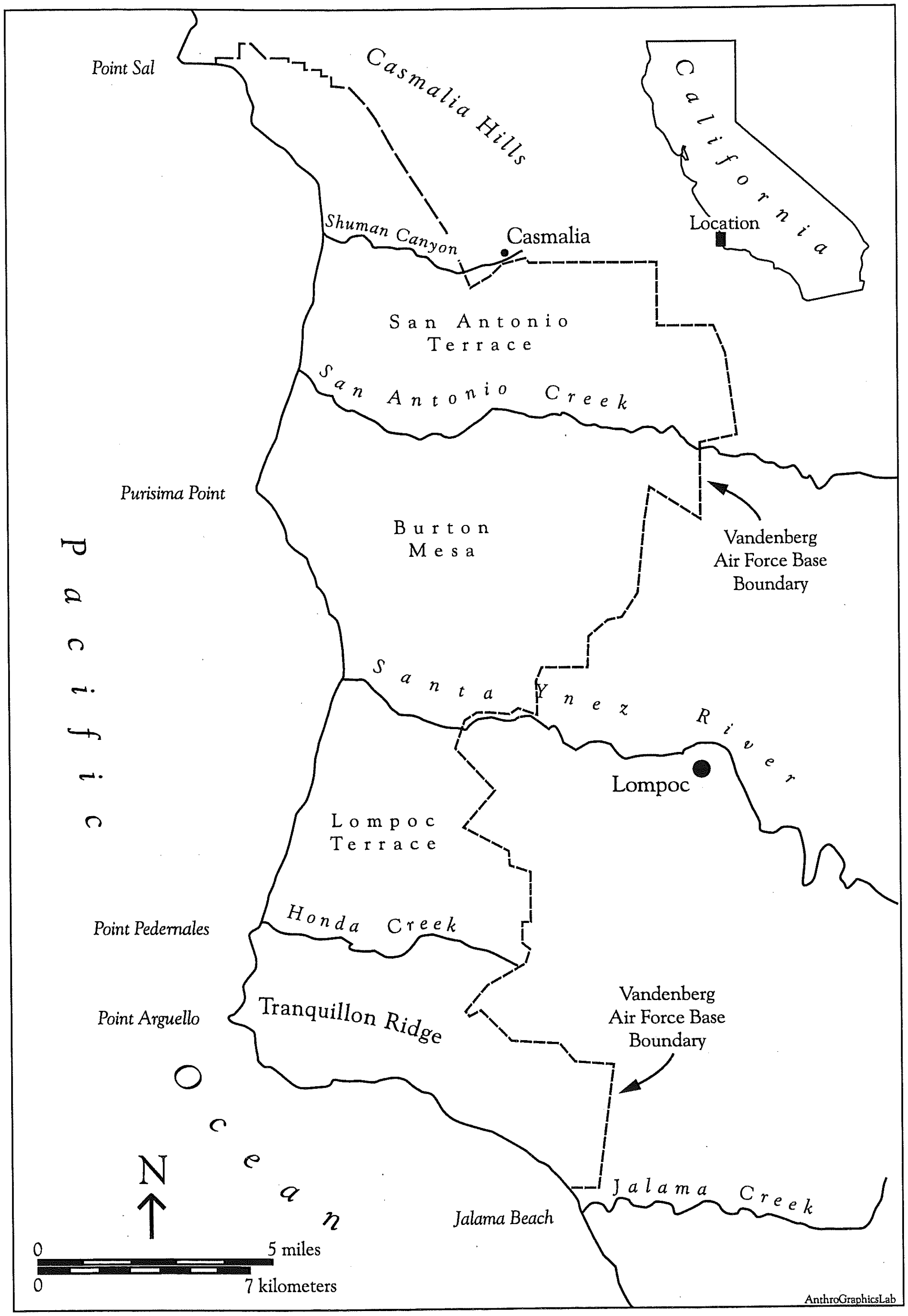

Figure 11.1 The Vandenberg region showing principal geographic features. *Prepared by David Lawson*

archaeological surveys extending over most of the lands of Vandenberg Air Force Base, the number of recorded sites now stands at approximately 2400, and probably more than three-quarters of them were used during the Late Holocene (some earlier as well). A number of these sites, especially those in dunes or capped by protective layers of alluvium, contain very well preserved cultural remains. Furthermore, the sites are in a wide variety of coastal and inland habitats, which implies that an equally wide variety of resource-extractive activities was carried out by site occupants. Finally, many relatively large-scale research projects have occurred during the last two decades, resulting in a substantial body of data and a good deal of information about prehistory. Within the last decade, several of these projects have taken place at sites inland from the coast and have significantly reduced the bias toward coastal sites.

The research issues that have become important to the coastal archaeology of the Vandenberg region are also characteristic of archaeology along the entire California Coast, even though they might be rendered differently by archaeologists who have worked in the Vandenberg region. These research issues include (1) chronology of site occupation, (2) development of maritime adaptations, (3) nature of and change in settlement systems, (4) character of and change in flaked stone tool technology, (5) development of interregional economic exchange, and (6) determinants of culture change. One research issue that has come to the fore in the coastal archaeology of Central and Southern California but has not yet been of concern in the Vandenberg region is the nature of the so-called Middle-Late Period Transition originally identified by Arnold (1992a, 1992b) in her investigations on Santa Cruz Island. Nonetheless, the archaeology of the Vandenberg region should have something to offer in understanding cultural development and its determinants during this interesting interval of time.

STATUS OF CHRONOLOGICAL FRAMEWORKS

Compared to certain other coastal regions of California, the archaeology of the Vandenberg region has not suffered from a plethora of competing chronological schemes. The earliest scheme used, by Carter in 1941, was an adaptation of schemes for the Santa Barbara Channel region developed by David B. Rogers in 1929 and Ronald Olson in 1930 (Carter 1941). No other chronological schemes were proffered until the 1980s, when data from the first large-scale archaeological investigations on the base were being reported (Chambers Consultants and Planners 1984; Glassow et al. 1981; Glassow et al. 1991; Woodman, Rudolph, and Rudolph 1991). At this time the chronological scheme developed by C. King (1974a, 1990) in the 1970s and 1980s for the Santa Barbara Channel area began to be used. This scheme divides prehistory into three periods: Early (5500 to 600 BC), Middle (600 BC to AD 1150), and Late (AD 1150 to 1804). King then divided each of these periods into a series of phases and subphases, the Early period having four, the Middle period having eight, and the Late period having six. I used King's divisions for devising a chronological scheme for analyzing data from sites investigated in light of Space Transportation System development on south Vandenberg (Glassow et al. 1991), but because site deposits were tied to relatively few radiocarbon dates, and collections pertaining to particular segments of time were relatively small and had less than ideal chronological integrity, I used only the period divisions of King's chronology. Only during the long time interval of the Early period did I distinguish between initial and terminal segments.

In recent years, some archaeologists have assigned archaeological deposits at Vandenberg sites to one of King's phases or subphases (for example, Colten et al. 1997; Woodman, Rudolph, and Rudolph 1991). These assignments have been made largely on the basis of suites of radiocarbon dates rather than large assemblages of shell beads that were the basis of King's chronological divisions. Because King linked his chronological scheme to calendar age on the basis of relatively few radiocarbon dates, such assignments may not always be accurate.

On the basis of currently available chronological information, it seems judicious not to be too concerned about how site components might be related to King's or any other chronological scheme. Instead, chronological divisions might simply refer to intervals or points in calendar time, and whichever intervals or points are selected would be those useful in addressing a specific research issue. Considering the substantial increase in the number of dated sites, however, as well as the larger number of ^{14}C dates used to tie many site components to calendar time, considerably finer chronological distinctions are now possible than was the case 10 to 15 years ago. I shall take advantage of this potential here. As mentioned earlier, the Late Holocene is taken to begin about 3500 radiocarbon years ago. In calendar time, this date would be approximately 1800 BC. All dates in this chapter are calendar ages, and I have calibrated all available ^{14}C dates for sites in the Vandenberg region using procedures described later.

In the late 1980s when I was preparing the final report of investigations carried out on south Vandenberg, there were 81 ^{14}C dates pertaining to 29 sites in the Vandenberg region (Glassow et al. 1991:5-3). Today, 237 ^{14}C dates pertain to 62 sites, most of which fall within the Late Holocene. Within the last 15 years, project funds have been available for obtaining much larger suites of dates than was the case prior to the early 1980s, and archaeologists working in the Vandenberg region have recognized the importance of large suites for obtaining a reasonable idea of a site's chronology of occupation. These more intensive dating programs have revealed that occupational histories of the region's sites often are quite complex.

Although artifacts serving as time-markers usually are rare in Vandenberg sites, they sometimes have been useful in chronology building. Some sites, for instance, have been dated to the period after circa AD 1200 based on the presence of *Olivella* callus cup beads (Glassow et al. 1991:12-12, 12-55, 12-136). Other artifacts having some utility in assigning sites to particular intervals of time are shaped mortars and pestles (probably after ca. 2000 BC), J-shaped shell fishhooks (ca. 200 BC to AD 900 [C. King 1990:231–232]), metates and/or manos in abundance (prior to 3000 BC), and contracting stem points (ca. 2500 BC to AD 500). Arrow points that presumably date after AD 500 have been used to date sites in the absence of any other chronological information (Chambers Consultants and Planners 1984:9-22–9-32). Although dating is somewhat tenuous, foliate arrow points appear to have been used between circa AD 900 and 1100, and concave base (Cottonwood triangular) arrow points appear to date after about AD 1200. These point forms eventually may become very useful in dating site occupation during the latter part of the Late Holocene.

EVIDENCE OF ENVIRONMENTAL CHANGE

Although the available evidence makes clear that environmental changes did occur during the Late Holocene, the exact nature and timing of these changes remains equivocal. Three sources of information provide some insight into Holocene environmental conditions and changes within the Vandenberg region: dune formations, fossil pollen, and environmental records pertaining to neighboring regions.

The most obvious evidence of environmental change during the Holocene is the extensive dunefields extending along the coast from Honda Creek on south Vandenberg to the northern limits of the region and beyond. These dunes formed during distinct intervals of time, as indicated by disconformities between more recent dunes and the more ancient dunes below them. Johnson (Chambers Consultants and Planners 1984:4-1–4-83; Glassow et al. 1991:A2-1–A-61) studied the dunes covering much of the San Antonio Terrace of north Vandenberg and defined three distinct formations. Modern Dunes are located immediately above the ocean beach and are whitish in color. They are currently relatively active and probably date within the last 500 years. Intermediate Dunes begin either at the coast or directly behind (inland from) or below Modern Dunes and may extend inland up to 7 km. They are light reddish brown in color and often take the form of longitudinal dunes, especially on the San Antonio Terrace. They usually exhibit weak soil development directly below their surfaces, and they generally have a cover of somewhat dispersed scrub or grassy vegetation, which keeps them relatively stabilized. They appear to have formed sometime between 500 and 5000 years ago. Old Dunes may underlie both Modern and Intermediate Dunes and extend much farther inland. They have lost much of their dunal topography and are capped by moderately developed soils and often denser vegetation than that covering Intermediate Dunes. They formed sometime between 5000 and 13,000 years ago.

These three dune formations usually are easy to distinguish from one another because of differences in color, topography, and soil development. In particular, the inland margins of Modern and Intermediate Dunes often are very distinct. Because of these differences, it is evident that they formed or were most active during distinct intervals of time separated from each other by intervals of lesser activity. The data Johnson used to determine the age of the dune formations do not have the resolution to determine when they were active during the time intervals he assigned to each. Furthermore, no definitive information is available regarding the environmental processes that favored dune formation and movement on the one hand and stabilization on the other. Creation of the Modern Dunes may be related to historic disruptions, including, for instance, the introduction of exotic plant species such as ice plant (*Carpobrotus edulis*) that help to capture sand in one spot. With regard to formation of the Intermediate Dunes, which apparently were active during the early segment of the Late Holocene, decreased vegetation cover during a period of greater aridity may have induced dune movement, but other factors may be of equal or greater importance.

Late Holocene archaeological sites may occur on the surfaces of all three dune formations, but one site, SBA-670, has archaeological deposits dating circa 1750 BC and earlier buried under a 15 m accumulation of Intermediate Dune sand (Glassow et al. 1991:10-1–10-3; Glassow 1996c:62), and much later archaeological deposits, dating circa AD 1400, cap this same dune. This Intermediate Dune therefore dates sometime between these two dates, but no data are available to indicate precisely when. As might be expected in light of the recency of Modern Dunes, a number of coastal sites are buried at least partly under Modern Dune sand. One of these sites dates to circa AD 1150 (SBA-699, Glassow and Gregory 2000), but it seems likely that sites dating even to the Protohistoric period could underlie Modern Dune deposits.

A sand stratum at site SBA-2696, located in the San Antonio Valley about 10.6 km from the coast, separates two archaeological strata. One radiocarbon date pertaining to this stratum is at AD 380, but the stratum above it yielded two dates over a hundred years earlier, and the stratum below has a date only 80 years earlier. At least it may be said that this sand stratum dates sometime between AD 1 and 400. Colten et al. (1997:4.14) believe that the stratum indicates a period of increased aridity. If so, comparable evidence of dune activity eventually should be found elsewhere, presumably closer to the coast. SBA-1010, a site located about 2 km upstream, lacks a distinct sand stratum, but this absence may be due to a more active alluvial setting. Nonetheless, this site appears to have a hiatus of occupation in the early centuries AD, perhaps when the sand stratum at SBA-2696 was formed (Woodman 1997:5-15–5-16).

Fossil pollen profiles appear to have a good deal of potential in delineating the vegetation history of the Vandenberg region, although there are problems in interpreting the existing pollen data. In the late 1970s Batchelder (Glassow et al. 1991:A3-1–A3-8) made an abortive attempt at palynology in connection with the Space Transportation System project on south Vandenberg. Work on an archaeological project along an oil pipeline route was more successful. Pollen profiles were obtained from sediments in two northern tributaries of the lower Santa Ynez (Lompoc) Valley (Woodman et al. 1991:72–93). These two profiles appear to indicate a shift from warm-dry to cool-wet conditions about 2900 BC or perhaps a few hundred years later. In addition, one of the profiles indicates that a warm-dry interval occurred between about AD 400 and 1000. One of the problems in interpreting the pollen data is that dating of the profiles is relatively loose. Two of seven ^{14}C dates for one of the profiles were out of stratigraphic sequence and rejected, as were three of the ten dates for the other. These high proportions of rejected dates imply that some of the accepted dates also may be inaccurate. Another problem is that the profiles may in part reflect microenvironmental conditions that shifted for reasons other than climatic change. Moreover, recent paleoenvironmental data from the Santa Barbara Channel region imply that precipitation and temperature were not necessarily correlated in the form of warm-dry and cool-wet combinations (D. Kennett 1998:305; see also chapter 9, this volume). Such problems as these surely can be resolved as the number of pollen profiles for the region increases and as dating of the profiles improves. At present, however, it is not clear what the two profiles are telling us about regional environmental change.

Several archaeologists working in the Vandenberg region have used the seawater paleotemperature curve produced by Pisias (1978) on the basis of changes in species of fossil radiolaria extracted from a marine sediment core taken from the Santa Barbara Channel. A recent study by Kennett and Kennett (2000; see also D. Kennett 1998:242) of fossil foraminifera obtained from another Santa Barbara Channel marine sediment core reveals a much different record of water temperature change. Because this record is associated with a large suite of ^{14}C dates and is based on the well-established use of oxygen isotopes to infer water temperature, it may be more accurate than Pisias's paleotemperature record (see Kennett and Conlee, chapter 9, this volume). The seawater paleotemperature record is significant because it serves as a proxy for air temperature, one of the components of climate, and it also may be used to infer changes in the productivity of certain categories of marine life that served as prehistoric food sources. For the Late Holocene, the Kennetts' seawater temperature curve shows a relatively abrupt shift from very warm to cool water temperatures at about 1700 BC and a shift back to moderately warm water temperatures about 700 BC. In addition, it shows a shift to very cool water temperatures about AD 300 and a shift back to warm water temperatures about AD 1500.

No clear correlation may be discerned between these different sources of paleoenvironmental information, although there are some possibilities. The shift to cool water conditions circa 1700 BC may correlate with the abandonment of SBA-670 and perhaps the onset of Intermediate Dune sand accumulation. Similarly, the time interval when dune sand accumulated at SBA-2696 may correlate with the onset of cool water conditions at about AD 300. The vegetation change noted in one of the pollen profiles from the northern margin of the Lompoc Valley as beginning about AD 400 actually may have been caused by a shift to cool-dry rather than warm-dry climatic conditions, which would make the pollen record consistent with the Kennetts' paleotemperature curve. These possible correlations remain speculative until more and better paleoenvironmental information is available, but they are worth keeping in mind when evaluating evidence of Late Holocene cultural changes. Moreover, it is noteworthy that available paleoenvironmental data clearly demonstrate that the environment was not stable during the Late Holocene and that there were intervals hundreds of years long when environmental conditions were significantly different from today's.

DEVELOPMENT OF MARITIME SUBSISTENCE

In general, the Late Holocene development of maritime subsistence parallels that of the Santa Barbara Channel and regions to the north, but there are notable differences. One significant difference is a lack of utilization of estuarine resources, because the coast of the Vandenberg region had no estuaries or enclosed bays, such as the Goleta Slough along the Santa Barbara Channel to the south or Morro Bay along the San Luis Obispo County Coast to the north. The Vandenberg coastline is blessed, however, with broad intertidal rocky shelves at headlands that produced large quantities of shellfish and other marine life. Although the strong surf created by the west-facing exposure of the coastline fostered this productivity, it also prevented the use of

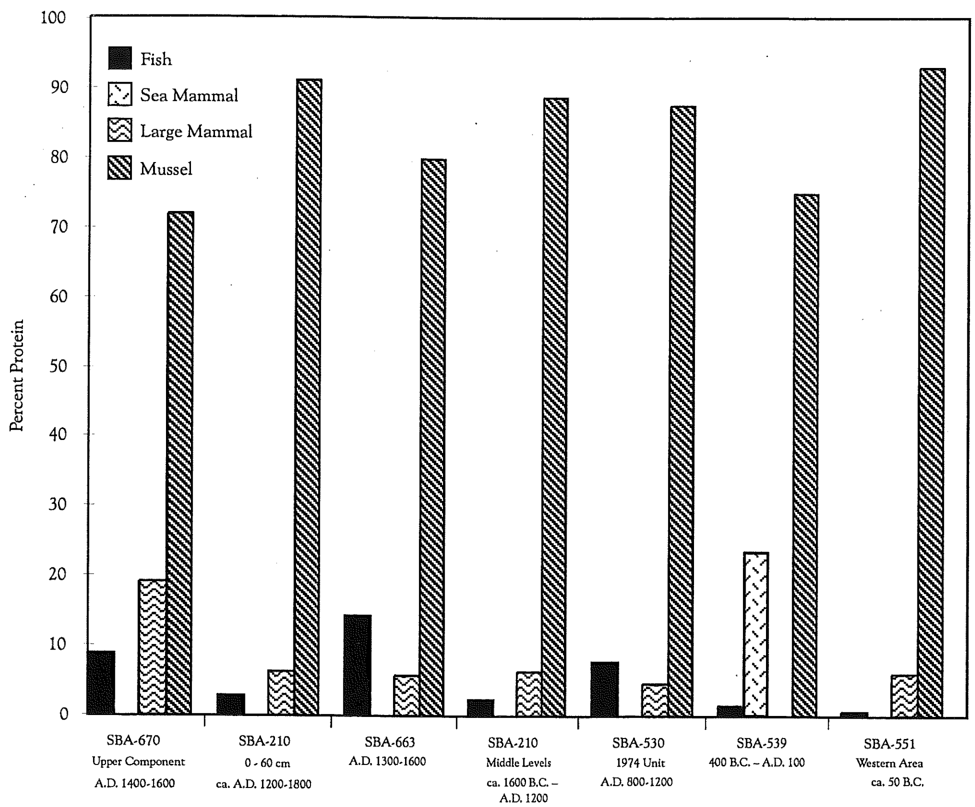

Figure 11.2 Relative dietary contribution of protein derived from fish, sea mammals, large mammals, and mussel. Data come from column samples obtained from coastal sites in the Vandenberg region. For SBA-539, sea mammal bone was distinguished from other large mammal bone, for the other sites it was not. *Data derived from Glassow 1996c:125*

watercraft commonly employed along the bight south of Point Conception. Indeed, the Chumash plank canoe was not in use along the Vandenberg Coast at the time of European colonization (A. Brown 1967:5–6). As a consequence, not only was fishing not done from boats, it was not consistently easy from shore. The exception to this generalization is the relatively small segment of south-facing coastline along the southern extreme of the region between Point Arguello and Jalama Creek. The waters here are generally much quieter, and although not ethnographically or ethnohistorically reported, it is conceivable that watercraft could have been used along this stretch of coastline at some time in the past.

Four categories of marine resources were important to Vandenberg populations of the Late Holocene: shellfish, sea mammals, fish, and aquatic birds. Each category had a different role in the development of maritime subsistence in the Vandenberg region, because their place in the subsistence system tended to vary independently through time.

Shellfish

While populations occupied residential bases and camps at or very near the coast, shellfish was the dominant animal food source throughout the Late Holocene with respect to both meat and protein weight (figure 11.2). Fish, sea mammals, and land mammals contributed varying amounts to the diet, but shellfish, especially California mussel (*Mytilus californianus*), was the mainstay. Even though shellfish would be ranked relatively low using the resource evaluation criteria of optimal foraging theory, the yields from higher ranked resources either were periodic or generally lower (Glassow and Wilcoxon 1988). Despite this constancy in the importance of shellfish, the dietary contribution of both marine and terrestrial vertebrates was clearly significant, and their role in subsistence varied through time.

Sometime after about AD 1200 shellfish collecting apparently intensified on south Vandenberg to the point that mussel had to be supplemented to a greater extent by smaller species of intertidal shellfish, especially the black turban (*Tegula funebralis*). This is most evident in the shellfish data from SBA-670, which show a higher proportion of black turban in the deposits dating after AD 1400 than in earlier deposits at this site or at nearby SBA-539 (Glassow 1992c:127; 1996c:135–136). A similar pattern may be seen in the shellfish assemblage from SBA-210. Nonetheless, mussel remains the dominant shellfish collected throughout the Late Holocene, and its decline late in prehistory is only on the order of several percent of the total shellfish food value.

At first glance, sites at and near Purisima Point on north Vandenberg appear to reflect such intensive shellfish collecting that black turban began to approach mussel in food value. At SBA-699, for instance, a site occupied circa AD 1180, black turban shell is between 40 and 50% of the total shellfish weight (Glassow and Gregory 2000), while elsewhere in the region it is usually only a few percent. The intertidal zone in the vicinity of Purisima Point differs, however, from those elsewhere along the region's coast in not containing extensive mussel beds. In contrast, black turban is relatively abundant. Consequently, the ratio of mussel to black turban at SBA-699 and other sites at or near Purisima Point simply reflects the relative availability of these two species in the nearby intertidal zone.

Of course, a decline in the size of mussels being collected from a specific locality would clearly indicate increasing collection pressure on mussel populations. The most definitive demonstration of a decrease in the size of mussel shells through time is an analysis performed by Colten et al. (1997:7.22–7.24) of an assemblage from inland site SBA-2696. Using a method developed by Moore for inferring mussel size from fragments (Moore et al. 1988:B1–B16), Colten et al. documented a decline in the size of mussel shells through the three intervals of time that the site was occupied, spanning a period between roughly 800 BC and AD 600.

Moore's earlier analysis found that the size of mussels at SBA-1816 was unusually small, which he interpreted as evidence of intensive collecting. An analysis of whole mussel shell sizes at SBA-699 (Glassow and Gregory 2000) also revealed that mussels collected by the site's inhabitants were very small, so small in fact that their size distribution was beyond that which Jones and Richman (1995:48) infer as evidence of stripping all mussels, regardless of size, from a patch of intertidal rock. Measurement of live mussels in beds near the site revealed that the maximum size of live mussels today is consistent with that of the SBA-699 mussel valves. Although data concerning variation in the size of mussels living along the Vandenberg Coast do not exist, personal observation reveals significant variation. Consequently, if the location or locations of mussel collecting by a site's population has not been ascertained, the average or maximum size of mussel valves present in an assemblage is not necessarily an indication of the intensity of collection.

One might also question the procedure Moore and Colten et al. used to infer mussel valve length from fragments. This procedure entails measurement of valve width one cm from the valve's apex. Moore does not present the details of the study upon which the procedure is based, and it is not likely to be sensitive if mussels were collected from beds with a high degree of crowding, which tends to distort the breadth of mussel shells as they grow larger. At present, therefore, evidence of increasing intensity of mussel collecting based on width measurements or even whole valve measurements is equivocal.

Sea Mammals

Sea mammals were important to subsistence beginning in Early Holocene times in the Vandenberg region, although few faunal assemblages from Vandenberg sites contain more than a few bones identifiable to species. Identified pinnipeds usually include California sea lion (*Zalophus californianus*) and harbor seal (*Phoca vitulina*). Southern (Guadalupe) fur seal (*Arctocephalus townsendii*) (Hudson 1994:C-5, C-13) and northern fur seal (*Callorhinus ursinus*) (Glassow et al. 1991:9–14) were also identified in bone assemblages. Fur seal species identifications should be treated as suspect due to difficulties in distinguishing among them (C. Williams 1996), although northern fur seal would be expected to have been present along the Vandenberg Coast. Bones of California sea otter (*Enhydra lutris*) commonly occur in coastal sites of the region, but their numbers are always very low. Despite the rarity of species-identified pinniped and sea otter bone in Vandenberg sites, bones identified at least to the order Pinnipedia are nonetheless a prevalent component in many faunal assemblages. This apparent contradiction is due to the tendency for pinniped bones in Vandenberg sites to break into pieces too small for identification to family, genus, or species.

Pinnipeds appear to have been relatively more important to subsistence from about 200 BC and AD 1200, as indicated by relatively higher proportions of bone in deposits at SBA-210 dating to this period (Glassow 1992c:121–123, 1996c:126; C. Williams 1996) and the unusually high densities of pinniped bone at SBA-539, SBA-551 (western part), and SBA-662. With the partial exception of SBA-539, none of the sites is associated with an adequate number of ^{14}C dates to understand the details of its depositional history, so it is possible that the importance of sea mammal hunting may have varied considerably through the period between 200 BC and AD 1200, let alone the periods before and after this interval. In general, sea mammals appear to have contributed proportionally less to the diet after AD 1200. Sea mammal hunting apparently continued to be an important pursuit in the vicinity of the prime pinniped haulout near Point Arguello on south Vandenberg. Here, a post-AD 1200 component (the eastern portion of SBA-551) yielded quantities of pinniped bones a good deal smaller than those from deposits at this site dating before AD 1200. Nonetheless, sea mammals contributed relatively more to the diet of the site inhabitants than was the case at other post-AD 1200 sites (Glassow 1992c:124).

Techniques for hunting sea mammals are uncertain. Hauled out pinnipeds could at times have been dispatched with weapons as simple as a club, but the contracting stem points in sites of this period (for example, at SBA-539) may have tipped darts or spears used in sea mammal hunting.

Table 11.1. Frequencies of taxonomically identified fish bones from Late Holocene sites of the Vandenberg region

TAXON		SBA-224	SBA-225	SBA-530	SBA-539	SBA-670*	SBA-699	SBA-1010	SBA-2696
Sardine/anchovy	Clupeidae/Engraulididae	2	26	32	562	68	4	7	153
Surfperch family	Embiotocidae	37	51	113	50	9	4	86	
Cabezon	*Scorpaenichthys marmoratus*	4	6	2	23	1	2	6	
Rockfish	*Sebastes* spp.	88	59	17	13	9	9		
Pacific mackerel	*Scomber japonicus*		1	3	2				
Pacific herring	*Clupea pallasii*		7						
Topsmelt	*Atherinops affinis*	1	2						
Kelp greenling	*Hexagrammos decagrammus*	1	1						
Opaleye	*Girella nigricans*	1							
Lingcod	*Ophiodon elongatus*	2		2					
California barracuda	*Sphyraena argentea*			1					
Kelp Bass	*Paralabrax clathratus*	4							
Jackmackerel	*Trachurus symmetricus*	2							
Black Croaker	*Cheilotrema saturnum*	1							
Giant Kelpfish	*Heterostichus rostratus*		1						
Silverside family	Atherinidae			1					
Sheephead	*Semicossyphus pulcher*	1	1		1				
Monkeyface prickleback	*Cebidichthys violaceus*		2						
Pacific hake	*Merluccucius productus*		23						
California halibut	*Paralichthys californicus*	1	7						
Right-eye flounder	Pleuronectidae		1						
C-O turbot	*Pleuronichthys coenosus*	1							
Shovelnose guitarfish	*Rhinobatos productus*	1	1						
Soupfin	*Galeorhinus zyopterus*		1						
Smoothhound	Triakidae	5		1					
Salmon shark	*Lamna ditropis*		1						

*Upper midden stratum only.

On the basis of pinniped bone analysis from sites SBA-210 and SBA-552, C. Williams (1996) argued that pinniped hunting took place at local haulouts rather than at such distant breeding grounds as San Miguel Island. Furthermore, on the basis of increases in sea mammal species diversity through time, he proposed that hunting pressure on pinnipeds increased through the course of prehistory. In particular, his taxonomic identifications reveal that resident breeders (harbor seals) became more important through time, even though migratory breeders (for example, California sea lions) continued to be hunted.

Fish

Although marine fish never became as important to the prehistoric diet as they did along the Santa Barbara Channel, they were a consistent component. A notable increase in the proportional contribution of fish to the diet appears to have occurred sometime around AD 1200 or 1300, but not all sites dating after this time show this pattern. In fact, the dietary importance of fish to the inhabitants of SBA-210 increased only minimally after this date. Much of the intersite variation in the importance of fish is probably due to differences in habitat circumstances and the role of a site in a settlement system.

The date when single-piece shell fishhooks came into use in the Vandenberg region is not clearly established, but the presence of J-shaped mussel shell hooks at SBA-539 implies that this type began to be used sometime between 400 and 50 BC. The impact of the use of the shell fishhook on fishing is not yet apparent in that sites dating prior to its introduction contain many of the same taxa (for example, SBA-931, Glassow et al. 1991:11–61) as those sites containing shell fishhooks. Four taxa are present at essentially all coastal (and some interior) sites for which information is available (table 11.1): sardine/anchovy (small clupeids and engraulids), surfperches, cabezon, and rockfish. A wide variety of other taxa are also represented in Late Holocene sites, but the number of skeletal elements per taxon almost always is very small. Nearly all of the taxa represented in assemblages of fish remains could have been caught from shore, and most probably were caught with hook and line. Sardines and anchovies must have been caught with dip or cast nets, although it is possible that some of the vertebrae of these small fish entered site deposits as the stomach contents of sea mammals. This may be the case at SBA-539, which has by far the largest quantity of sardine/anchovy vertebrae in its fish bone assemblage (86% of the total identified vertebrae) and also contains significant quantities of sea mammal bone. Surfperches also may have been caught with nets, although they can be caught with hook and line. Because of the small size of vertebrae represented in the assemblage from SBA-530, Salls (1994:C-8 – C-9) proposed that the site's inhabitants used beach seines. In addition to hook and line and nets, some fish may have been captured by hand in tide pools. Bowser (1997:C-4) also proposed that "poke poles," traps, spears, and harpoons could have been used.

Some researchers have entertained the possibility that boats were used for fishing along the Vandenberg Coast some time during the Late Holocene. Bowser (1997:C-4) pointed out that if pacific hake (*Merluccius productus*), several bones of which are present in the SBA-1010 assemblage, actually was fished and not fortuitously acquired as sea mammal stomach contents, boats must have been used. Colten et al. (1997:8.3) also point out that capture of such species as Pacific mackerel (*Scomber japonicus*) and California barracuda (*Sphyraena argentea*) may have required the use of boats. Yet, the rarity of the bones of these species implies that they were acquired either by chance near shore or through trade with peoples of the Santa Barbara Channel. Although there is no compelling evidence for the use of boats at any time during the prehistory of the Vandenberg region, the number of assemblages of identified fish bones currently is too small to be confident that boats were not used. Furthermore, because of the limited knowledge of fish behavior in waters along the Vandenberg Coast, the chances of acquiring particular species from shore generally cannot be estimated.

Aquatic Birds

Both marine and terrestrial aquatic birds probably were more important to the Late Holocene diet than the numbers of their bones in faunal assemblages imply. Because of their fragility, bird bones frequently break into pieces so small that they cannot be confidently identified as pertaining to the class Aves, let alone to a particular species. Nonetheless, the number of assemblages with identified avian bones is large enough to discern distinct patterns. The most consistent pattern is a relatively high proportion of cormorant bones in assemblages from sites at or very near the coast. Three species are represented: double-crested cormorant (*Phalacrocorax auritus*), Brandt's cormorant (*P. penicillatus*), and pelagic cormorant (*P. pelagicus*) (Guthrie 1991:A5-1–A5-19). Their prevalence probably is related to both their relative abundance along the coast and the ease of their capture while roosting (Guthrie 1993:163). A wide variety of other aquatic birds is also represented in assemblages, with the number of taxa often ranging between 10 and 20.

SBA-690 and -1040, two sites dating after about AD 1200 and located adjacent to the mouth of the Santa Ynez River, contain unusually high densities of bird bone, and the bulk of the bone is of aquatic terrestrial species such as green-winged teal (*Anas crecca*), cinnamon teal (*A. cyanoptera*), ruddy duck (*Oxyura jamaicensis*), and American coot (*Fulica americana*). These two sites are adjacent to a lagoon surrounded by dunes in the river bottomlands, and the birds undoubtedly were acquired from this lagoon and perhaps other wetlands that may have existed in the vicinity. No other sites in the Vandenberg region have yielded such high concentrations of bird bone, implying that these two sites were used for intensive acquisition of aquatic birds quite late in prehistory. Bones of various species of ducks were collected from SBA-1010, a site adjacent to a large interior wetland (Woodman 1997:B-6), but the density of bird bone at this site is far lower than that at SBA-690 and SBA-1040.

EVOLUTION OF MARITIME SUBSISTENCE

In general terms, the Late Holocene development of maritime subsistence in the Vandenberg region appears rather conservative. While populations occupied coastal or near-coastal sites, shellfish remained the principal food throughout the Late Holocene, as it was during the Early and Middle Holocene. With respect to dietary contribution, shellfish contributed more than 70% of the protein to the Late Holocene diet (Glassow 1992c:121, 1996c:125). Fish, sea mammals, and aquatic birds contributed much of the remainder. It must be kept in mind, however, that not all subsistence was maritime. Terrestrial fauna, especially deer and rabbit, also contributed protein and calories to the diet, although the available data imply that the contribution of these sources was more or less on a parallel with fish and sea mammals (Glassow 1992c:122–124, 1996c:126–127).

Terrestrial plant foods were also of some importance, although their dietary contribution remains largely unknown. Two baking pits (earth ovens) encountered at SBA-2767, located just south of Shuman Canyon about eight km inland from the coast, yielded the clearest evidence of plant foods so far encountered in the region (Lebow and Harro 1998). Carbonized yellow nutgrass tubers were present in both baking pits, which date sometime between AD 1205 and 1460 (Lebow and Harro 1998:3.4–3.17, 3.22, 3.23). Of course, the dietary significance of nutgrass tubers cannot be determined on the basis of this one find, but it does suggest that plant foods may have been much more important to the diet when populations occupied interior sites than when they occupied coastal sites.

Despite the apparent conservatism in the development of maritime subsistence, some notable changes did occur. First, there is some evidence of intensification of shellfish collecting through time. This intensification may have begun as early as circa 200 BC if the data from SBA-2696 are indicative, but it is otherwise apparent in the archaeological record dating after AD 1200. Second, shell fishhooks began to be used for fishing by 50 BC, if not as early as 400 BC, although the impact of this form of hook and line fishing is not yet apparent. Third, fish became relatively more important to the diet sometime after AD 1200, even though shellfish continued to be a dominant source of protein.

Fourth, there is some evidence that pinniped hunting was relatively more important some time around 200 BC than it was either earlier or later. Finally, intensive acquisition of aquatic birds from the lagoon at the mouth of the Santa Ynez River began sometime after AD 1200. These patterns imply that the process of maritime subsistence intensification was complex. The most obvious evidence of subsistence intensification comes from sites dating after AD 1200, when fishing and fowling became noticeably more important.

SETTLEMENT SYSTEM CHANGE

Any archaeologist considering the nature of settlement systems in the Vandenberg region is immediately impressed with the region's unusually high site density. This high density would seem to be a result of a high degree of residential mobility, which appears to have been as much the case during the Late Holocene as it apparently was during the Early and Middle Holocene. One must keep in mind, however, that sites are dense in large part because of their visibility. Abundant shellfish remains mark site locations even at some distance from the coast, and substantial quantities of chert debitage may otherwise define a locus of human activity. Nonetheless, ethnohistoric data hint at a relatively high degree of mobility at the time of the Spanish land expeditions through the region in the 1770s (King 1984:I-27–I-28; see also Glassow 1996c:15).

Characterizations of settlement systems in the Vandenberg region have been based largely on knowledge about sites at or near the coast. As more archaeological investigations have been carried out in the interior of the Vandenberg region (Colten et al. 1997; Woodman 1997; Woodman et al. 1991), it is increasingly apparent that an understanding of regional settlement systems requires greater attention to interior sites. Interior sites commonly contain shellfish, fish, and marine mammal remains that reveal some kind of articulation with the coast (Colten et al. 1997:6.8, 7.7, 8.2; Woodman 1997:6–6, 7–3; Woodman et al. 1991:151, 156). The importance of these sites in a settlement system should come as no surprise, considering that three of the seven historically documented Purisimeño Chumash village locations are in the interior. Specifically, Lompo' was located in the Santa Ynez Valley about 5 km from the coast, near the modern city of Lompoc. Step was located along San Antonio Creek about 11 km from the coast, and S'axpilil was located just south of Shuman Canyon, about 9 km from the coast near the modern town of Casmalia. Coastal settlements, including Shilimaqshtush, Noqto, Lospe, and 'Ataxis (the locations of the latter two are not firm), were located at the coast on the lee side of points of land (McLendon and Johnson 1998: figure 3.1). At the time of Spanish colonization, at least, inhabitants equally preferred interior and coastal locations as main residential bases.

Of all the historically documented Purisimeño Chumash villages, Noqto (SBA-210) was in the most favorable location with respect to access to coastal resources and protection from wind and fog. Located 5.2 km east of Point Arguello along the longest stretch of south-facing coastline in the region, the site is protected by Tranquillon Ridge from much of the wind and fog prevailing along the west-facing coastline to the north. Because of its favorable location, Noqto and the adjacent site, SBA-552, were probably a principal residential base throughout the Late Holocene, and the substantial deposits dating to the Early and Middle Holocene imply that this role within a settlement system may have persisted for about 8000 years (Glassow et al. 1991:12-2–12-80; Glassow 1996c:86–89).

A site such as Noqto obviously was the focal point of a settlement system. For present purposes, I call a site such as Noqto a "principal residential base," that is, a site where residential occupation lasted over significantly longer periods during a year than at other residential bases, usually on the order of months. Typically, a principal residential base would be occupied at least during winter months, but this may not always have been the case. In contrast, a subsidiary residential base is a site that inhabitants occupied for much shorter periods, generally on the order of a few days to several weeks. Activities carried out at a principal residential base are generally more diverse and tend to involve relatively greater attention to maintenance of technology used for food acquisition and processing, whereas the activities carried out at subsidiary residential bases tend to be more restricted and sometimes focused on a narrow set.

In attempting to understand Late Holocene settlement systems and their change through time in the Vandenberg region, it is well to keep in mind that principal and subsidiary residential bases, as defined here, may have articulated with settlement systems in a variety of ways. Indeed, the dominance of a principal residential base such as Noqto may have varied through time. At the time Spanish expeditions visited the village in the 1760s and 1770s, it probably was occupied through the winter months, and segments of the village population likely resided there during summer months as well. Earlier in prehistory, however, the site may have been the most favored residential base among several, and its use during winter months may not have been so exclusive. In other words, drawing a dichotomy between the settlement system type characteristic of "collectors" and "foragers" (Binford 1980) would not always be useful in constructing models of Late Holocene settlement systems of the Vandenberg region. The degree of differentiation between principal and subsidiary residential bases is best viewed as continuous.

Other researchers in the Vandenberg region have drawn a distinction between different kinds of residential bases similar to the one I make here. For example, in their study of sites near the mouth of Spring Canyon on South

Vandenberg, Moore et al. (1988:12-1–12-3) distinguish between a "long-term residential base" and a "short-term occupation site." They define a long-term residential base in much the same way I describe a principal residential base. Their short-term occupation site is, however, a locus where occupants focused their energies on a narrow set of closely related activities and did not necessarily occupy again. Their dichotomy is, in fact, between two ends of a broad spectrum of residential settlement, and it does not incorporate the considerable variation that surely existed between these two ends.

Settlement systems of the Vandenberg region included many other kinds of sites beyond residential bases, and some that did serve as residential bases were occupied for reasons other than to carry out the routine tasks related to survival. For instance, Swordfish Cave (SBA-503), a rock art site located near the head of Honda Canyon, yielded evidence of occupation between 1600 and 1450 BC. Large nodules of red ocher in the deposits are strong evidence that at least some of the rock art in the cave was produced at this time (Lebow and Onken 1997). During this time, Swordfish Cave may have served as a shrine, with residence entailing the practice of religious ritual.

In an effort to understand the nature of settlement system change on the San Antonio Terrace on north Vandenberg, I classified the sites investigated in the course of the MX project (Chambers Consultants and Planners 1984:10-14–10-15) into a series of settlement types: seasonal residential bases, overnight camps, and day-use locations (consistent with Binford's [1980] settlement type classification). This classification was based on density of shell and bone, density and diversity of artifacts, density of chert flakes, density of fire-affected rocks, presence of asphaltum, and degree of soil discoloration. It took into consideration arguments developed by Bamforth, who analyzed the flaked stone collections from the project sites (Bamforth 1984:9-94–9-99). Dating of the sites in most instances was based on the presence of projectile points, arrow points being indicative of occupation sometime after AD 500 and dart points being indicative of occupation prior to this date. My analysis revealed that sites classified as seasonal residential bases were located along the southern edge of the San Antonio Terrace, adjacent to the bottomlands of the San Antonio Creek. These sites dated after circa AD 500. Overnight camps occupied prior to AD 500 and day-use locations occupied after AD 500 were also present along the terrace edge. Immediately to the north of the terrace edge was a series of sites classified as day-use locations, which dated both before and after AD 500. Finally, toward the northern margin of the San Antonio Terrace were three sites classified as overnight camps—two dated pre-AD 500 and one dated post-AD 500. In my analysis, this pattern indicated that settlement systems encompassing the San Antonio Terrace shifted through time. During the pre-AD 500 period, populations were relatively mobile and wide ranging while occupying the terrace, using only overnight camps and a few day-use locations. After AD 500, terrace edge residential bases began to be used, and their occupants used relatively nearby day-use locations.

In a later study of San Antonio Terrace sites, Tetra Tech, Inc. archaeologists reached different conclusions regarding the manner in which the resources of the stabilized dune area of the terrace were used (Tetra Tech, Inc. 1990:9-17–9-57). First, the Tetra Tech archaeologists argued that the evidence for an earlier and later use of the terrace was weak in that the large contracting stem points used to identify earlier occupation could have been used during the later period as well. They based this argument on Greenwood's (1978b:522) conclusion that contracting stem dart points were contemporaneous with arrow points at sites she investigated at Diablo Canyon along the coast of San Luis Obispo County. Second, they argued that the evidence that hunting was the predominant activity on the dune area was equivocal, and they proposed that plant collecting was probably more important. Specifically, they felt that the sample of tool edges identified through microwear analysis as being associated with meat butchering and hide preparation is too small and not sufficiently definitive to indicate that the majority of the flaked stone tools were hunting related.

While identification of the time depth of occupation of the San Antonio Terrace remains tenuous, the form and size of contracting stem projectile points found as either isolates or within sites on the terrace are typically associated with sites or site components elsewhere in the region dating prior to circa AD 500, their prevalence at SBA-539 being an example (Glassow et al. 1991:9–13). Greenwood's contention that contracting stem points and arrow points were contemporaneous at Diablo Canyon fails to consider the strong likelihood that gopher burrowing mixed earlier and later deposits, which typically is extensive in coastal California middens with a loamy soil matrix. At SLO-2 small-leaf shaped points (Greenwood's type 2a, undoubtedly arrow points) are found most frequently in the upper 100 cm of the site deposits, whereas contracting stem points (Greenwood's type 6a) are most often found between 50 and 150 cm (Greenwood 1972:13). A similar situation may be seen in the distribution of points at SBA-210 on south Vandenberg, where leaf-shaped arrow points (type 4A) and contracting stem dart points (type 9) were similarly distributed vertically but with obvious differences in concentrations (Glassow et al. 1991:12–21). Although the extent to which populations continued to make large points after the introduction of the bow and arrow sometime around or after AD 500 remains an open question, it is reasonable to propose people inhabited the San Antonio Terrace before and after AD 500.

With regard to whether the stabilized dune area of the terrace was used mainly for hunting or plant food collecting, the argument Tetra Tech archaeologists made is based largely on the modern distribution and abundance of plants and animals on and adjacent to the terrace rather than on definitive archaeological evidence. Although Bamforth's analysis may be questioned in light of the small samples of tool edges with identifiable use-wear, these and the projectile points indicate that at least some hunting did take place on the terrace. The Tetra Tech archaeologists pointed out that deer actually would have been more prevalent in the bottomlands near San Antonio Creek, just south of the terrace, where they propose that hunting would have been concentrated. An emphasis on hunting in this locality would not, however, necessarily preclude occasional hunting forays into the stabilized dune area of the terrace. On the basis of currently available data, it seems reasonable to conclude that the settlement system change Bamforth and I proposed remains a viable hypothesis and that the relative importance of hunting and plant collecting will require further research to determine.

A number of other archaeologists working in the Vandenberg region have grappled with the nature of and change in Late Holocene settlement systems. To date, Woodman, Rudolph, and Rudolph (1991) arguably made the most concerted effort to discern change in settlement systems within a segment of the Vandenberg region, and their analysis is influencing others doing research in the region (for example, Doyle et al. 1996). Woodman and his colleagues' analysis considered a string of sites along a pipeline corridor from the coast near the mouth of the Santa Ynez River to a location inland near the northern end of Santa Lucia Canyon, about eight km from the coast. As an aspect of their analysis of the place of sites in settlement systems, they attempted to define both the duration of occupation, through stratigraphic analysis and radiocarbon dating, and the extent of reuse, based on the areal complexity in the distribution of different categories of cultural remains. In her analysis of settlement change in the project area, Rudolph (1991:328–338) argued that Middle period sites were located in a more restricted set of environmental zones, most being in the floodplain/terrace zone near the Santa Ynez River, whereas Late period sites were distributed relatively evenly in a variety of environmental zones, including not only the floodplain/terrace zone but also the inland/marsh, inland/upland, and coastal strand zones. This shift toward occupation of a greater diversity of environmental zones after about AD 1200 also is seen on south Vandenberg (Glassow et al. 1991:13–25; Glassow 1996c:136–137) and appears to reflect more intensive use of the region's resources.

Woodman and his colleagues' attempt to ascertain the duration of occupation and extent of reoccupation is both creative and provocative. Their argument that site structure, that is, the areal and vertical distribution of different categories of cultural remains, can provide useful information regarding a site's function and its place within a settlement system is justified, but their reasoning seems to oversimplify the site formation processes that create complexity in distributional patterns. In particular, areal complexity in distributions is not necessarily indicative of reoccupation. For instance, several discrete residence groups occupying a site for a period of several months during only one year are likely to create a more complex pattern than a single group that occupied a site for a few weeks at a time over a period of several decades, especially if faunalturbation has affected each site over a period of a few millennia. Interestingly, Rudolph (1991:329) did not find any significant differences between the Middle and Late periods in the duration of site occupation or reoccupation, which implies that the manner in which sites in their project area were used apparently did not change significantly.

A fundamental problem in understanding the nature of settlement systems is establishing the contemporaneity of sites. The distribution of sites within a time period that is several hundred years long would not necessarily reflect the pattern produced by a single settlement system or set of contemporary settlement systems, because a good deal of change may have occurred over this period of time. Another problem, of course, is that the distribution of dated sites is strongly biased by the location of proposed land development projects to which archaeological investigations were a response. The lack of attention paid, until very recently, to sites in the interior parts of the region was mentioned previously, and only a few inland localities have received archaeological attention.

As a preliminary and exploratory exercise, I plotted the locations of sites dating within two separate 100 year intervals for which frequencies of dated sites are relatively high: 100 to 200 BC and AD 1400 to 1500 (figures 11.3 and 11.4). These two intervals have the highest site frequencies dating to the Late Holocene, and because they are only 100 years long, the chances are relatively high that the sites within each interval are essentially contemporaneous. Although the biases created by irregular geographic coverage of archaeological investigations are very strong, there are some interesting broad differences in the distribution of sites dating to these two time intervals.

The most obvious difference between the two distributions is that a larger proportion of sites dating between 100 and 200 BC are located inland, which implies that

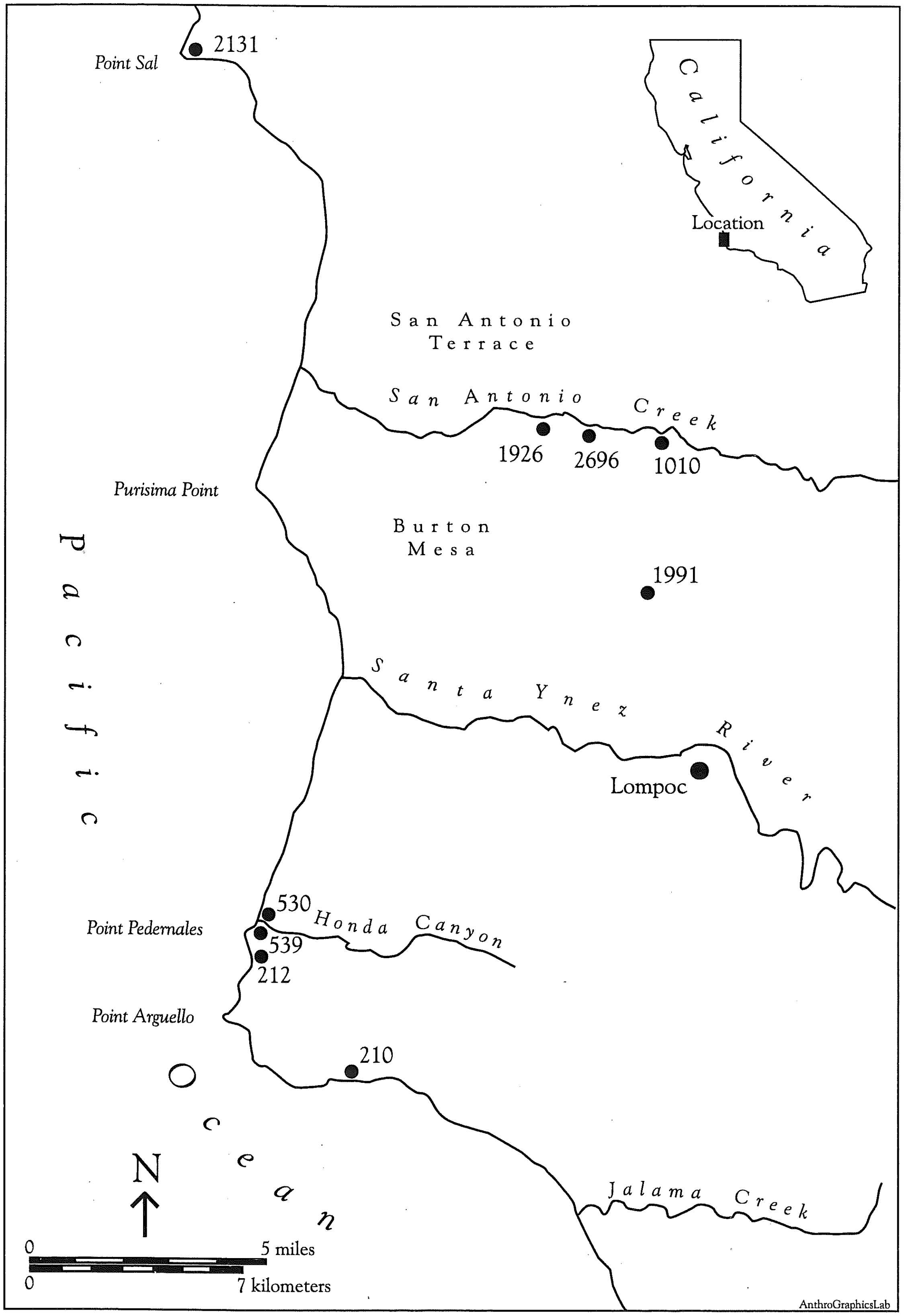

Figure 11.3 Distribution of sites in the Vandenberg region associated with ^{14}C dates falling between 200 and 100 BC. *Prepared by David Lawson*

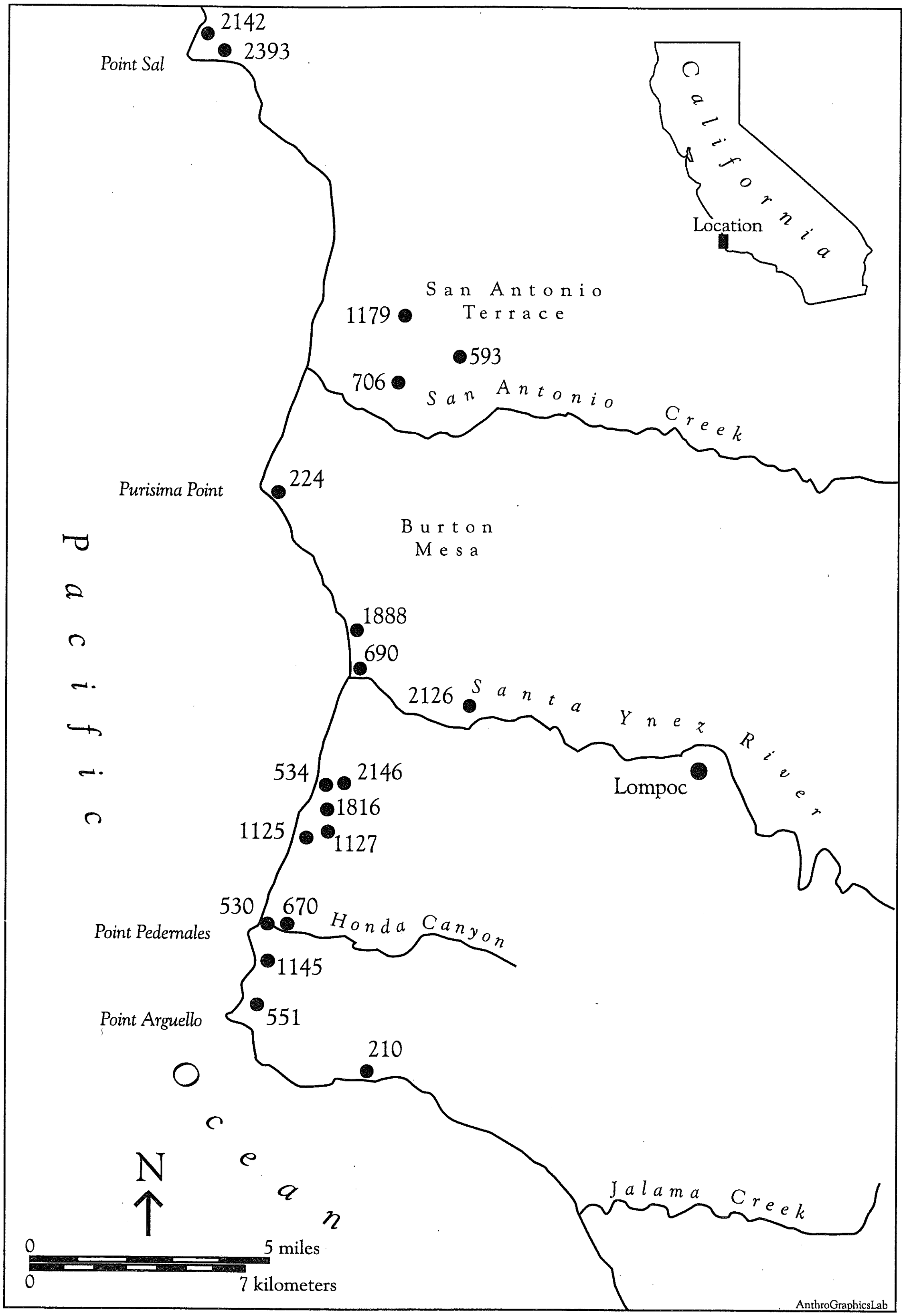

Figure 11.4 Distribution of sites in the Vandenberg region associated with ^{14}C dates falling between AD 1400 and 1500. *Prepared by David Lawson*

settlement systems of this time interval placed a good deal of emphasis on terrestrial resources. Furthermore, none of the sites dating between AD 1400 and 1500 is located as far inland as sites dating between 100 and 200 BC. Another difference is that coastal sites dating between 100 and 200 BC appear to be clustered in areas near headlands. The concentration near Point Arguello and Point Pedernales is most obvious, but this is probably because of the greater degree of archaeological research in this locality. Nonetheless, headlands would have been prime locations for shellfish collecting and sea mammal hunting; hook and line fishing also would have been productive.

Sites dating between AD 1400 and 1500 are relatively more dispersed along the south Vandenberg Coast than sites dating between 100 and 200 BC. In part, this is probably because the former are considerably more abundant. Furthermore, although many of the coastal sites dating between AD 1400 and 1500 are located near headlands, many others are not. The reasons for the apparent concentration of settlement at or near the coast between AD 1400 and 1500 are not clear. The increased emphasis on fishing sometime after AD 1200 was mentioned earlier. Even though fish remained a relatively minor aspect of the diet, it seems likely that many of the coastal sites dating between AD 1400 and 1500 were occupied to facilitate fishing, especially if increased emphasis was being placed on net fishing along sandy beaches. Acquisition of aquatic birds also may have kept populations at or near the coast. Another possibility is that settlement systems dating between AD 1400 and 1500 undoubtedly were more logistical, especially during the winter months. By this time, some of the principal residential bases probably were located inland, and occupation of subsidiary residential bases during the winter may have been at a minimum. Conversely, summer may have been a time of greater mobility, much of which may have been at or near the coast.

This exercise demonstrates the potential to acquire a good deal of information regarding the nature of settlement systems by considering the distribution of sites within relatively narrow intervals of time. The sample of dated sites currently is too small, however, to gain more than a hint of distributional patterns and differences between patterns pertaining to narrow time intervals. My proposed interpretations, therefore, should be treated as hypotheses that probably will have to be revised as more data become available.

CHERT BIFACE PRODUCTION AND USE

One of the most striking aspects of the Vandenberg region archaeological record is the abundance of chert waste products derived from the manufacture of flaked stone tools at a substantial number of the region's sites. Few other regions along the Pacific Coast of North America contain so many sites with such high concentrations of chert waste flakes, cores, and rejected preforms. In fact, many Vandenberg sites are defined solely on the basis of the presence of these items. This unusual abundance is partly due to the prevalence of naturally occurring chert in the Vandenberg region in comparison with neighboring regions (Arnold 1992c:83–87; Grivetti 1984), which allowed knappers to be more wasteful than would be the case if source material was scarce. As well, occupants of the Vandenberg region may have been supplying chert artifacts to populations in surrounding regions and as a consequence were producing flaked stone artifacts beyond their own needs. Although the chert occurring either as cobbles along beaches or streams or as lenses in shale outcrops of the Monterey Formation is not of particularly high quality, Arnold (1992c:97) found that few items were discarded during the reduction process because of flaws in the chert. Consequently, the low quality of the chert source material apparently was not a significant factor in accounting for the abundance of chert waste products.

Spanne (1975) recognized that most large, roughly shaped bifacial points, common in many Middle and Late Holocene sites of the Vandenberg region, were most likely rejected biface preforms produced in manufacturing projectile points and knives. These biface preforms are far more common here than in comparable sites of neighboring regions, such as the mainland coast of the Santa Barbara Channel. In the earlier literature, they were generally classified as some sort of knife or large "blade" (for example, Lathrap and Hoover 1975:50–54). Supporting Spanne's original contention that these bifaces are preforms, very few are complete, and very few subjected to microscopic examination exhibited evidence of use as tools (Arnold 1992c:99–100; Bamforth 1991:226–228).

In her analysis of south Vandenberg sites, Arnold found that preforms were produced during the manufacture of either large projectile points and knives or various forms of macrodrills (Arnold 1992c:89–92). The former type is by far the most prevalent. Arnold (1992c:96) found that the intermediate stages of biface manufacture are most represented in the south Vandenberg preform collections, with the initial and terminal stages also present.

The prevalence of intermediate-stage preforms may in part be a product of variations in the rate of discard at different points along the manufacturing trajectory. Most of the initial shaping apparently took place at the source, such as an outcrop on a ridge, at the seacliff, at a streambed, or at a cobble beach. Consequently, these initial stages would be poorly represented at habitation sites. Furthermore, once a preform survived the intermediate manufacturing stage, its chances of breakage or rejection owing to flake removal problems may have diminished considerably, and consequently so would discard. Bamforth (1991:214–216) offers another explanation for the apparent lack of late-stage preforms in Vandenberg collections. He found that bifaces classified as stage 3 preforms, using Callahan's classification (also used by Arnold), showed evidence of hafting, and he therefore surmised that they actually were hafted knives rather than preforms. He was unable, however, to identify use-wear on the edges of the stage 3 bifaces, which makes his interpretation equivocal.

Not all Vandenberg sites appear to contain a predominance of intermediate stage preforms. Collections from SBA-2696 contain a large proportion of stage 5 and 6 preforms (Colten et al. 1997:10.18). Other analysts of preforms may have excluded these under the presumption that they are finished artifacts. If these preforms are disregarded, the SBA-2696 collections contain a large proportion of stage 2 preforms and small proportions of stage 3 and 4 preforms, a pattern that seems analogous to that seen in other analyzed collections. The small assemblage from SBA-1010, located not far from SBA-2696 in the San Antonio Valley, contains primarily stage 3 and 4 preforms, seemingly just the opposite of the pattern seen at SBA-2696. It is unlikely that the two sites are functionally related with respect to biface production, which reinforces the likelihood of differences among analysts in preform classification.

Although macrodrills are present in collections from SBA-210, which contain a greater variety of artifact classes than practically any other site in the region, they are absent in collections from other sites containing macrodrill preforms. There is no obvious explanation for this apparent anomaly. It is conceivable, however, that although macrodrills were manufactured at a variety of sites, they almost never were used at a habitation site unless that site was a principal residential base (for example, SBA-210), where various manufacturing activities involved drilling holes in wood, shell, or soft stone.

Arnold's analysis entailed identification of broad trends through time in preform production. The best data come from SBA-210, where strata dating prior to circa AD 1000 to 1200 contain significantly higher densities of preforms than strata dating later in time (Arnold 1992c:101; compare with chronological information in Glassow et al. 1991:12–20). The most likely explanation for this pattern is the shift in the size of projectile points that occurred when arrow points replaced dart points. Dart points appear to have been derived from biface preforms, while arrow points were manufactured either from flakes or naturally occurring, very thin slabs of chert. The persistence of preform production after the introduction of the bow and arrow probably was related to the manufacture of knives, lance points, and perhaps harpoon points.

Arnold (1992c:107–109) identified finished projectile points, knives, lance points, and macrodrills in collections from a variety of sites along the mainland coast and islands of the Santa Barbara Channel region that apparently were made of Monterey chert from the Vandenberg region. The larger of these finished bifaces, especially those exceeding about 8 cm in length, almost surely were made of Vandenberg chert, but dart points under 6 cm in length may have been made of chert from outcrops near Gaviota along the Santa Barbara Channel mainland coast. One of these outcrops occurs near SBA-93, a site located about 5 km east of Gaviota. Recent testing at this site by a University of California Santa Barbara field class yielded high densities of waste flakes and some preforms, implying that point manufacture occurred there. The chert outcrops near SBA-93 are of distinctly lower quality than those of the Vandenberg region, but they yield pieces large enough for manufacturing dart points.

Although one may reasonably conclude that some of the production of points and knives in the Vandenberg region during the Late Holocene was for export, Arnold (1992c:129) emphasized that there is no evidence of full-scale craft specialization of the type she investigated on Santa Cruz Island (Arnold 1987). Nonetheless, it seems likely that the production of finished bifacial artifacts, and possibly preforms, was a means by which populations living in the Vandenberg region articulated with an interregional exchange system. On the basis of Arnold's analysis, this exchange seems most obvious with respect to the Santa Barbara Channel region, but other adjacent regions such as the middle Santa Ynez River Valley and the Central California Coast to the north also may have been destinations for Vandenberg flaked stone artifacts. A good deal more work needs to be accomplished in expanding the still relatively crude knowledge of temporal change in preform production within the Vandenberg region, as well as the nature of the exchange systems in which finished Vandenberg bifaces flowed. As well, Bamforth's argument that some intermediate stage preforms may actually be finished knives needs further evaluation.

DEVELOPMENT OF SOCIOECONOMIC COMPLEXITY AND THE MIDDLE-LATE PERIOD TRANSITION

As mentioned earlier, cultural systems in the Vandenberg region at the beginning of European colonization of California were not as complex as they were along the Santa Barbara Channel. Several factors probably account for this difference. First, populations living in the Vandenberg region were involved in economic reciprocal relationships with their neighbors at a much lower intensity than was the case between the channel mainland coast and the Channel Islands. In part, this was due to the fact that neither Vandenberg populations nor their neighbors living in adjacent regions produced items that were so crucial to interregional relationships as were shell beads to people living on either side of the Santa Barbara Channel. Second, Vandenberg populations lacked a food resource that could be intensified to the same extent as the nearshore fish caught from boats along the Santa Barbara Channel. Consequently, the Vandenberg region could not support village populations as large as those along the central Santa Barbara Channel, nor could its populations produce substantial surpluses from an intensifiable resource that might have played an important role in economic exchange and social relations. Third, Vandenberg populations did not manufacture expensive technical items important to food production, such as the plank canoe of the Santa Barbara Channel, the ownership of which fostered social status ranking (Arnold 1995a).

To be sure, Vandenberg populations did participate in economic exchange with their neighbors in adjacent regions, and ethnohistoric data do indicate obvious social status differentiation (C. King 1984:I-37–I-44). The level of social and economic complexity was significantly lower, however, than that in the central Santa Barbara Channel region. I proposed in an earlier publication that political organization and its attendant relationship to social and economic systems may have resembled a "Big Man" system in which political leaders were in large part dependent on the abilities of an individual to lead (Glassow 1996c:17). Although heredity may have played a role in the succession of political leaders, it is likely that, over time, recruitment to leadership positions was more flexible than was the case along the Santa Barbara Channel.

Some of the social and economic complexity that existed in the Vandenberg region at the time of European colonization was undoubtedly a result of the participation of populations in a money-based economic exchange system that had its center in the central Santa Barbara Channel region. If density of shell beads may be taken as an indication of the intensity of this participation, the money-based economy appears to have had only minor impact. Although sites or site components dating after about AD 1200 tend to contain higher densities of shell beads, including *Olivella* callus cup money beads, than do earlier site deposits, the difference is not as significant as is the case along the Santa Barbara Channel. At SBA-210, for example, the uppermost 60 cm of deposits do not contain any higher frequencies of beads than deeper deposits dating earlier during the Late Holocene (except in one test unit that apparently was placed adjacent to a cemetery area) (Glassow et al. 1991:12-14–12-18).

Interestingly, there is evidence that Vandenberg populations made some of their own shell beads throughout the Late Holocene, as indicated by the presence of *Olivella* shell detritus at SBA-210 and SBA-551 (Glassow et al. 1991:12-43–12-44, 12-102). Certainly the intensity of this manufacture was minuscule when compared to shell bead production on the Channel Islands, but the fact that Vandenberg populations were making some of their beads indicates their interest in participating in some of the economic relationships characteristic of the Santa Barbara Channel, whether these were intra- or interregional in scope. More specifically, it indicates that Vandenberg populations apparently had difficulty in providing commodities that they could trade for quantities of shell beads sufficient for meeting their monetary needs.

Arnold (1991a, 1992a, 1992b) has argued that Santa Barbara Channel political and economic systems underwent a major reorganization at the beginning of King's Late period and that there was a transitional interval of perhaps 100 to 150 years during which this reorganization took place, between roughly AD 1150 and 1250 or 1300. This interval has come to be called the Middle-Late Transition, consistent with Arnold's original terminology. Aspects of Arnold's proposal have attracted a good deal of attention among Southern and Central California archaeologists (Erlandson and Gerber 1993; T. Jones 1995:214–223; C. King 1990:xviii–xxii; Raab 1994; Raab et al. 1995; Raab and Larson 1997), and there is a general consensus that some kind of reorganization did occur. Controversy surrounds its causes, and differences of opinion have arisen regarding the beginning and end dates of the transitional period (compare, for instance, Arnold 1992b with T. Jones 1995).

Data from the Vandenberg region are not yet of a quality and quantity for determining the nature of changes that may have occurred during the Middle-Late Transition. Nonetheless, there is evidence that a relatively significant cultural change did occur at approximately the time of the transition. Evidence of shifts in subsistence and settlement systems that appear to have occurred sometime around AD 1200 was mentioned previously. Specifically, certain food resources were more intensively utilized after this date, and settlement entailed subsidiary residential bases being located in a wider variety of environmental situations. It is not clear whether these changes actually occurred during the Middle-Late Transition or perhaps somewhat earlier or later. For instance, the distribution of sites dating from AD 1400 and 1500 may have been more focused on the coast than were sites dating within the preceding 200-year interval.

A hallmark of the post-transition sites in the Santa Barbara Channel region is a marked increase in the use of shell bead money and the intervillage economic exchange it fostered. As the preceding discussion makes clear, there is no obvious evidence indicating that the increase in shell bead money use was as significant in the Vandenberg region.

If in fact it was not so important to economic exchange, one might argue that the Middle-Late Transition did not entail the political and economic transformation that occurred in the Santa Barbara Channel region and that cultural change was largely restricted to subsistence and settlement systems.

DETERMINANTS OF CULTURE CHANGE

In general, archaeologists working in the Vandenberg region have been cautious in positing possible causes of cultural change. In large part this is because the databases with which they have been working are too restrictive for perceiving changes on a scale larger than those occurring at a particular site or cluster of sites. Nonetheless, archaeologists have attempted to relate changes in site use or function to models of culture change, and they have recognized the role that environmental change may have played in conditioning or triggering culture change (for example, Colten et al. 1997:12.2; Tetra Tech, Inc. 1990:9–57; Woodman 1997:11–5; Woodman, Rudolph, and Rudolph 1991:333, 337).

In fact, environmental change has been viewed as an important factor in accounting for some of the changes seen in the archaeological record. Colten et al. (1997:12.2–12.3) proposed that decreased use of site SBA-2696 in the San Antonio Valley, from its earliest to latest occupation, was related to a local and perhaps regional shift from relatively wet climatic conditions between circa 800 and 1 BC, which fostered high productivity in plants and animals, to dry climatic conditions prevailing after AD 150, when food resource productivity was significantly lower. Rudolph (1991:337) related an expansion of settlement occurring between AD 1 and 1000 in localities of the lower Santa Ynez River and Santa Lucia Canyon to warmer and drier climatic conditions. As discussed earlier, the paleoenvironmental reconstructions for the Vandenberg region and beyond conflict with one another, and no clear picture of paleoenvironmental change exists. As a consequence, these various interpretations of the relationship between cultural development and environmental change are called into question.

Archaeologists concerned with the Middle-Late Transition in the Santa Barbara Channel region have proposed that (1) reduced fresh water availability and depletion of plant and animal productivity brought about by increased aridity and/or (2) depletion of marine resources created by warmer seawater temperatures triggered the cultural changes that occurred during the transition (Arnold 1992a, 1992b; Arnold, Colten, and Pletka 1997; Kennett 1998; Kennett and Kennett 2000; Raab and Larson 1997). While there is disagreement regarding whether one or the other of these two factors was paramount, all seem to agree that some sort of disruptive environmental event occurred. At present, archaeological data from the Vandenberg region are insufficient to contribute to resolving this controversy, but the changes in subsistence and settlement sometime during the Middle-Late Transition imply that environmental stresses of some sort affected Vandenberg populations.

Consideration of population growth and decline may be helpful in seeking explanations of cultural change, as well as identifying periods of more and less favorable environmental conditions. If environmental conditions were favorable for producing the plants and animals upon which Vandenberg populations depended, population would be expected to grow. Conversely, if food resources declined and remained depressed for extended periods, population would be expected to decline. To investigate the patterns of population fluctuation, I have looked at frequency distributions of radiocarbon dates obtained from sites in the Vandenberg region under the assumption that frequencies of ^{14}C dates per time interval are largely dependent on the volume of archaeological deposits created within that time interval. This volume, in turn, is dependent upon the number of people producing archaeological deposits (see Glassow 1999 for a more detailed explication of this logic).

To produce distributions of ^{14}C dates for the Late Holocene of the Vandenberg region, I calibrated all dates not reported in calibrated form using the Calib 3.0.3c computer program (Stuiver and Reimer 1993), assuming a fractionation correction of 415 years and a regional reservoir correction of 225±35 years[2]. For one of the distributions (figure 11.5), I treated all calibrated dates from one site falling within a 100-year interval (as defined for the frequency distribution) as one date by using the average of the set. For the other distribution (figure 11.6), which considers only dates between AD 900 and 1600, I used a 50-year interval instead. I considered 181 individual dates falling within the Late Holocene (excluding five calibrated as modern), which include those listed in *California Radiocarbon Dates* (Breschini, Haversat, and Erlandson 1996) coming from sites in the Vandenberg region, as well as others obtained from reports at the Central Coast Archaeological Information Center. To arrive at the frequency distribution presented in figure 11.5, this number was reduced to 150 by grouping dates, and for the distribution in figure 11.6, 66 of the 181 Late Holocene dates were reduced to 56.

The frequency distribution by 100-year intervals (figure 11.5) shows little apparent patterning between 1800 and 200 BC due to low frequencies per interval. The absence of dates between 1300 and 1100 BC may be significant, however, as it appears to correlate with depressions in date frequencies seen elsewhere in Southern California (Glassow 1999). This period may be the interval during which 15 m of Intermediate Dune sand accumulated on top of the lower component at SBA-670 and perhaps elsewhere along the Vandenberg Coast (Glassow 1996c:105). After 200 BC, three relatively

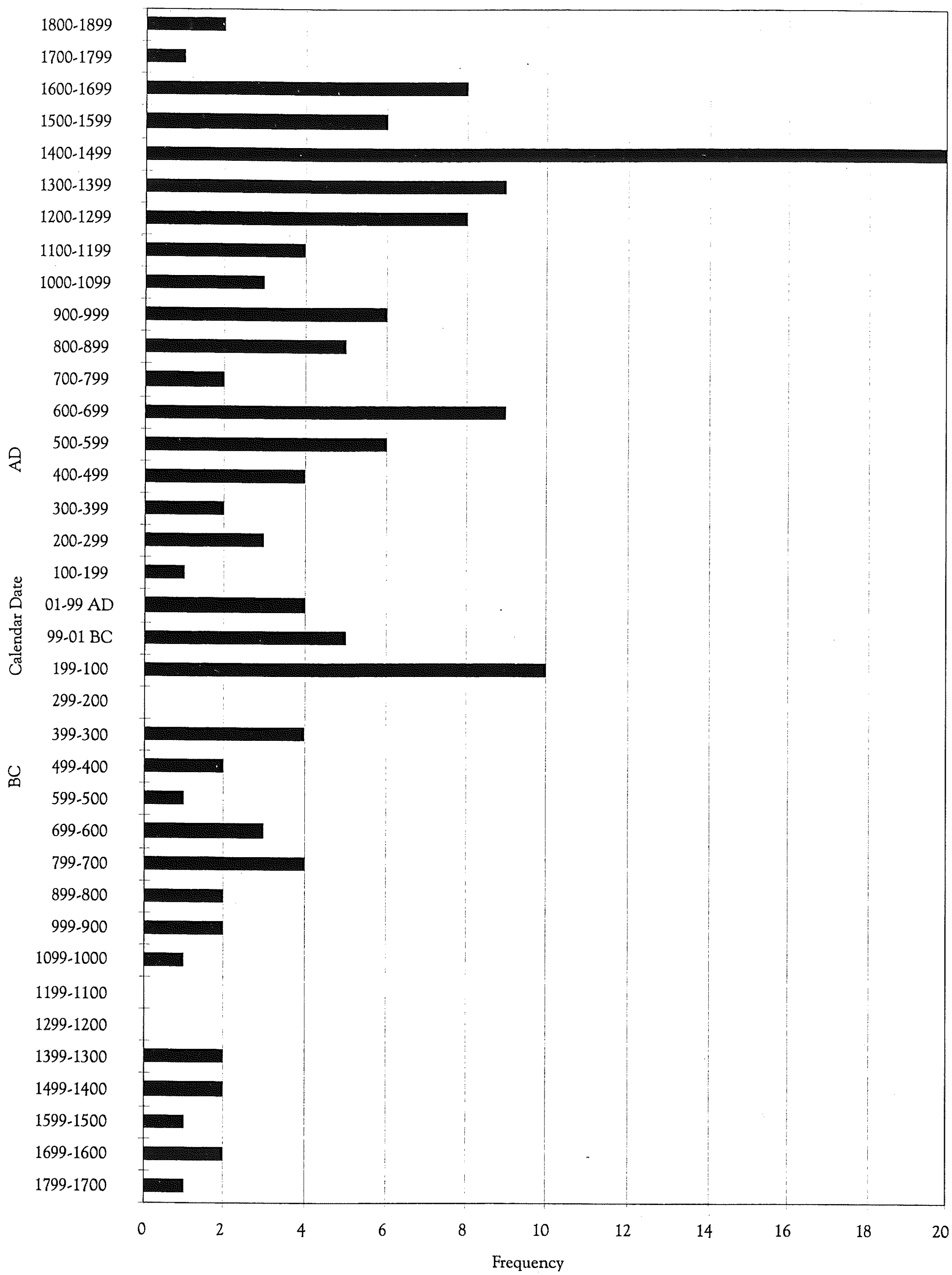

Figure 11.5 Frequency distribution of Vandenberg region calibrated ^{14}C dates by 100-yr intervals from 1800 BC to AD 1900. (If more than one date from a site fell within an interval, the dates were averaged and represented in the distribution as one date).

prominent peaks in date distributions occur: 200 to 100 BC, AD 600 to 700, and AD 1400 to 1500, the last being especially high.

One hypothesis to account for the apparent fluctuation in regional population is that changes in water temperature affected the productivity of marine life upon which Vandenberg populations depended. Cooler water temperatures presumably would be associated with higher productivity, whereas warmer temperatures would be associated with lower productivity. The three peaks in radiocarbon date frequencies do not appear, however, to correlate with either especially cool or especially warm temperatures on the Kennetts' water temperature curve. This lack of relationship might be expected in light of the Vandenberg Coast's consistent exposure to the

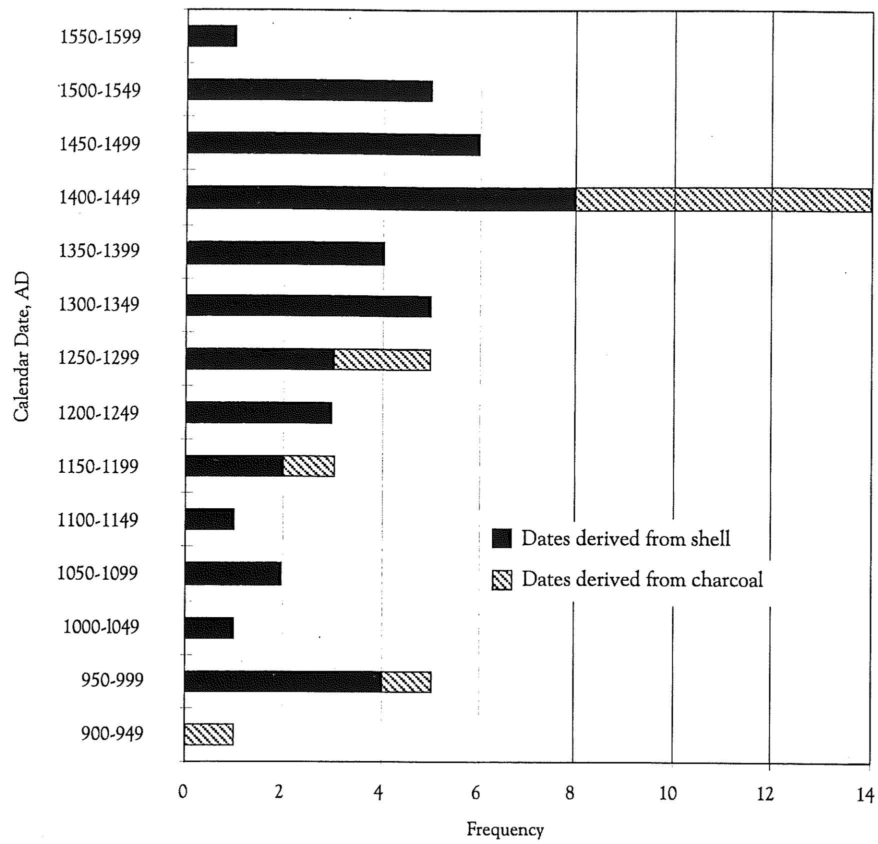

Figure 11.6 Frequency distribution of Vandenberg region calibrated ^{14}C dates by 50-yr intervals from AD 900 and 1600. (If more than one date from a site fell within an interval, the dates were averaged and represented in the distribution as one date).

California current coming down the coast from the north. Greater fluctuation in water temperature might be expected in the Santa Barbara Channel, to which the Kennetts' temperature curve pertains, due to mixing of the California current with the warm waters of the Southern California countercurrent coming north up the coast.

Another hypothesis is that fluctuation in precipitation affected the productivity of terrestrial resources, including deer, rabbits, and a variety of edible plants. In other words, the size of Vandenberg populations was responding more to fluctuation in the availability of terrestrial foods than marine foods. In fact, there is some degree of correlation between fluctuation in ^{14}C date frequencies and precipitation in the record produced by Larson and Michaelsen (1989). Their moderate precipitation peak in the AD 500s is only slightly earlier than the peak seen in date frequencies occurring in the AD 600s. Their very high peak in the AD 900s correlates with a slight peak in ^{14}C date frequencies, and their pair of high peaks in the AD 1300s and 1400s correlates well with the higher frequencies of dates during the same intervals. The sharp decline in date frequencies during the AD 1500s may be related to the onset of the Little Ice Age, as well as to lower precipitation levels during the AD 1600s and 1700s.

Figure 11.6, showing date distributions by 50-year intervals, was produced to assess the nature of population fluctuation during the Middle-Late Period Transition. A 50-year interval may be stretching the resolution of ^{14}C dates too far in that it is less than the 1 sigma counting error associated with most dates. Nonetheless, the distinct peak in the AD 1400 to 1450 interval implies that at least some patterning can be discerned. Assuming that the Middle-Late Transition occurred between AD 1150 and 1300, when precipitation was below average on Larson and Michaelsen's record, there is no clear indication in the date distribution of an effect on population (for example, a decrease). There is a possibility, however, that populations were relatively low between AD 1000 and 1150, but frequencies are too low on either side of this interval to be sure.

The peak in the AD 1400 to 1450 interval implies that population numbers rapidly rose and remained at a relatively high level during a very short time and that thereafter population rapidly declined to a lower level, which persisted between AD 1450 and 1550. The further decline after AD 1550 may be a product of the impact of European colonization and its associated spread of diseases (Erlandson and Bartoy 1995; Erlandson, Kennett, and Walker 1997; Preston 1996). Not all of the sharp peak at the AD 1400 to 1450 interval may be a response to population growth. A supplemental hypothesis is that part of this peak is a product of the more extensive availability of fresh water expected during a period of persistently higher precipitation. If fresh the Late Holocene remains poorly understood. Within the last decade or so, archaeologists have investigated an increasing number of sites in the interior parts of the region, and the importance of terrestrial resources, especially land mammals, is becoming more apparent.

The heavy dependence on shellfish as a food resource is in sharp contrast with Late Holocene subsistence of Santa Barbara Channel mainland populations that depended much more on fishing and sea mammal hunting. The subsistence of Vandenberg populations had much in common with that of populations living on the Channel Islands and along the open coasts of Central California. Despite a heavy dependence on shellfish, Vandenberg populations did intensify to a moderate extent their fishing efforts after about AD 1200, coincident with a marked increase in fishing among Santa Barbara Channel populations. At the same time, aquatic birds became a special focus of subsistence activities in certain localities. Earlier in prehistory, sea mammal hunting was especially important, possibly for a relatively short period of time during the second century BC.

Although Vandenberg populations interacted with their neighbors along the Santa Barbara Channel, cultural systems of the region remained much simpler than those of the channel. In large part this is because the strong surf along the Vandenberg Coast prevented effective offshore fishing and because residents did not participate in the intensive economic exchange that existed between island and coastal mainland populations of the channel. Nonetheless, the exchange systems and attendant social and political complexity probably did affect cultural development in the Vandenberg region. It is likely, for instance, that the Santa Barbara Channel was the main recipient of chert tools made by Vandenberg populations, and this export may have fostered more intensive exchange within the region than otherwise would have existed.

Despite the substantial knowledge about Late Holocene cultural change in the Vandenberg region that has accumulated over the last three decades, we still have only a general picture of the nature of this change, and our control over chronology remains relatively loose. To expand our understanding beyond that presented in this chapter, several courses of action are necessary. First, the sample of sites from which excavated collections have been obtained must be expanded and made more representative of the region as a whole. Second, suites of radiocarbon dates must be extensive enough to bracket confidently each distinct period of occupation at a site and the intervening periods during which a site was not used. Third, the multifaceted analyses of the variety of data that may be derived from a site that has characterized much of the contract-funded research in the region over the last decade must continue, but greater effort must be made to ensure comparability of the results of these analyses to facilitate regional synthesis.

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Notes

1 In carrying out research for this paper, I consulted the report archive of the Central Coast Information Center, Department of Anthropology, University of California, Santa Barbara. All radiocarbon dates in reports dating from 1980 were checked against the Santa Barbara County date list in *California Radiocarbon Dates* (Breschini, Haversat, and Erlandson 1996); any not in the date list were added to the database used for this paper. As well, the date information was forwarded to Coyote Press for inclusion in a future publication of *California Radiocarbon Dates*. I also attempted to incorporate any definitive interpretations associated in the reports pertaining to the Vandenberg region, although I may have overlooked some important work that should have been cited. For the most part, I did not consider research not confidently associated with dates pertaining to the Late Holocene. Unfortunately, I recognized during the course of my research in the Information Center that the archive of reports pertaining to the Vandenberg region is not complete, but time was not available to locate copies of some of the missing reports.

2. The $^{13}C/^{12}C$ fractionation correction of 415 years, used for uncorrected radiocarbon dates derived from marine shell, is based on fractionation corrections obtained for 24 dates pertaining to sites in the Vandenberg region. The average correction for these 24 dates was 413 years, which I rounded to 415 years. I used the CALIB program's Marine Bidecadal Data Set to calibrate shell dates, and the (tree-ring) Bidecadal Data Set was used for charcoal dates. For the latter, the calibration curve was smoothed using a five point (100 year) running average, which eliminated most instances in which a radiocarbon date could be two or more alternative calendar dates. In those few instances in which this was the case, an average of the alternative calendar dates was used.

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CHAPTER 12

Deintensification Along the Central Coast

Terry L. Jones and Jennifer A. Ferneau

With the emergence of cultural ecology and adaptation as unifying themes in California archaeology, it has become increasingly common to equate the Late Holocene, particularly the last millennium before European contact, with all-time peaks in social complexity, population, and cultural sophistication. These zeniths are often envisioned as the logical outcome of slow but steady population growth that advanced prehistoric cultures along a trajectory of unilineal progress from simple to more complex through the Holocene (for example, Fredrickson 1974a; Chartkoff and Chartkoff 1984). In some areas (for example, the North Coast Ranges reported by Fredrickson [1974a]), the archaeological record shows at least some diachronic increases (for example, in exchange goods and technology) consistent with incremental, population-driven progress. Theories of optimal foraging and economic intensification applied in the last decade or so (see Basgall 1987; Erlandson 1991a; T. Jones 1991, 1992; among others) posit similarly linear trajectories (Fredrickson 1994b), albeit based on different economic principles. In cases where patterns in the faunal record match the expectations of optimal foraging (see Broughton 1994a, 1994b, 1999), these models provide significant insights into subsistence change and its possible relation to sociopolitical developments (for example, Hildebrandt and Jones 1992; Jones and Hildebrandt 1995).

Although it has not been applied in this manner in California, optimal foraging theory also provides insight into cases where patterns of settlement and diet do not conform to the predictions of relentless intensification. In such instances, as along the Central California Coast after circa AD 1200, dietary changes that do not match optimization predictions suggest processes other than relentless population growth at work in the archaeological record. These processes include cultural or environmental events that may have disrupted growth and precipitated demographic crises. The functionalist premise of continuously effective adaptation that underlies most cultural ecological models and many applications of evolutionary ecology has tended to foster regional prehistories that are unrealistically bereft of crises—despite seminal theoretical discussions that acknowledge the ecological risks inherent in hunter-gatherer intensification (Cohen 1977, 1981; Testart 1982, 1988).

In 1994, Stine presented compelling, if not dramatic, evidence for prolonged and severe droughts in the interior ranges of Central California between circa AD 800 and 1350, a period he refers to as the Medieval Climatic Anomaly. This characterization was corroborated by an independent study of tree rings in the southern Sierra Nevada (Graumlich 1993), and is consistent with an earlier tree ring study (LaMarche 1974). In two recent papers, Jones et al. (1999) and Jones and Kennett (1999) suggested that the Medieval Climatic Anomaly may have precipitated demographic problems in Central California, and that such problems are reflected in settlement disruption and dietary change. J. Johnson (2000) makes a similar case for the southern Central Coast. Here we further explore and document trends in settlement and diet across the Medieval Climatic Anomaly along the Central California Coast, and argue that the patterns reflect not ongoing intensification, but rather "deintensification," as the regional economy reached the zenith of its productivity and intensity during the early centuries of the Medieval Climatic Anomaly. The working hypothesis is that droughts of the late Medieval period caused ecological crises that reversed earlier trends of growing populations, increasing diet breadth and expanding interregional exchange. Demographic pressure seems to have decreased as local economies became less intensive during the last four centuries before historic contact than

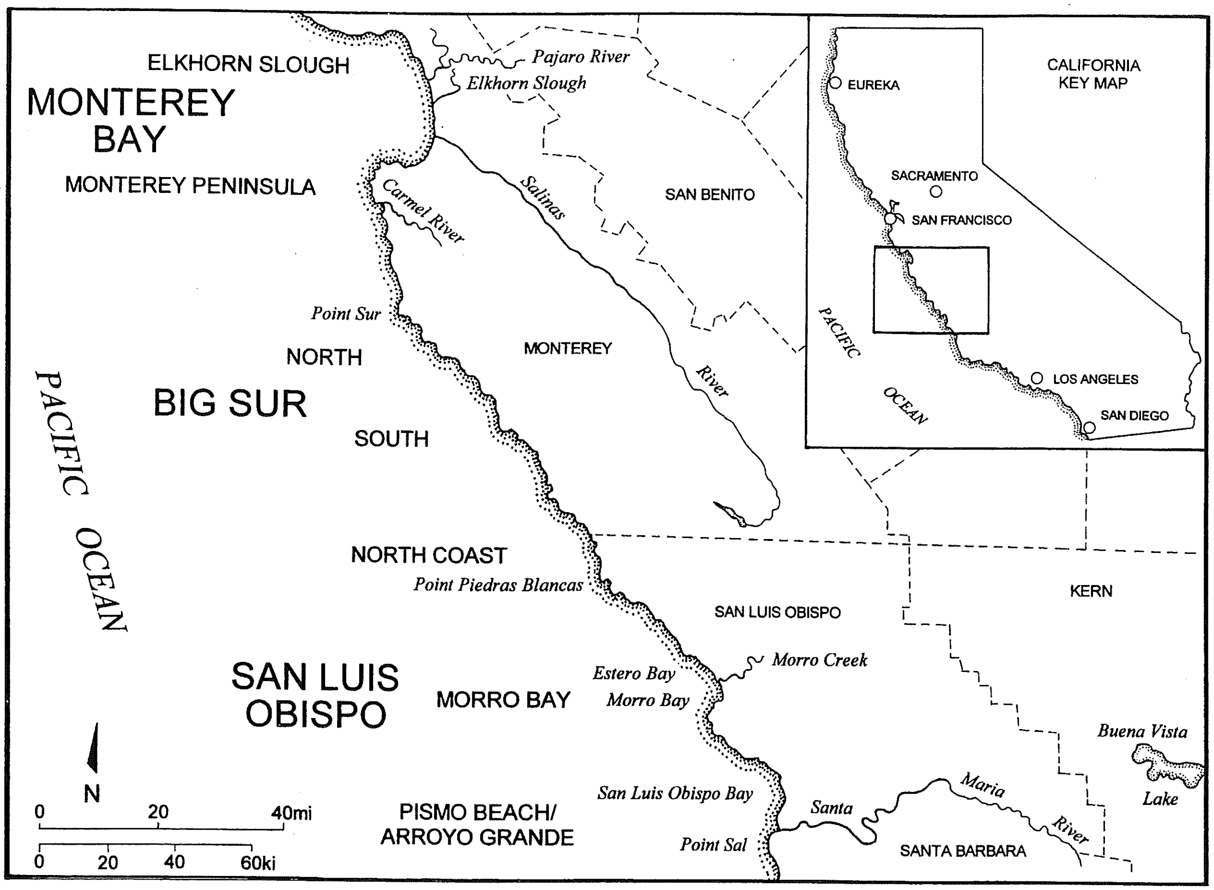


Figure 12.1 Archaeological districts and localities of the Central California Coast

they were at the beginning of the Medieval Climatic Anomaly.

The primary foci of this chapter therefore are changes marking the end of the Middle (600 BC–AD 1000) and Middle-Late Transition periods (AD 1000–1250) and the beginning of the Late period (AD 1250–1769).[1] As this chapter also provides an overview of Late Holocene archaeology and prehistory along the Central Coast, our essay begins with a description of the environmental and ethnohistoric setting, the history of archaeological research, an evaluation of key components, and a discussion of regional culture history. Topics of settlement and dietary change are then addressed emphasizing evidence for widespread disruption in site occupation during the late Medieval period that suggests increased movements of people. It is not unreasonable to suspect that this disruption marks ecological problems caused by decreased availability of food and water that precipitated a decline in human population and overall deintensification in human pressure on local ecosystems. Decreased human presence and reduction in pressure were likely exacerbated during the Protohistoric period when foreign diseases probably began to affect Native populations (Erlandson and Bartoy 1995; Preston 1996). Because there are no clearly dated Protohistoric burial populations from the Central Coast and few if any well-defined, well-sampled components, the Protohistoric cannot at present be examined as a separate, discrete interval. Protohistoric crises remain likely, but the available record allows only for the entire Late period (AD 1250–1769) to be viewed as a whole.

ENVIRONMENTAL SETTING AD 1769

Syntheses of historic documents (for example, Gordon 1979) allow for fairly precise characterization of the precontact landscape of the Central California Coast despite the effects of more than 200 years of development. Coastal habitats are perhaps better representations of precontact conditions than are their terrestrial counterparts. Two distinctive types of coastline are found along the shores of Monterey and San Luis Obispo Counties: open coast (that is, unprotected surf-swept beaches or rocky headlands) and lagoon/estuaries. The latter are the products of sea level rise and the drowning of river valleys during the late Pleistocene through mid-Holocene that provide significant shelter from the open ocean. The Central Coast is dominated by exposed shoreline with a mixture of rocky and sandy substrates that shifted in expanse throughout the Holocene. Major estuaries and lagoons are found at Elkhorn Slough and Morro Bay (figure 12.1).

The terrestrial environment of the Central Coast is diverse, owing to its midlatitude location, but much of the coastal region supports coastal scrub, grassland, and oak woodland. Redwood forest occurs at moderate elevations in the coastal mountains within reach of summer fog. Redwoods are at their southern limit near the border of Monterey and San Luis Obispo Counties. Marshland comprised a significant proportion of the precontact landscape in the vicinity of estuaries and small inland lakes. The Central Coast vegetation mosaic supports a variety of large and medium size terrestrial mammals, including black-tailed deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), cottontail rabbit (*Sylvilagus audubonii*), and jack rabbit (*Lepus californicus*). Archaeofaunas and historic accounts (Gordon 1979:141) indicate that tule elk (*Cervus elaphus*) were once common.

The open rocky shorelines offer a distinctive suite of resources. Common shellfish taxa include California mussel (*Mytilus californianus*), barnacle (*Balanus* spp.), limpet (*Collisella* spp.), chiton (*Nuttalina californica*), black abalone (*Haliotis cracherodii*), and black turban snail (*Tegula funebralis*). The red abalone (*H. rufescens*) occurs as well, but only in the low intertidal zone (Ferguson 1984:58). Dense kelp forests along open rocky shores provide habitat for a diverse array of rock fish, including cabezon (*Scorpaenichthys marmoratus*), surf perch (Embiotocidae), rockfish (*Sebastes* spp.), 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 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*) currently breed at Point Piedras Blancas in northern San Luis Obispo County, but archaeofaunas from sites near this rookery indicate they were not present prehistorically (Bouey and Basgall 1991; Jones and Ferneau 2002). A number of authors have suggested that historic pinniped distribution patterns reflect populations significantly depressed as a result of millennia of prehistoric overexploitation (Burton 2000; Hildebrandt and Jones 1992; Jones and Hildebrandt 1995). Permanent marine mammal residents include the sea otter (*Enhydra lutris*) and harbor seal (*Phoca vitulina*).

Central Coast estuaries alternately support salt marsh and mudflat communities that 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*). Oysters (*Ostrea lurida*) and mussels (*Mytilus trossulus*) occur at locations with firm substrates. The latter are particularly abundant in some sites at Morro Bay (for example, SLO-626 [Gibson 1984]). The open beach Pismo clam (*Tivela stultorum*) is a significant resource on sandy beaches as far north as Estero Bay. Central Coast estuarine marshes, particularly at Elkhorn Slough, 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 species. Perhaps the most significant resource of the lagoonal habitats is their fisheries. Both Elkhorn Slough and Morro Bay served as seasonal nurseries for a vast number of fish, including bat rays (*Myliobatus californica*), plainfin midshipman (*Porichthys notatus*), skates, sharks, and sculpins (Horn and Allen 1976; Yoklavich et al. (1991). Late Holocene middens at both estuaries show dense accumulations of fish bone, testifying to the richness of prehistoric fisheries (see Breschini and Haversat 1995a; Jones et al. 1996; Mikkelsen, Hildebrandt, and Jones 2000; Milliken et al. 1999).

PALEOENVIRONMENT

The paleoenvironmental history of the Central California Coast is not well documented for the Late Holocene. The region has seen few major studies, and reconstruction of its recent past is largely dependent on findings from more heavily studied areas to the south and east. Nonetheless, historic records and contemporary climatic patterns indicate some level of synchrony between the Central Coast and these other areas (particularly the interior ranges), so that trends represented inland can be assumed to have had comparable expressions on the coast. Seminal studies from Southern California (Glassow et al. 1994; Kennett 1998; Pisias 1978, 1979) have shown the value in documenting trends in sea surface temperatures as potential indices of marine productivity and a major influence on coastal climate. Much short-term climatic variation along the Central California Coast is associated with sea temperature changes, particularly those linked to the El Niño southern oscillation (ENSO). Historic records indicate that the Monterey Coast experienced four very strong El Niño events in the last century during which sea temperatures were unusually high, marine productivity was low, and rainfall was high (Jones and Kennett 1999). Long-term flux in sea surface temperature also affects climate, albeit less catastrophically, as warming seas facilitate colonization of Central Coast marine habitats by southern species (Barry et al. 1995). Long-term declines in sea temperature have the opposite effect.

Jones and Kennett (1999) presented a sea temperature chronology for the Central Coast based on oxygen isotope readings from dated archaeological mussel shells. The sequence covers only the last two millennia and is less fine-grained than reconstructions available from the Santa

Barbara Channel (for example, Kennett 1998:299; Kennett and Kennett 2000), but it is important as the only direct regional record. Three periods of sea temperature are evident along the Central Coast: between AD 1 and 1300 seas averaged 1°C cooler than present and appear to have been relatively stable; between AD 1300 and 1500 seas showed greater seasonal variation than present with extremes above and below historic levels; and between AD 1500 and 1700, seas were 2 to 3°C cooler than today (figure 12.2a and 12.2b). The maximal dating of the period of high variability (1 sigma probability) is AD 1270 to 1520; the minimum is AD 1310 to 1460. Jones and Kennett (1999) associated it with the Medieval Climatic Anomaly. The following period of cool seas (maximal dating: AD 1460 to 1860) is associated with the so-called "Little Ice Age." This sequence is not fully concordant with findings from the Santa Barbara Channel, but the Central Coast is not affected by the Southern California countercurrent, which seems to cause greater variability in the Channel region. Changes in archaeological faunal assemblages and isotope signatures are significantly more pronounced on the Channel Islands than along the Central Coast mainland, probably because of greater stability through time in ocean circulation patterns.

Direct records of the Late Holocene terrestrial environment are all but lacking for the Central Coast. A pollen core from Elkhorn Slough shows a decline in redwood pollen from circa AD 300 to 1850, but dating of this record is not sufficient to define the actual sequence of change. A pollen core reported by Morgan et al. (1991) from Santa Barbara County shows an increase in coastal scrub pollen between circa AD 400 and 1400 that suggests warm, dry conditions. Late Holocene pollen cores recently reported by Mensing (1993) from Santa Barbara and Los Angeles Counties show equivocal evidence for warm/dry conditions during the Medieval period, perhaps due to the coarse-grained nature of pollen sequences or cores reflecting localized as opposed to regional or global climate. More compelling and fine-grained data come from the Sierra Nevada and western Great Basin, where the Medieval Climatic Anomaly (AD 800 to 1350) stands out as a period of unusually warm, dry conditions. Stine's (1994:549) dating of drowned tree stumps at Mono Lake and other locations suggests "epic" droughts circa AD 892 to 1112 and 1209 to 1350. Data from the bristlecone pine (*Pinus longaeva*) tree ring sequence in the White Mountains (LaMarche 1974:1047) match the patterns Stine identified. Evidence of warm, dry conditions during the Medieval Climatic Anomaly also comes from Graumlich's (1993) tree ring sequence from the southern Sierra Nevada. She argued that the period between AD 1100 and 1375 was highly unusual because of increased summer temperatures that peaked circa AD 1150. Severe droughts were evident at circa AD 1020 to 1070, 1197 to 1217, and 1249 to 1365, but Graumlich felt these were less anomalous relative to the precipitation cycle of the last millennium than were the high summer temperatures. Swetnam (1993:887) found that fires were more frequent in the southern Sierra between AD 1000 and 1300 than during any other interval in the last two millennia. Anderson (1994) argued that the Medieval Climatic Anomaly was marked by a low frequency and low intensity of ENSO events.

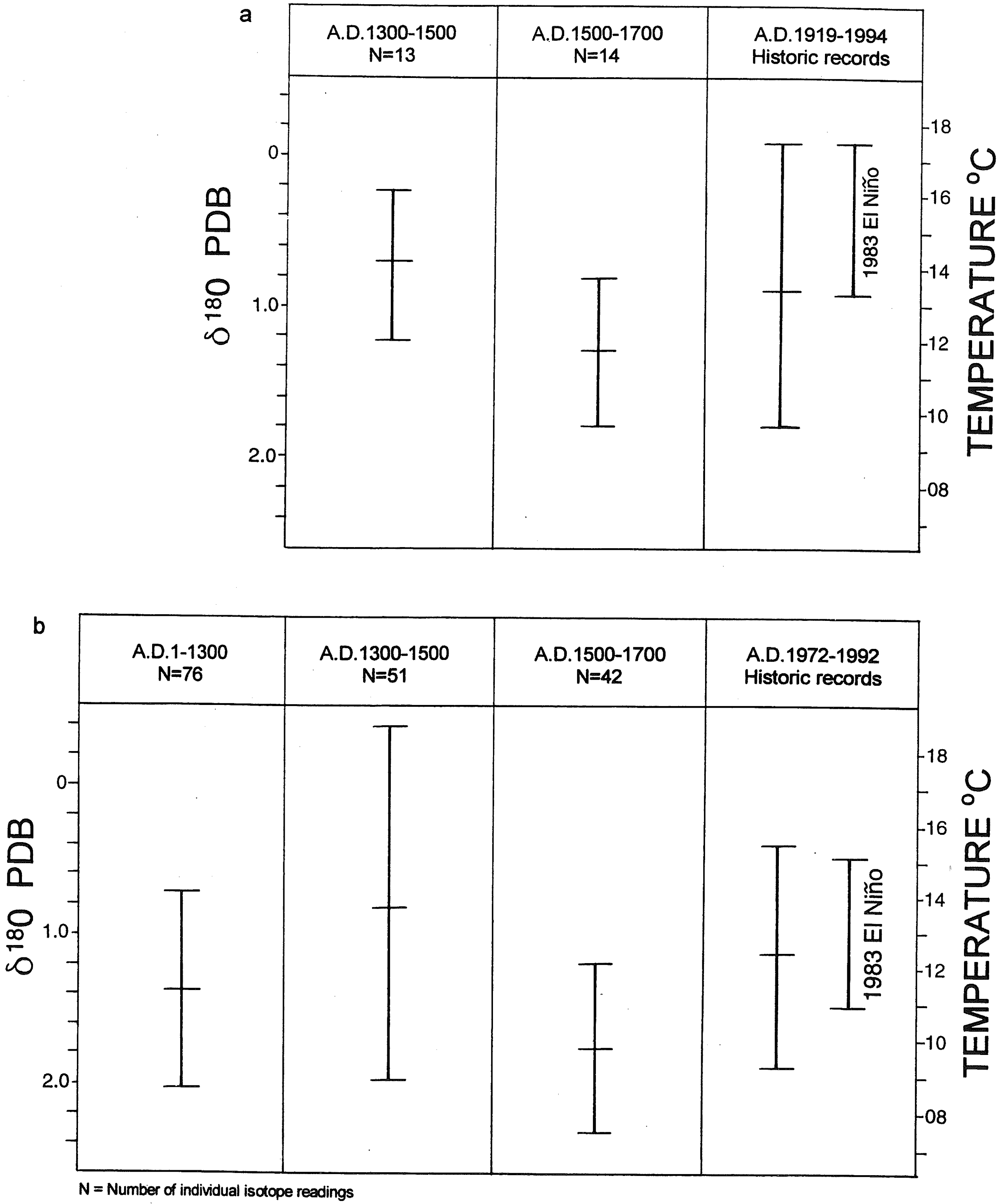
Most general reconstructions of the California paleoenvironment suggest that the Little Ice Age, which followed the Medieval Climatic Anomaly (ca. AD 1400 to 1800), was marked by cool, wet conditions. Glacial advances in the Sierra Nevada and the filling of Southern California desert lakes corroborate these conditions. The slightly colder seas suggested in the oxygen isotope record from the Central Coast suggest a climatic regime vaguely similar to that of the present day southern North Coast Range. A profusion of red abalone shells in Monterey County middens dating to the Little Ice Age may at least partially reflect colder seas during that period.

ETHNOHISTORIC SETTING

When the Spanish explorers arrived in AD 1769, the Central California Coast south of San Francisco Bay and north of the Santa Barbara Channel was occupied by a large number of small, autonomous Native communities. Kroeber (1955b) coined the term "tribelet" —a cross between band and tribe—to describe polities marked by clusters of related settlements within defined territories. According to Kroeber, a tribelet consisted of

> ...several settlements–there might be three or four or five of them–sometimes more or less the same size, but more often one was dominant or permanent, the other more like suburbs of it. They might be situated some miles away. The smaller settlements were likely to be inhabited seasonally, or by certain families only perhaps for a stretch of years, after which their population might drift back to the main settlement (Kroeber 1962:33).

The ethnographic/ethnohistoric record of the inhabitants of these tribelets is one of the poorest in California. Actual ethnographic observations were afforded only to the earliest Spanish explorers and missionaries, and the documentation resulting from these early contacts is woefully incomplete and biased. Attempts at more systematic anthropological description of Native cultures were not initiated until early in the twentieth century following 150 years of impacts and changes to Native societies, first at the hands of the Spanish (AD 1769–1822), then under the rule of Mexico (AD 1822–1848), and finally as part of the United States (after AD 1848). Native populations declined precipitously during this period,



12.2 Range and midpoint of ^{18}O values and inferred temperatures for 14 archaeological specimens of *Mytilus californianus* compared with historic ranges and midpoints: *a*, Monterey Bay; *b*, outer coast of Big Sur and northern San Luis Obispo County from Jones and Kennett (1999:80) (PDB= PeeDee Belemnite, the standard carbonate used to calibrate oxygen isotopic measurements) and lifeways were dramatically altered. Speakers of Native languages were still present in the early 1900s, and the earliest salvage ethnographies emphasized documentation of dying languages (for example, J. Mason 1918; see Turner 1988 for a history of some of these efforts). In the case of at least one language (Esselen), this effort was too late to recover much information, but for other areas, such as Salinan, the linguistic record is relatively complete. Because the remaining speakers had forgotten the actual Native names for their tribelets, language has been used as a means of aggregating the small autonomous Native societies into groups ("tribes") under a false premise that tribelets speaking related dialects and/or languages shared ethnic identities (see Kroeber 1955b).

Four language families were defined by anthropologists for the Central Coast (from north to south): Costanoan in the Monterey Bay Area, Esselen in the upper drainage of the Carmel River and northern Santa Lucia Range, Salinan along the Big Sur Coast, and northern Chumash along the coast of San Luis Obispo County. Modern descendents in the Monterey Bay area prefer the term "Ohlone," based on the name of a tribelet in the San Francisco Bay area, and this term is used here in place of "Costanoan." More recent analyses of records from the Spanish missions have provided the names of tribelets for the areas in which the Ohlone, Esselen, and Salinan languages were spoken (see C. King 1974b, 1994b; Milliken 1981, 1988, 1991, 1994), as well as individual village names (for example, Gibson 1983; Merriam 1968). Actual village locations and tribelet boundaries remain poorly documented, however. There are also remarkably few documented associations between named villages and known archaeological sites, and even fewer instances where named villages were excavated. Ongoing work with Mission records, unpublished salvage ethnographies (especially those of J.P. Harrington from early this century), and the archaeological record (for example, Jones et al. 2000; Milliken 1995; Rivers 1994; Rivers and Jones 1993) shows promise for refining village and tribelet locations in the future.

Settlement and Subsistence

The manner in which subsistence was accomplished within tribelet communities vis-à-vis systems of seasonality and settlement is frustratingly unclear for the Central Coast. Missionaries and early historic visitors recorded accounts of Native resource exploitation that provide general ideas about the types of foods exploited and technologies associated with them. In AD 1595, Sebastian Rodriguez Cermeño recorded the following observations while near Estero Bay:

> ...there were observed on the shore of the sea many people on the top of some bluffs, where they had made their settlements, and I saw how the Indians had on shore many balsas made of tule, which are like reeds....The balsas were made like canoes, and with these they go fishing...we gave them to understand by signs that they should bring us something to eat, as we had no food. Understanding our necessity, they went ashore and brought some bitter acorns and mush made of these acorns...They use the bow and arrow and their food consists of bitter acorns and fish. They seemed to be about three hundred in number....The land seemed to be good as it was covered with trees and verdure. (Wagner 1924:15–16)

In AD 1602, Sebastian Vizcaino, while exploring the California Coast for Spain, recorded the following observations in the Monterey Bay area:

> The land is well populated with Indians without number, many of whom came on different occasions to our camp. They seem to be gentle and peaceful people; they say with signs that there are many villages inland. The sustenance which these Indians eat most daily, besides fish and shellfish, is acorns and another fruit larger than a chesnut; this is what we could understand of them. (Broadbent 1972:47)

Later, Pedro Fages described resource procurement in the Monterey Bay area in his journal of the AD 1769 expedition and in his summary report. Near Point Año Nuevo he noted that Indians were ". . . very clever at going out to fish embarked on rafts of reeds, and they succeed, during good weather, in getting their provisions from the sea. . . the land also provides them with an abundance of seeds and fruits" (Fages 1937:70). Fages (1937:69) also noted heavy exploitation of a summer run of sardines. He remarked that the local inhabitants "do not have fixed places for their villages, but wander here and there wherever they can find provisions at hand" (Fages 1937:67). In the Salinas Valley he observed that "Many antelope were seen going by, and the place was named Real de los Cazadores, for there were then round about it some Indians who were so absorbed and occupied in hunting game that they did not notice us . . . (Fages 1911:67). At Mission San Carlos, Fages (1937:68) noted that:

> Those who are in this mission and nearby obtain few acorns, the lack of which they supplement in part with blackberries and strawberries, which abound around the point of the Monte de Pinos; there are many boletes or mushrooms, and another wild fruit about the size of an ordinary pear which is eaten roasted and boiled though it is somewhat bitter. The tree which bears it is rather whitish, like a fig tree, but not very tall. When it bears fruit it sheds its leaves entirely.

In AD 1792, the Scottish naturalist for the George Vancouver expedition, Archibald Menzies (1924:293–294), recorded that

"Their food at this time was chiefly shellfish which the women collected along the shore, while the men lounged about the country with their bows and arrows, killing rabbits and quails." Based on such data, it is clear that the Native inhabitants of the Central Coast exploited a broad spectrum of terrestrial and aquatic foods. Hypothetical seasonal rounds have also been constructed (for example, Breschini and Haversat 1994; Dietz and Jackson 1981) from these sources.

By combining the historic accounts with archaeological findings, Dietz and Jackson (1981) proposed that late prehistoric and postcontact peoples were probably inland based "collectors" (Binford 1980), who maintained primary residential bases in the interior and visited the coast to acquire specialized resources. Dense deposits of whole abalone shells recovered from archaeological sites on the Monterey Peninsula were thought to represent one type of specialized resource, as abalone were apparently harvested en masse, shelled, dried, and transported inland for later consumption (figure12.3). Radiocarbon results for these features, so far known only from the Monterey Peninsula, show consistent dating to the late prehistoric and early postcontact period (Breschini and Haversat 1991). Other researchers suggest that an intense focus on acorns may have contributed to a preference for inland habitation (Jones et al. 1989; Hildebrandt and Jones 1992; T. Jones 1995, 2003), although the historic record is fairly mute concerning the degree to which Central Coast peoples relied on acorns. Regional settlement patterns show an emphasis on inland site locations for the post-AD 1000 period, however (T. Jones 1992:14). Based on historic accounts, Breschini and Haversat (1994) suggested that trips to the coast were made in the summer to take advantage of seasonal fish runs. Hildebrandt (1997a, 1997b), however, argued (contrary to Jones 1997) that inland people made excursions to Elkhorn Slough in the winter.

While the abalone shell features of the Monterey Peninsula suggest a "collector" type of settlement system for the very late prehistoric era, the full mechanics of that system are not well understood, nor are settlement practices for the broader Central Coast during the rest of the Late Holocene. Existing historical sources and archaeological models are fraught with contradictions. One of the primary reasons Kroeber (1955b) developed the term tribelet to describe Central Californian Native communities was that the term "band" suggested frequent movements between seasonal encampments. Kroeber felt the "villages" of coastal Central California were more permanent than the encampments of typical band societies. While there seems to be some validity to Kroeber's assessment, early Spanish accounts indicate seasonal movements by entire social groups (see Gordon 1979:29; Rivers and Jones 1993).

Figure 12.3 Late period abalone shell feature from MNT-170

Ambiguity regarding ethnohistoric settlement and subsistence is also apparent for the southern portion of the Central Coast, inhabited by Chumash speakers. Greenwood's (1978b) summary of early historic accounts clearly shows that populations north of the Santa Barbara Channel were considerably less dense, that people lived in smaller and less elaborate settlements, and they seem to have been more mobile than their kin to the south. Greenwood (1978b:52) suggested that the nonpopulous, mobile, band-like adaptation suggested by early historic accounts was preceded by a sedentary prehistoric adaptation represented archaeologically at SLO-2, which she interpreted as the remnant of a year-round village. She further surmised that Protohistoric diseases effected population decline and cultural devolution during the centuries preceding historic contact.

Level of Social Complexity

The incomplete archaeological and ethnographic records make it difficult to reach firm conclusions about the complexity of Native cultures along the Central Coast. Most of the available evidence suggests elaboration more complex than the typical band, however, and more akin to the tribal form of organization (Hester 1978a, 1978b; Harrington 1942:32; Kroeber 1908, 1955b; Levy 1978), with one historic account suggesting a hierarchical political structure. As discussed previously, there is some evidence (albeit ambiguous) of low residential mobility, but settlement does not seem to have been fully sedentary. Formal leadership statuses existed (Levy 1978:487), and most evidence suggests that authority was limited to individual villages, village clusters, and/or lineages. An AD 1775 description by Fages, however, suggests the presence of paramount chiefs and political hierarchy in the Monterey Bay area:

> Besides their chiefs of villages, they have in every district another one who commands four or five subordinate villages together, the village chiefs being his subordinates. Each of them collects every day in his village tribute which the Indians pay him in seeds, fruits, game, and fish . . . . The subordinate captain is under obligation to give his commander notice of every item of news or occurrence, and to send him all offenders under proper restraint, that he may reprimand them and hold them responsible for their crimes. . . . Everything that is collected as the daily contribution of the villages is turned over to the commanding captain of the district, who goes forth every week or two to visit his territory. The villages receive him ceremoniously, make gifts to him of the best and most valuable things they have, and they assign certain ones to be his followers and accompany him to the place where he resides (1937:73–74).

Chiefly duties were mostly limited to ritual and warfare. There are some suggestions that chiefly power was hereditary and chiefs could acquire wealth (Harrington 1942:33). Responses of the Spanish mission *interrogatorio* (a questionnaire sent from Spain to be completed by the missionaries) of AD 1814 included this statement in reference to the Monterey Bay area: "The principal Indians are their chiefs or kings. Each nation has one. They obey and respect him all their lives. The position is inherited by succession, or in the case of wont of direct succession, it goes to the nearest relative" (Kroeber 1908:21). Indications of relatively egalitarian social values exist (Harrington 1942:31), but there is also one record of remarkably high rates of usury among Salinan speakers (Kroeber 1908:18). Warfare was common (Broadbent 1972:73; J. Mason 1912:181). Populations were apparently organized into unilineal descent groups, and possibly into bear and deer moieties among the Ohlone (Harrington 1942:32).

Hallmarks of greater complexity seen elsewhere in the archaeological and historic records of California are absent from the Central Coast. The high population density, sedentism, and craft specialization of the Santa Barbara Channel area, for example, are not evident, nor is the elaborate maritime economy with its sophisticated watercraft. Signs of remarkable wealth accumulation, social stratification, and slavery known from the ethnographic record of Northern California are also absent. As discussed in more detail below, the archaeological record from the Middle period shows some evidence, albeit ambiguous, for status ascription. Overall, the lower mobility, frequent warfare, ascribed statuses, suggestions of wealth, and organization into lineal descent groups and/or moieties suggest a level of sociopolitical organization more complex than the typical band. Some evidence even suggests a hierarchical or chiefdom type of organization.

ARCHAEOLOGY AND PREHISTORY

Unlike the more heavily studied areas of California, the coast of Monterey and San Luis Obispo Counties was largely ignored during the seminal investigation of California prehistory. Until the advent of the modern cultural resources management (CRM) era circa 1970, only a handful of investigations were completed (e.g., Abrams 1968a, 1968b; Clemmer 1962; Leonard 1968; Pohorecky 1964; Pritchard 1968; Reinman 1961). Most of these produced evidence for Late Holocene occupation (for example, MNT-282 [Pohorecky 1964], SLO-175 [Abrams 1968a, 1968b], and Whale Rock Reservoir [Reinman 1961]) but fell short of providing data sufficient for regional culture histories. As a consequence, through the 1970s Central Coast cultural chronology was interpreted largely through reference to adjoining areas (for example, the Santa Barbara Channel and San Francisco Bay areas). In the 1980s, the Central Coast region emerged as a discrete cultural historical province based on data obtained from a series of important investigations undertaken primarily within CRM contexts (for example, Breschini and Haversat 1980, 1989a; Cartier 1993a, 1993b; Dietz 1987, 1991; Dietz and Jackson 1981; Dietz, Hildebrandt, and Jones 1988; Fitzgerald, Farquar, and Farrell 2000; Gibson 1979; Greenwood 1972; Hildebrandt and Mikkelsen 1993; Jones and Waugh 1995; Jones et al. 1994, 1996; Mikkelsen, Hildebrandt, and Jones 2000, Milliken et al. 1999; Roper et al. 1997; Waugh 1992). Most of these projects produced well-dated and well-sampled components dating to the Late Holocene.

Regional Culture History

For purposes of cultural historical integration, Jones (1993) divided the Central Coast into three districts: Monterey Bay, Big Sur, and San Luis Obispo (figure 12.1). Each district was subdivided into localities based largely on dominant coastal landforms and their influence on the faunal composition of local middens. The Monterey Bay district includes the Elkhorn Slough and Monterey Peninsula localities, the Big Sur district is divided into northern and southern localities, and the San Luis Obispo district includes the North Coast, Morro Bay, and Pismo Beach localities. At the regional level, the cultural sequence shows a significant amount of interdistrict uniformity, although each district is marked by distinctive local traits. For the last 3000 years, the Central Coast time-space grid is broken into the following periods:

Early-Middle Transition: 1000 to 600 BC
Middle: 600 BC to AD 1000
Middle-Late Transition: AD 1000 to 1250
Late (including Protohistoric): AD 1250 to 1769
Historic: post AD 1769

Named phases have been defined for each district for most of these periods based on important single components, although data are lacking for some districts. For the most part, the Central Coast sequence is clearly distinct from the San Francisco Bay and the Sacramento/San Joaquin Valley. More cultural traits are held in common with the Santa Barbara Channel, at least during the Middle and Middle/Late Transition periods. Fewer similarities are apparent for the Late period.

Key Components. The Late Holocene begins with the terminal centuries of the Early period (3500 to 1000 BC) and the Early/Middle Transition. The latter is a somewhat hypothetical period, represented by poorly delineated components at MNT-391 (Cartier 1993a), MNT-234 (Breschini and Haversat 1995a; Milliken et al. 1999), and MNT-229 (Dietz, Hildebrandt, and Jones 1988), where there is some indication of co-occurrence of the Early period (*Olivella* Class L) with the Middle period (*Olivella* saucers) bead types. For the most part, however, the Late Holocene is defined by the Middle and Late periods. The Middle period has proven particularly easy to define, as many investigations, including the first in the region (Willow Creek [MNT-281 and MNT-282] and Little Pico Creek [SLO-175]) produced components dating between 600 BC and AD 1250. Research during the last two decades shows that Middle period residential sites are ubiquitous, and that the largest, most visible shell middens almost inevitably contain Middle period materials. Several of the early excavations produced extensive artifact collections, including some from burial contexts, but burial populations are generally limited from this region. Because many Middle period sites were abandoned prior to the end of the Middle-Late Transition, problems of intercomponent (Middle and Late) mixing are minimal, and discrete Middle period components have been identified in all six Central Coast localities (table 12.1). The Middle-Late Transition is more poorly represented, largely because it is an extension of the Middle period, and is most commonly found at sites that also contain Middle period materials. Few Middle period sites have produced significant Late period components because they tend to occur as separate, single-component deposits.

Late period components are fewer in number (table 12.1) and less visible along the coast. In the Monterey and Big Sur districts, more Late period components have been found inland than along the shoreline, with the notable exception of abalone collecting sites on the Monterey Peninsula, which rarely produce significant artifact samples. In the Morro Bay locality, several Late period components have been identified near the bay shore, almost exclusively as single-component deposits (Joslin and Bertrando 2000). In general, the spatial separation of Late from Middle and Middle-Late components has facilitated definition of a Late Holocene culture history in an area where stratigraphic mixing is a significant problem because of large populations of burrowing animals. Nonetheless, well-sampled, well-dated Late period components are yet to be reported for much of the region.

Cultural Sequence. The regional cultural sequence is perhaps best represented in the Big Sur and northern San Luis Obispo districts where discrete Middle and Late period components have been isolated. For the most part, absence of adequate artifact samples from adjoining areas makes it necessary to rely on components from these areas to represent the region (figure 12.4). The Middle period at Big Sur and throughout the Central Coast is marked by an expression of what is sometimes called the "Hunting Culture," the middle of three cultural complexes first recognized in the Santa Barbara Channel by David Banks Rogers in 1929. The concept of a Hunting Culture has fallen from favor in the Santa Barbara Channel, in part because Middle Holocene adaptations in that area are not accurately described under the simple rubric of "hunting." Nonetheless, the concept has some value on the Central Coast as a cultural historical unit that encompasses assemblages of large stemmed projectile points, bowl mortars, pestles (often well made), milling slabs, handstones, pitted stones, and bi-pointed fish gorges that occur throughout the region. These assemblages first appear during the Middle Holocene (Early period ca. 3500 BC) and continue with minor additions through the Middle-Late Transition. Formal phases have been assigned to designate Middle period expressions of the Hunting Culture in each of the three Central Coast districts: Vierra in the Monterey Bay district based on findings from MNT-229, Willow Creek in the Big Sur District based on findings from MNT-282, and Little Pico II on the San Luis Obispo Coast based on findings from SLO-175. These components generally produced utilitarian assemblages of large contracting-stemmed points, handstones and milling slabs, bowl mortars, grooved stone net weights and pitted stones (figure 12.5), curved shell fishhooks (figure 12.4), and an assortment of bone tools (awls and strigils) (figure 12.6). While there is some suggestion

Table 12.1. Key Late Holocene components from the central California coast.

LOCALITY	MIDDLE PERIOD (600 BC–AD 1000)		MIDDLE/LATE TRANSITION PERIOD (AD1000–1250)		LATE PERIOD (AD 1250–1769)	
	SITE	REFERENCE	SITE	REFERENCE	SITE	REFERENCE
Elkhorn Slough	MNT-228	Jones et al. (1996)			MNT-1765	Fitzgerald et al. (1995)
	MNT-229[1]	Dietz et al. (1988)	MNT-229[1]	Dietz et al. (1988)	MNT-234[2]	Milliken et al. (1999)
	MNT-234	Breschini and Haversat (1995a) Milliken et al. (1999)				
	SCR-44	Breschini and Haversat (1989b)				
Monterey Peninsula Coastal	MNT-101	Dietz (1987)	MNT-3	Jones (1998)		
	MNT-115	Dietz and Jackson (1981)				
Monterey Peninsula Interior			MNT-1485/H	Breschini and Haversat (1992)	MNT-1486/H	Breschini and Haversat (1992)
					MNT-1601	Breschini and Haversat (1995b)
Big Sur Coastal	MNT-63	Jones (1995)	MNT-1233	Jones (1995)	MNT-759/H	Jones (1995)
	MNT-282	Pohorecky (1964)	MNT-281	Pohorecky (1964)	MNT-1223	Jones (1988, 1995)
					MNT-1227	Jones (1995)
					MNT-1235	Jones (1995)
					MNT-1236	Jones (1995)
					MNT-1277/H (*Matilce*)	Jones (1995)
Big Sur Interior	MNT-521	Jones and Haney (1997a)			MNT-569 Midden B	Jones and Haney (1997b)
	MNT-332	Haney and Jones (1997)				
San Luis Obispo North Coastal	SLO-175	Abrams (1968) Jones and Waugh (1995)	SLO-179	Waugh (1992)		
	SLO-267	Bouey and Basgall (1989) Ferneau (1998) Jones and Ferneau (2002)				
Morro Bay Coastal	SLO-165[3]	Jones et al. (1994) Mikkelsen et al. (2000)			SLO-214	Hoover and Sawyer (1977) Bertrando (1997)
					SLO-464	Sawyer 1988
	SLO-2[3]	Greenwood (1972)				
Pismo Beach Coastal	SLO-406	Tainter (1971)				
Pismo Beach interior	SLO-1809	Fitzgerald et al. (2000)	SLO-1809[1]	Fitzgerald et al. (2000)	SLO-372	Baker (1977)

[1]Occupation continued into the Middle/Late Transition, but M/L component could not be segregated.
[2]Occupation indicated by radiocarbon dates only- no significant artifact assemblage.
[3]Mixed.

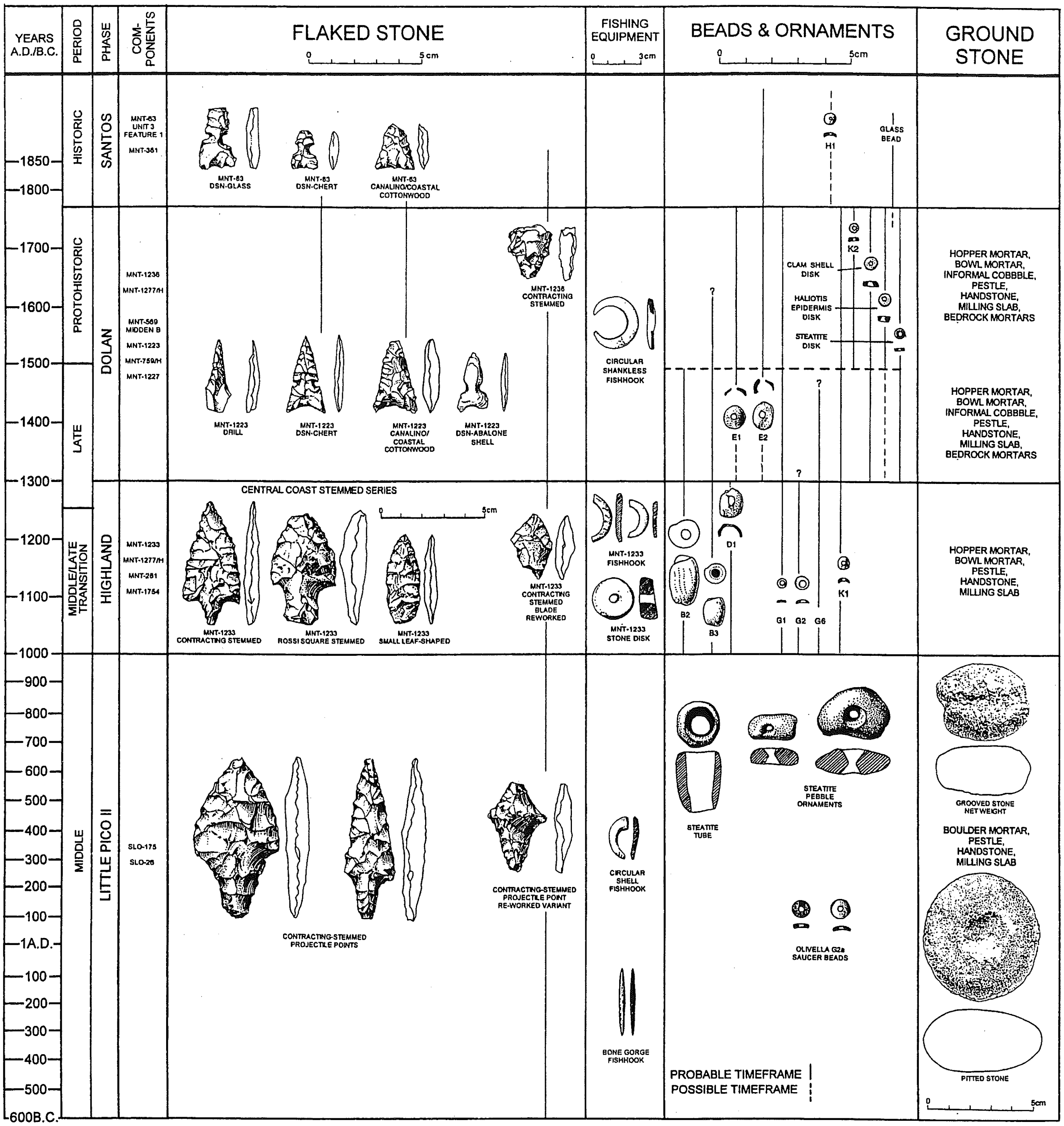
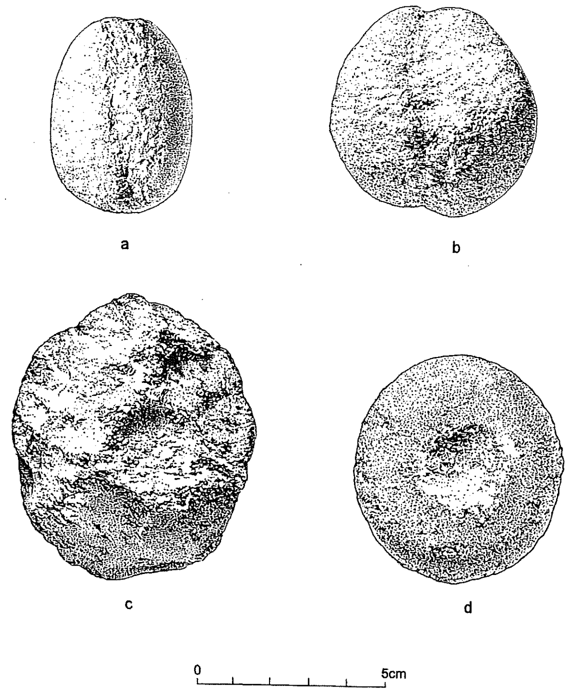


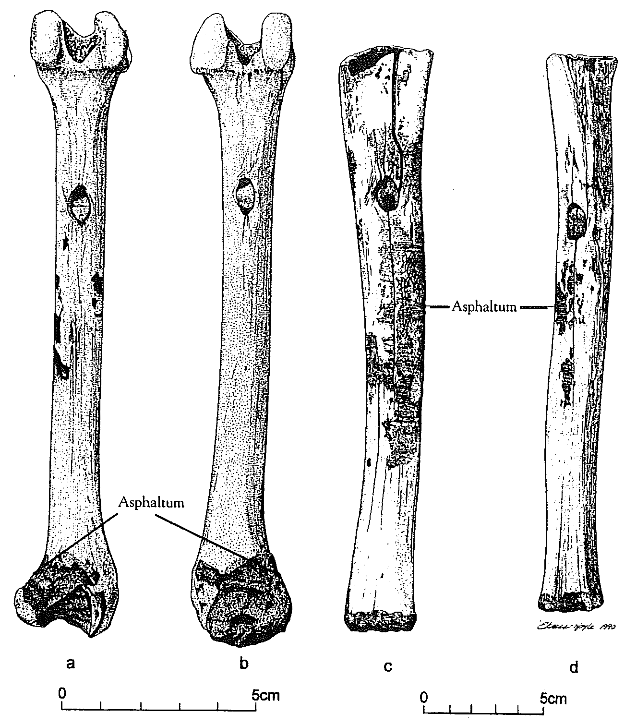
Figure 12.4 Composite Late Holocene culture history for the Big Sur District and northern San Luis Obispo locality

that square-stemmed and side-notched points persisted into the Middle period, well-delineated components at SLO-267 and MNT-282 suggest these types were much more common in the Early period, and that contracting-stemmed and occasional concave-base points mark the Middle period. Milling assemblages vary through the region as the Middle period component at MNT-229 produced only bowl mortars and pestles, while MNT-521 in the interior of Big Sur showed near exclusive use of handstones and slabs.

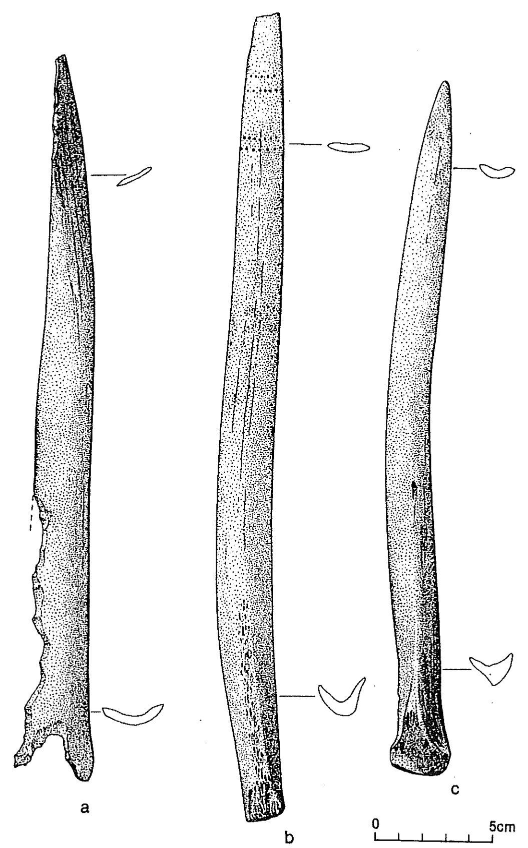
Burial populations from MNT-229, SLO-2, SLO-175, and SLO-406 illuminate mortuary practices and ideotechnic artifact types associated with the Middle period. The degree to which cemeteries were formalized during the Middle period is somewhat unclear. Gravesites have only been identified within areas of residential occupation marked by middens. Some cemeteries in the San Francisco Bay area,



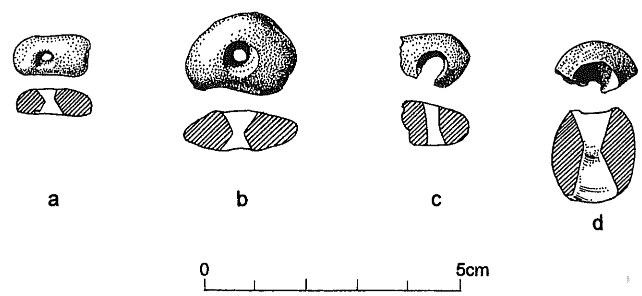
12.5 Middle period grooved stone net weights: *a*, 582-04-63 from SLO-267; *b*, 580-A-75 from SLO-179 and pitted stones: *c*, 582-21-45 from SLO-267; d, 582-03-38 from SLO-267. *Jones and Ferneau 2002*



12.7 Middle period bone whistles from SLO-175: *a*, 511-1966B14d; *b*, 511-1966B14f; *c*, 511-1966B14b; *d*, 511-1966B14h. *Jones and Waugh 1995*



12.6 Middle period bone strigils from SLO-175: *a*, 511-444; *b*, 511-891; *c*, 511-983. *Jones and Waugh 1995*

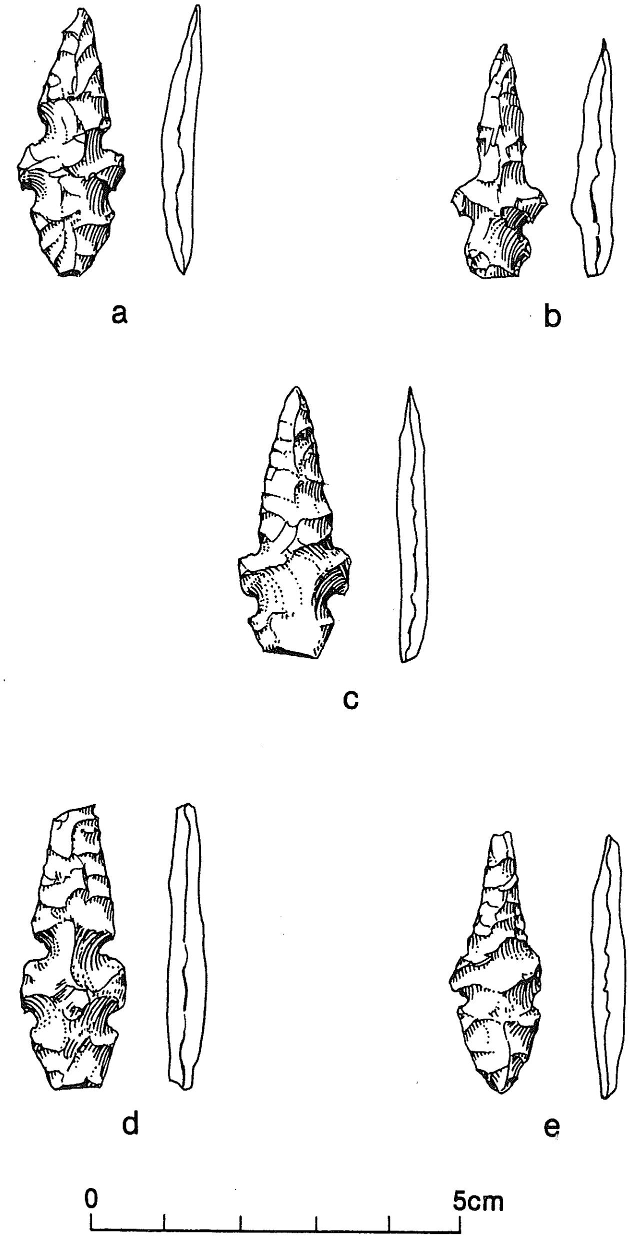


12.8 Middle period steatite objects from SLO-267: *a*, 582-11-95; *b*, 582-17-31; *c*, 582-17-97; *d*, 582-12-33. *Jones and Ferneau 2002*

in contrast, were clearly separated from residential areas, with interments found in culturally sterile soil. Middle period middens on the Central Coast often produce burials in clusters or in certain segments of a deposit (but not others), suggesting some structure to or organization of the settlement. Most interments were primary, and at SLO-175 some graves had clear markers above them suggesting a designated cemetery area. Examples of reburied individuals, however, are known from SLO-406 (Tainter 1971:9), and most burials from the region, such as MNT-229 show no signs of nonperishable grave markers. Grave posture was generally flexed, with no obvious preference for tight or loose, or a particular cardinal orientation. Several dogs were interred at SLO-406 in association with individual human graves. Violence or ritual killing is represented by at least one grave from SLO-406, where an adult female was interred with 12 projectile points in her body.

The shell bead type that is a hallmark of the Middle period is the Class G *Olivella* saucer, particularly the G2. A G6 variant defined at MNT-229 (Dietz, Hildebrandt, and Jones 1988) has most recently been resubsumed within G2 (Mikkelsen et al. 2000). G2 examples were directly dated at MNT-229 (three specimens were dated to 17, 580, and 740 cal. BC [Dietz, Hildebrandt, and Jones 1988:286]), SLO-1797 (one G2 bead dated to cal. AD 40 [Fitzgerald 2000), and SLO-165 (one G2 bead dated to cal. AD 40, and another dated to 680 cal. BC [Mikkelsen et al. 2000: Table 9]). Burials with impressive quantities of *Olivella* saucers were reported from MNT-229 (3251 G6 from burial 5) and SLO-406 (2956 saucers from burial 9). More elaborate grave items include a variety of bird and mammal bone tubes and whistles, as represented at MNT-229, SLO-2, SLO-175, and SLO-406 (figure 12.7a). Those from San Luis Obispo County show elaborate use of asphaltum and bead applique. Several sites, such as SLO-2 and SLO-175, produced bone whistles made from the femurs of mountain lions and coyotes (figure 12.7b). Less common grave accompaniments include large contracting-stemmed projectile points, bowl mortars, and a variety of abalone shell ornaments (see Tainter 1971:Pls. 1, 2). Another common Middle period artifact in the San Luis Obispo (Little Pico II phase) and Big Sur (Willow Creek phase) districts are steatite tubes, barrels, and drilled pebble ornaments, as represented at SLO-406 (Tainter 1971: Pl. 2), SLO-267 (figure 12.8), MNT-521, and SLO-165 (Mikkelsen et al. 2000:104–105).

The Middle-Late Transition, more tentatively defined than the Middle period, is marked by co-occurrence of large stemmed projectile points (holdovers from the Middle period) with small leaf-shaped variants that may reflect early bow and arrow technology. Hopper mortars seem to make their first appearance at this time. The period is best represented at MNT-1233, type site for the Highland phase in the Big Sur district, where a suite of ^{14}C dates defined an occupation dating between cal. AD 1000 and 1250 (Jones and Haney 1992). Recalibration of the original dates and acquisition of two more (reported by Jones and Kennett 1999) indicate that occupation may have continued as late as cal. AD 1430. One sigma probabilities from seven ^{14}C dates suggest a maximum occupation span of cal. AD 910 to 1520, and a minimum of cal. AD 1120 to 1310 (Jones and Kennett 1999). Since arrow points generally predate AD 1000 in western North America, the beginning date for this phase may eventually be pushed back as far as AD 500. At present, however, there are no arrow points from the Central Coast unequivocally dated before AD 1000. In the Big Sur and San Luis Obispo districts, a unique Cambria double side-notched point marks the Middle-Late Transition (figure 12.9). Burials from this period are known from Willow Creek and Little Pico Creek. At the latter, two group interments (both with four individuals in supine extended position in a common pit) were found, one of which included Cambria double side-notched points. Goods found with another Double side-notched grave included *Olivella* B2, B3, G2, and K1 beads, indicating that these types were also used during this period, although none are restricted to the Middle-Late Transition. The ^{14}C dates from MNT-234 suggest that G1 *Olivella* saucers may date primarily to the Middle-Late Transition (Milliken et al. 1999), supporting findings from



12.9 Cambria double side-notched projectile points from SLO-175: *a*, 511-B12a; *b*, 511-38a; *c*, 511-40a; *d*, 511-41a; *e*, 511-41b. *Jones and Waugh 1995*

MNT-237 (Jones 2000). Additional Middle-Late components are known from MNT-3 in the Monterey Peninsula locality and SLO-1796 near Pismo Beach (Jones and Lopez 1997). Neither of these components had associated graves, but the latter produced a *Megathura* limpet ornament similar to those dated AD 1150 to 1250 in the Santa Barbara Channel area (C. King 1990). Both sites also produced radiocarbon evidence for occupation as recent as circa AD 1400. One additional Middle-Late artifact type known from MNT-281 on the Big Sur Coast is the small-incised slate tablet, which commonly shows chevron-like designs (see Swernoff 1982).

Well-dated, well-sampled components are much less ubiquitous for the Late period which shows changes in most artifact types after circa AD 1250 to 1300.[2] Late materials and dates are known from MNT-1765, MNT-115, MNT-1486/H, MNT-1223, MNT-1227, MNT-569B, SLO-2, and SLO-214. Of these, the most important is MNT-1223, the defining component for the Dolan Phase on the Big Sur Coast. This site produced a typologically cohesive suite of artifacts from a deposit dated with seven ^{14}C dates between AD 1220 and 1720 (T. Jones 1995, 2003). The assemblage includes desert side-notched and Canaliño projectile points, circular shell fishhooks, punched spire-lopped (A4), appliqué spire-lopped (A5), round thin lipped (E1a), oval thin lipped (E1b), and cupped (K1) *Olivella* beads, and small, thin steatite disks.[3] The cupped and saucer beads are holdovers from the previous phase. At MNT-1223, ground stone was limited to the slab hopper mortar and pestle. At other sites, particularly in the inland valleys, Late period components are associated with bedrock mortar features[4] and crude cobble pestles (Haney and Jones 1997). Small handstones and slabs were also recovered from MNT-1227. There are some suggestions, based on findings from MNT-1236 (figure 12.4) and Mission San Antonio (Hoover and Costello 1985:26), that large contracting-stemmed points continued in use through the Late period. If this is true, they represent a very minor part of the assemblages. A small, crude core-microblade industry was also represented at MNT-1223, apparently associated with the modest production of shell beads (T. Jones 1995, 2003). The sophisticated and profuse microblade/drill industry of the Santa Barbara Channel is only modestly suggested north of Point Arguello. Betrando (1997) reported several microblade drills from SLO-214, and private collections from San Luis Obispo County show some evidence of the industry.

While Late period assemblages in the Monterey Bay and San Luis Obispo districts remain poorly defined, variation identified to date may in some instances reflect ethnic differentiation. Class M Rectangular *Olivella* beads have not been found south of MNT-1485/H in the upper Carmel River watershed. This type was widespread during the Late period in the San Francisco Bay area (see Hylkema, chapter 13, this volume), and may be an Ohlone/Costanoan marker. Obispeño Chumash sites likewise seem to distinguish themselves by arrow point types other than the desert side-notched—mainly small triangular, concave-base specimens referred to alternatively as Canaliño, Cottonwood, or Coastal Cottonwood types.

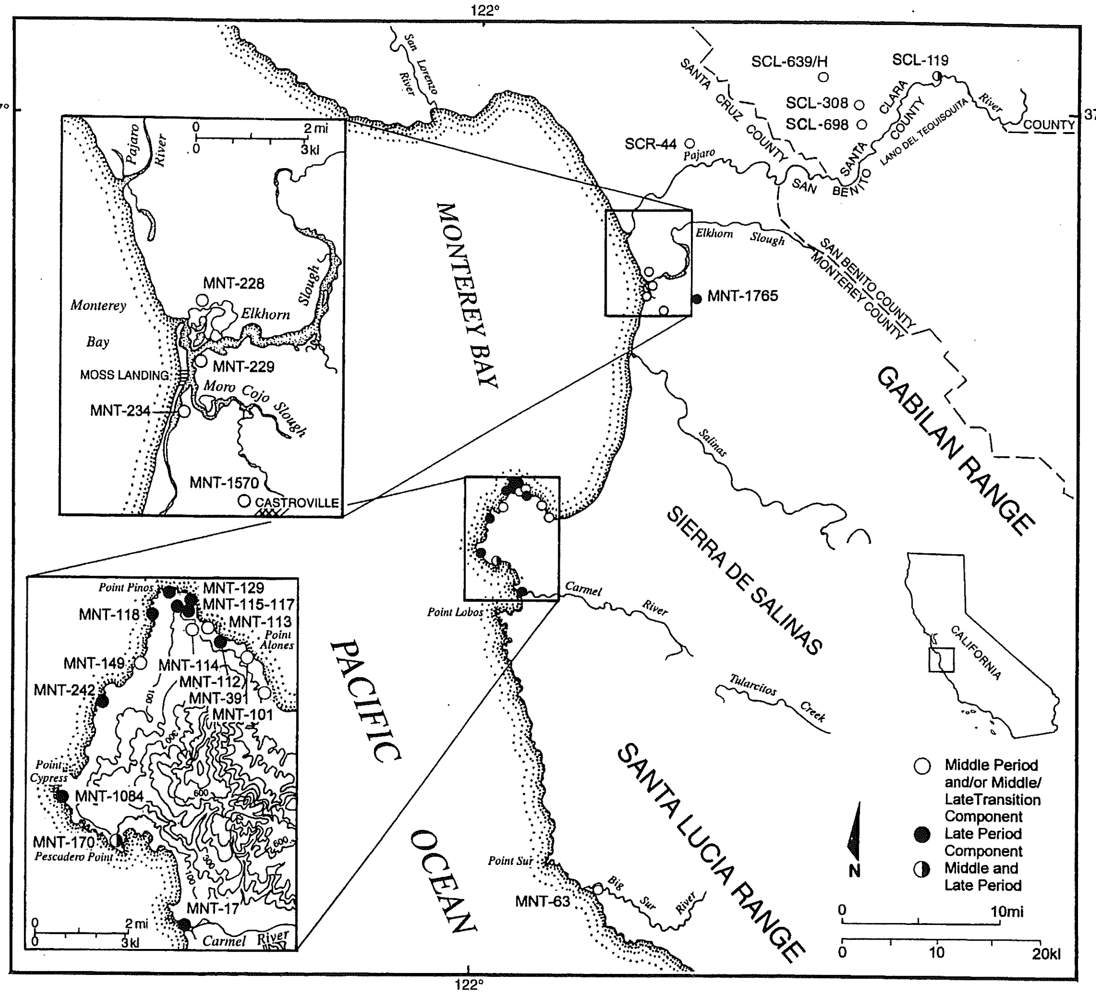
The Historic period is distinguished from the precontact era by glass beads, glass projectile points (desert side-notched and Canaliño types), mussel, abalone, *Olivella* (Class H) and clam disks, *Olivella* thick lipped (E2), bushings (K2), and ground cupped (K2 and K4). This period is well represented on the Big Sur Coast at MNT-1277/H, the ethnographic Salinan village of Matilce, and at MNT-63 (Jones 1995, 200).

SETTLEMENT AND DIET

In terms of basic subsistence and site location patterns, the Middle period shows continuity from the Early period. Many coastal sites with Early components also show evidence for occupation during the Middle period (for example, MNT-391, SLO-175). By the onset of the Middle period, virtually all Central Coast habitats were inhabited and exploited, and Middle period midden sites are known from all Central Coast localities: MNT-229, MNT-228, and MNT-234 at Elkhorn Slough; MNT-101 on the Monterey Peninsula; MNT-63 and MNT-282 on the Big Sur Coast; MNT-521 in the interior east of Big Sur; SLO-175 on the coast of San Luis Obispo; SLO-165 on Morro Bay; SLO-2 on the rocky headlands south of Morro Bay; and SLO-406 and SLO-809 near Pismo Beach. Most of these sites are found on the immediate shoreline, which is consistent with an intense focus on marine foods that is also suggested by faunal remains, particularly microfauna. Sites sampled using fine-grained techniques (for example, water processing with 3 and/or 1.5 mm mesh), especially those situated along estuaries (for example MNT-234 at Elkhorn Slough and SLO-165 at Morro Bay) show dense concentrations of fish bone from such species as silversides (Atherinidae), herring and sardine (Clupeidae), and surf perches (Embiotocidae) (table 12.2). Middle period sites on the open coast, such as MNT-63, SLO-175, and SLO-267, show less fish bone overall but higher representation of rockfishes (*Sebastes*) and cabezon (*Scorpaenichthys marmoratus*) (table 12.3). Bird and mammal remains from Middle period middens (for example, MNT-228, MNT-229, SLO-267) are generally dominated by deer, cottontail rabbits, and sea otters (table 12.4). Dietary reconstructions based on minimum numbers of individuals (MNIs) and meat weights suggest that fish were an important part of most Middle period diets on the coast (Jones 1995, 200; Jones and Waugh 1995), although problems with such indices must be acknowledged (see Erlandson 1994; Mason et al. 1998).

Many sites occupied during the Middle period continued to be used during the Middle-Late Transition, so discrete

Figure 12.10
Northern localities of the Central California Coast: Middle and Late period site locations



Transition components are limited to finds from MNT-3, MNT-1233, and SLO-179—all on the open coast. These sites produced significant assemblages of fish bone (table 12.3), and there is some suggestion of greater fish bone density in middens dating to this period on the open coast (Jones and Kennett 1999), as well as a greater reliance on small taxa such as northern anchovies (Ferneau 1998; Jones 1995, 2003; Jones and Kennett 1999). Mammal and bird assemblages from MNT-3 and SLO-179 show greater reliance on cottontail rabbits than on deer.

The most striking characteristic of the Late period on the Central Coast is the lack of occupational continuity across the Middle-Late Transition. Sites occupied during the Middle period in most cases did not see continued use into the Late period. Most Late period sites were initially occupied sometime after the end of the Middle period. Sites with significant Late period components rarely produce substantial Middle period materials, as indicated by a locality by locality review of ^{14}C-based occupational histories (figure 12.10 through 12.18). At Elkhorn Slough, sites like MNT-229 have produced abundant evidence for Middle period habitation (19 ^{14}C dates, 11 graves, and a large tool assemblage), but almost nothing (a single arrow point and glass trade bead) indicating occupation after circa AD 1300 (figures 12.10, 12.11). A similar pattern is evident at MNT-234, where Milliken et al. (1999) found radiocarbon evidence of Late period habitation but no complementary artifact assemblage. Their data also show a gap in the radiocarbon record between cal. AD 500 and 1100.

On the Monterey Peninsula, the same pattern is apparent: no sites show unbroken occupation from the Middle through Late period or significant superimposed Middle and Late period components. Most Middle period sites were abandoned before or during the Middle-Late Transition, while many other sites were initially occupied during the Transition or Late period (figure 12.11). On the Big Sur Coast (figures 12.12, 12.13), only MNT-376 produced Middle and Late period materials, unfortunately from mixed contexts. In the San Luis Obispo district, occupational discontinuity is evident in all three localities, as most Middle period sites appear to have been abandoned during the M-L Transition, while most Late period sites show few signs of occupation before the Transition (figure 12.15 through 12.18). Recent analysis of settlement patterns and ^{14}C dates from Morro Bay shows strict separation of Late period components (Joslin and Bertrando 2000).

Table 12.2 Fish remains from Middle period components at Elkhorn Slough

COMMON NAME	SPECIES	NISP MNT-228 UNIT 10, 3 MM MESH (1.1 M³)	NISP MNT-234 UNIT 1, 60–70 & 120–130 CM, 3 MM MESH (0.2 M³)
Freshwater			
Sacramento perch	*Archoplites interruptus*	90	20
Minnow family	Cyprinidae	46	31
Thicktail chub	*Gila crassicauda*	16	12
Hitch	*Lavinia exilicauda*	3	1
Sacramento blackfish	*Orthodon microlepidotus*	2	3
Sacramento squawfish	*Ptychocheilus grandis*	1	0
Sacramento sucker	*Catostomus occidentalis*	0	15
Minnow or Sacramento sucker	Cyprinidae or *Catostomus occidentalis*	8	0
	SUBTOTAL	166	82
Euryhaline			
Silversides	Atherinidae	1279	287
Topsmelt	*Atherinops affinis*	5	0
Herring and sardine	Clupeidae	538	290
Pacific herring	*Clupea pallasi*	21	0
White croaker	*Genyonemus lineatus*	0	1
Surfperches	Embiotocidae	467	122
Shiner perch	*Cymatogaster aggregata*	140	12
Sturgeon, white or green	*Acipenser* sp.	7	0
Threespine stickleback	*Gasterosteus aculeatus*	341	6
Staghorn sculpin	*Leptocottus armatus*	104	16
Sculpins	Cottidae	4	0
Cabezon	*Scorpaenichthys marmoratus*	0	1
Starry flounder	*Platichthys stellatus*	6	3
Steelhead	*Oncorhynchus mykiss*	10	1
Pacific hake	*Merluccius productus*	0	4
	SUBTOTAL	2922	743
Marine			
Cartilaginous fishes	Chondrichthyes	2	0
Rays	Rajidae	1	0
Requiem sharks	Carcharhinidae	1	0
Bay ray	*Myliobatis californica*	34	1
Pacific sardine	*Sardinops sagax*	26	0
Jacksmelt	*Atherinopsis californiensis*	2	0
Northern anchovy	*Engraulis mordax*	153	16
Black perch or striped seaperch	*Embiotoca* sp.	9	0
Barred, calico, or redtail surfperch	*Amphistichus* sp.	2	6
Rubberlip seaperch	*Rhacochilus toxotes*	1	0
Pile perch	*Rhacochilus vacca*	13	3
Rockfish	*Sebastes* sp.	0	1
Plainfin midshipman	*Porichthys notatus*	56	7
Righteyed or lefteyed flounder	Pleuronectidae or Bothidae	21	160
Speckled sanddab	*Citharichthys stigmaeus*	1	0
Pacific sanddab	*Citharichthys sordidus*	0	1
English sole	*Pleuronectes vetulus*	4	0
Hornyhead turbot	*Pleuronichthyes verticalis*	2	0
	SUBTOTAL	328	195
	GRAND TOTAL	3416	1020
	NISP/m³	3105	5100

Sources: Breschini and Haversat 1995a:199 ; Jones et al. 1999:96

Table 12.3 Fish remains from rocky coast archaeological sites

COMMON NAME	SPECIES	MIDDLE		MIDDLE-LATE		LATE		
		MNT-63	SLO-267	MNT-1233	SLO-179	MNT-1223	MNT-1227	MNT-1277/H
Requiem sharks	Carcharhinidae	5	0	0	5	0	0	0
Shark or ray	Elasmobranchi	1	0	0	0	0	0	0
Herrings	Clupeidae	0	79	0	880	0	0	0
Pacific sardine	*Sardinops sagax*	0	7	0	72	0	0	0
Steelhead	*Oncorhynchus mykiss*	5	0	0	0	0	0	0
Northern anchovy	*Engraulis mordax*	0	0	0	2	0	0	0
Pacific hake	Merluccius productus	0	0	9	0	0	2	1
Smelts	Osmeridae	0	0	0	0	0	0	0
Northern clingfish	*Gobiesox maeandricus*	0	3	0	1	0	0	0
Silversides	Atherinidae	1	23	0	105	0	0	0
Rockfishes	*Sebastes spp.*	299	212	747	719	94	303	144
Rock or kelp greenling	*Hexagrammos sp.*	28	46	32	86	6	28	15
Lingcod	*Ophiodon elongatus*	18	2	35	10	1	9	2
Sculpins	Cottidae	0	1	0	2	0	0	0
Cabezon	*Scorpaenichthys marmoratus*	117	28	88	77	10	109	48
Surfperches	Embiotocidae	26	81	68	343	8	35	3
Barred, red, calico surfperch	*Amphistichus spp.*	2	0	0	2	0	0	0
Striped seaperch or black perch	*Embiotoca spp.*	3	1	0	2	0	5	0
Pile perch	*Rhacocheilus vacca*	0	36	0	56	0	0	0
Senorita	*Oxyjulus californica*	0	0	0	10	0	0	0
Pricklebacks	Stichaeidae	1	253	0	9	0	2	0
Monkeyface prickleback	*Cebidichthys violaceus*	65	22	1	89	8	4	0
Rock prickleback	*Xiphister mucosus*	13	74	6	28	2	16	5
Clinids	Clinidae	0	0	0	6	0	0	0
Striped kelpfish	*Gibbonia metzi*	0	6	0	8	0	0	0
Giant kelpfish	*Heterostichus rostratus*	0	1	0	4	0	0	0
Chub mackerel	*Scombes japonicus*	0	4	0	1	0	0	0
Plainfin midshipman	*Porichthys notatus*	0	0	0	7	0	0	0
White seaperch	*Phaneron furcatus*	0	0	0	1	0	0	0
Skate or ray	*Myliobatus*	0	0	0	1	0	0	0
Pacific barracuda	*Sphyraena argentea*	0	0	0	2	0	0	0
Croaker	*Genyonemus lineatus*	0	0	0	3	0	0	0
Jack mackerel	*Trachurus symmetricus*	0	0	0	7	0	0	0
Queenfish	*Seriphus politus*	0	0	0	3	0	0	0
Steelhead rainbow trout	*Salmo gairdnerii*	0	0	0	5	0	0	0
Spiny dogfish	*Squalus acanthias*	0	0	0	0	0	0	0
Righteyed or lefteyed flounder	Pleuronectidae or Bothidae	0	0	0	2	0	0	0
Penpoint gunnel	Apodichthys flavidus	0	0	0	1	0	0	0
Salmon shark	Lamna ditropis	0	0	0	1	0	0	0
TOTAL		584	880	988	2550	129	513	218

Sources: Gobalet and Jones 1995; Jones 1995; Jones and Ferneau 2002

Another recent excavation in the Pismo Beach locality at SLO-1809 produced abundant evidence for Hunting Culture occupation during the Early and Middle periods but no evidence for occupation after cal. AD 1300 (Fitzgerald, Farquar, and Farrell 2000). Exceptions to this pattern include SLO-267 (with separate middens marking Middle and Late period occupations) on the northern San Luis Obispo Coast (Bouey and Basgall 1991; Ferneau 1998; Jones and Ferneau 2002) and SLO-2 (a large, deeply stratified site with clear evidence of Middle and Late period materials, but imprecise dating).

In the Monterey Bay and Big Sur districts, Late period sites show some evidence of greater emphasis on inland rather than coastal habitats (Dietz and Jackson 1981; T. Jones 1992:14) and decreased reliance on marine resources. Recently completed testing projects at MNT-1892 (Hildebrandt and Jones 1998) and MNT-1942, however, have produced evidence of coastal exploitation not previously represented in the regional record. Well-sampled Late period sites like MNT-1223 produced fewer fish remains than Middle period sites and fewer remains of diminutive species like northern anchovies (T. Jones 1995, 2003; Jones and Kennett 1999).

Table 12.4 Mammal remains from Middle period and Middle-Late Transition components

COMMON NAME	SPECIES		ELKHORN SL.		MONTEREY C.		MONTEREY INT.		BIG SUR C.		BIG SUR INT.	S.L. OBISPO. NO. C.		
		MNT-228	MNT-229	MNT-234	MNT-101	MNT-115	MNT1485/H	MNT-3	MNT-63	MNT-1233	MNT-521	SLO-179	SLO-175	SLO-267
Terrestrial														
Deer	*Odocoileus hemionus*	85	403	0	51	9	197	40	38	203	44	83	22	93
Cottontail rabbit	*Sylvilagus* sp.	37	114	13	32	1	9	177	52	21	16	129	15	88
Tule elk	*Cervus elaphus*	5	95	1	0	0	1	9	0	2	0	0	0	0
Jack rabbit	*Lepus californica*	4	25	1	3	0	9	42	0	0	9	0	0	0
Wood rat	*Neotoma fuscipes*	1	0	1	2	0	0	0	0	0	0	0	0	0
Coyote/dog	*Canis* sp.	5	9	9	23	0	14	17	2	1	6	107	3	51
Badger	*Taxidea taxus*	3	3	0	0	0	2	1	0	0	1	1	2	2
Bobcat	*Lynx rufus*	15	5	0	0	0	3	1	0	1	2	4	0	1
Gray fox	*Urocyon cinereoargenteus.*	5	0	0	0	0	6	0	1	0	0	0	1	1
Grizzly bear	*Ursus horribilus*	0	0	1	0	0	3	2	0	0	1	0	0	0
Skunk	*Mephitis mephitis*	10	2	0	0	0	3	0	0	0	0	4	0	0
Black bear	*Ursus* sp	1	1	0	0	0	0	0	1	0	0	1	0	1
Weasel	*Mustela frenata*	1	2	0	0	0	2	0	1	0	0	0	0	0
Raccoon	*Procyon lotor*	8	9	0	0	0	0	0	0	0	1	2	0	4
Shrew	*Sorex* sp.	2	0	0	0	0	0	0	0	0	0	0	0	0
Pronghorn	*Antilocapra americana*	0	3	0	0	0	0	0	0	0	0	0	0	0
Mountain lion	*Felis concolor*	0	0	0	0	0	0	0	0	0	0	1	0	
SUBTOTAL		182	671	26	91	10	252	289	95	228	80	332	43	241
Marine														
Sea otter	*Enhydra lutris*	35	89	2	64	6	1	0	14	2	0	54	1	12
Harbor seal	*Phoca vitulina*	20	17	2	0	3	0	0	10	4	0	2	1	1
Northern fur seal	*Callhorinus ursinus*	3	8*	10	7	45	2	0	15	0	0	5	0	0
Guadalupe fur seal	*Arctocephalus townsendii*	1	8*	0	0	0	0	0	0	0	0	2	0	1
Steller sea lion	*Eumetopias jubata*	0	3	0	3	2	0	0	0	1	0	2	0	5
California sea lion	*Zalophus californianus*	3	4	0	29	2	0	0	6	1	0	20	0	13
Porpoise	*Phocoena phocoena*	1	0	1	0	0	0	0	0	0	0	0	0	0
Dolphin	*Tursiops truncata*	0	0	0	0	0	0	0	0	0	0	0	0	1
SUBTOTAL		63	129	15	103	58	3	0	45	8	0	85	2	32
GRAND TOTAL		245	800	41	204	68	255	289	140	236	80	417	45	273

SL = Slough; S.L. OBISPO = San Luis Obispo; C = Coast; INT. = Interior; NO. = North

Sources: Breschini and Haversat 1992; Dietz 1987; Dietz, Hildebrandt, and Jones 1988; Dietz and Jackson 1981; Jones 1995, 1998; Jones and Ferneau 2002; Jones and Waugh 1995; Jones et al. 1996

Table 12.5 Mammal remains from important Late period components

COMMON NAME	SPECIES	MNT-1765	MNT-112	MNT-1486/H	MNT-1601	MNT-1223	MNT-1227
Terrestrial							
Deer	*Odocoileus hemionus*	7	7	217	28	105	109
Cottontail rabbit	*Sylvilagus* sp.	2	20	7	3	10	14
Jack rabbit	*Lepus californica*	0	0	6	5	0	0
Wood rat	*Neotoma fuscipes*	0	0	0	0	0	0
Coyote/dog	*Canis* sp.	0	0	20	0	0	0
Tule elk	*Cervus elaphus*	0	0	1	0	0	0
Badger	*Taxidea taxus*	0	0	0	0	0	0
Bobcat	*Lynx rufus*	0	0	1	3	0	1
Gray fox	*Urocyon cinereoargenteus*	0	0	3	1	1	0
Black bear	*Ursus* sp.	0	0	0	0	1	0
Grizzly bear	*Ursus horribilus*	0	0	0	0	0	0
Skunk	*Mephitis mephitis*	0	0	3	0	0	0
Weasel	*Mustela frenata*	0	0	0	0	0	0
SUBTOTAL		9	27	258	40	117	124
Marine							
Sea otter	*Enhydra lutris*	1	6	2	0	1	1
Harbor seal	*Phoca vitulina*	0	0	0	0	0	0
Northern fur seal	*Callorhinus ursinus*	0	0	2	0	0	0
Steller sea lion	*Eumetopias jubata*	0	0	0	0	0	0
California sea lion	*Zalophus californianus*	0	0	3	0	0	0
SUBTOTAL		1	6	7	0	1	1
GRAND TOTAL		10	33	265	40	118	125

Sources: Breschini and Haversat 1992, 1995b; Dietz and Jackson 1981; Fitzgerald et al. 1995; Jones 1995

Nearly all well-sampled Late period sites are dominated by deer remains, with very few marine mammals (table 12.5). At some locations, rabbits are the second most abundant taxon (although below deer by a considerable margin); at others (for example, MNT-1486/H and MNT-1277/H) dog and coyote remains were more important (table 12.5). Dietary reconstructions suggest less emphasis on fish and marine mammals, and greater reliance on land mammals (T. Jones 1995, 2003). This de-emphasis on marine foods is not apparent in the Morro Bay locality, where several Late period estuarine sites have been identified (Joslin and Bertrando 2000).

The settlement strategy represented by Middle and Late period deposits has been a matter of some debate (see Breschini and Haversat 1980; Dietz, Hildebrandt, and Jones 1988; D. Jones 1992) vis-à-vis so-called collector versus forager systems. Early interpretations (for example, Breschini and Haversat 1980; Moratto 1984) associated the Late period abalone shell features of the Monterey Peninsula with a collector strategy that was initiated as early as circa AD 500. More recent interpretations attributed high residential mobility to the Middle period, with the ethnohistoric collector system emerging only after AD 1000 (Dietz, Hildebrandt, and Jones 1988). Excavations in the interior of the Coast Ranges at Fort Hunter Liggett (Haney and Jones 1997) subsequently revealed a range of specialized site types more consistent with a collector strategy during the Middle period. These types included debitage and projectile point scatters (hunting stations?), flaked and ground stone scatters (temporary camps?), and midden residential sites. A greater range of site types seems to mark the Late period, when bedrock mortar (BRM) milling stations proliferated.[4] In the inland areas of the Coast Range, BRMs occur as isolates and in association with middens, flaked stone scatters, and shell scatters. Subsurface investigation of one BRM outcrop inland from the Big Sur Coast (MNT-361) revealed two hearth/ash features that produced abundant remains of buckeye (*Aesculus californica*), gray pine (*Pinus sabiniana*) nut, and acorns (Miksicek 1997). Radiocarbon dates indicated use of these ash features around the time of historic contact. The profusion, variety, and wide distribution of Late period sites do not seem consistent with a fully sedentary lifeway, thus supporting historic accounts of seasonal group movements.

Portable mortars (from SLO-175 and MNT-229) and acorn remains (from MNT-521) suggest some reliance on storage and a measure of sedentism as early as the Middle period, but seasonality studies have been neither exten-

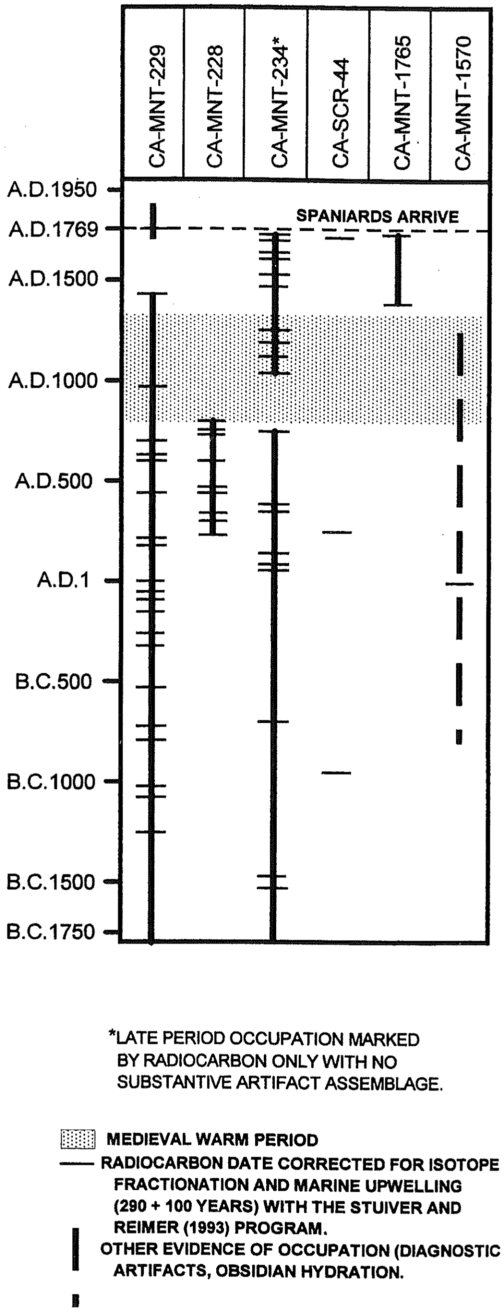


Figure 12.11 Occupational histories of Elkhorn Slough locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly

sive nor rigorous enough to determine the actual degree of sedentism during the Late Holocene. Analysis of annuli in fish otoliths from Middle period deposits at MNT-234 suggested nearly year-round occupation of Elkhorn Slough, with an emphasis on summer (Breschini and Haversat 1995a), the season of greatest richness in the local fishery (Yoklavich et al. 1991). Oxygen isotope analysis of growth rings in mussel shells from MNT-521 and SLO-267 suggest that, during the Middle period, people split time between the open coast, occupied during late summer through winter, and inland valleys, occupied in spring-early summer (Jones and Ferneau 2002; Kennett 2003). These trips were not taken in the late summer/early fall. Annuli from deer teeth collected in Big Sur, however, indicate inland and coastal groups simultaneously pursued winter deer hunting (T. Jones 1995, 2003; Moffitt 2003), suggesting a more complex system of seasonal movements, with some group members residing in one place while others moved. The seed and nut remains from the BRM-associated features at MNT-361 suggest that nut-processing stations were used in the fall during the Late period.

While there was clearly a shift or disruption in settlement following the end of the Middle period, there is little indication of increased sedentism over time. An apparent proliferation of bedrock mortar sites suggests increased reliance on nut crops and seeds during the Late period, which is consistent with locational trends showing greater emphasis on terrestrial habitats, at least in the northern part of the Central Coast. Both the archaeological and ethnohistoric records suggest a certain degree of seasonal movement at the time of historic contact. The unusually diverse resource base of the Central Coast seems to have promoted a certain degree of mobility in local systems of settlement and subsistence throughout the Late Holocene.

Site structure is also not suggestive of full sedentism during either the Middle or Late periods, although few excavations have been extensive enough to address this topic with any rigor. Jones and Waugh (1995) argued for a modicum of internal settlement organization at Little Pico Creek, where deposits on one side of the creek (SLO-1259) contained little besides a profuse quantity of flaked stone detritus, suggesting an area set aside specifically for flaked stone reduction. Several Middle period sites have produced subsurface pit features (for example, MNT-229, -521, SCR-44 [Breschini and Haversat 2000]), which may have served some type of storage function, although this interpretation is far from secure. Middle period sites more commonly produce amorphous rock concentrations, the function of which is unknown. Few house features have been identified from any temporal context. A large floor was identified by Clemmer (1962) at SLO-239 on the shore of Morro Bay in an apparent Middle-Late period context. A circular arrangement of charred postmolds indicated a semisubterranean dwelling with a living area about 7 m in diameter. Burials were interred within the floor (Clemmer 1962:22). A smaller, less elaborate Late period house floor was identified at MNT-1227 on the Big Sur Coast.

TRADE AND EXCHANGE

The most powerful index of interregional exchange on the Central Coast is obsidian. Sources of this stone occur no

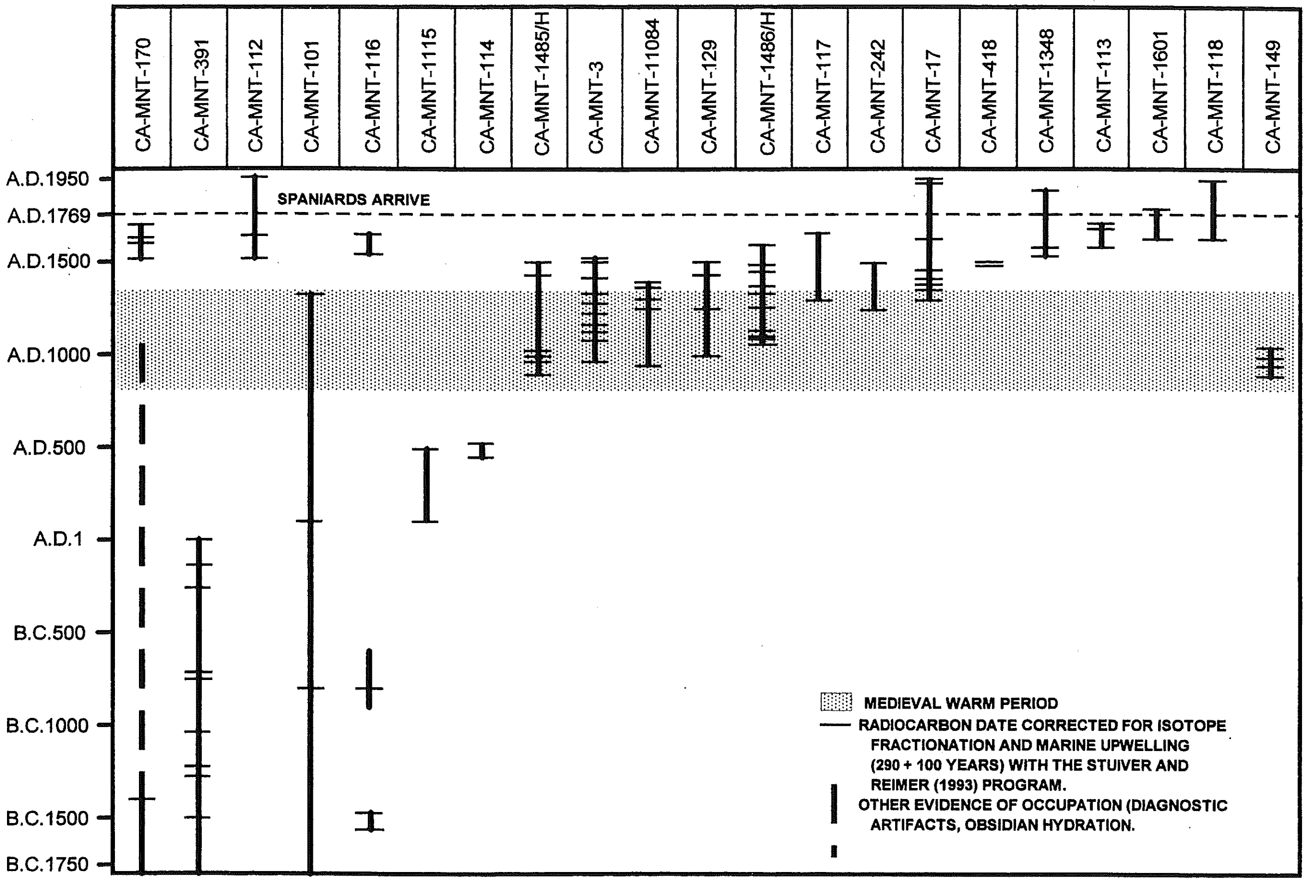


Figure 12.12 Occupational histories of Monterey Peninsula locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly

closer than 200 km away, and there is little likelihood that the commodity was obtained by any means other than down-the-line trade. Material from nine different sources has been found in Late Holocene archaeological sites. The closest sources are Napa and Annadel at the southern end of the North Coast Range, 200 km north (350 km north of Morro Bay at the southern end of the study area). To the east 300 km are the southern Sierran sources: Casa Diablo, Mono Craters, Mono Glass Mountain, Bodie, and Queen. The Mount Hicks source, 400 km distant, is the farthest represented archaeologically. The Coso source in the southern Owens Valley is 300 km east of Big Sur (figure 12.19). Source distribution frequencies have been summarized by Hildebrandt and Mikkelsen (1993), Jones et al. (1996), and Mikkelsen et al. (2000) using slightly different hydration conversion formulas but showing similar patterns. During the Middle period, glass from all nine sources is represented on the Central Coast; Casa Diablo dominates in the Monterey Bay District, while Coso dominates in Big Sur and San Luis Obispo. During the Late period, obsidian disappears almost entirely; a small sample from the upper Carmel River is made up primarily of specimens from the Napa source (Breschini and Haversat 1992). Cumulative hydration frequencies show very few specimens with readings in the Late period range (Jones and Waugh 1995:131; Jones et al. 1999:152), although debate over conversion of hydration readings into calendric dates is ongoing (see Bouey and Basgall 1991; Jones and Waugh 1995; Mikkelsen et al. 2000; Jones and Ferneau 2002). Most Late period deposits show significantly lower frequencies of obsidian than do Middle period deposits, and many produce no obsidian whatsoever (Jones and Haney 1997a:153).

ETHNICITY

The degree to which distinctions in the material record reflect the ethnolinguistic divisions apparent on the Central Coast at the time of historic contact is an issue that can be traced to Kroeber's (1925) assertion that the distribution of language stocks in Central California indicated a late intrusion of Utian (or Penutian) speakers, following earlier settlement by Hokan speakers. A myriad of difficulties plagues attempts to define ethnic markers in the California archaeological record (see Hughes 1992),

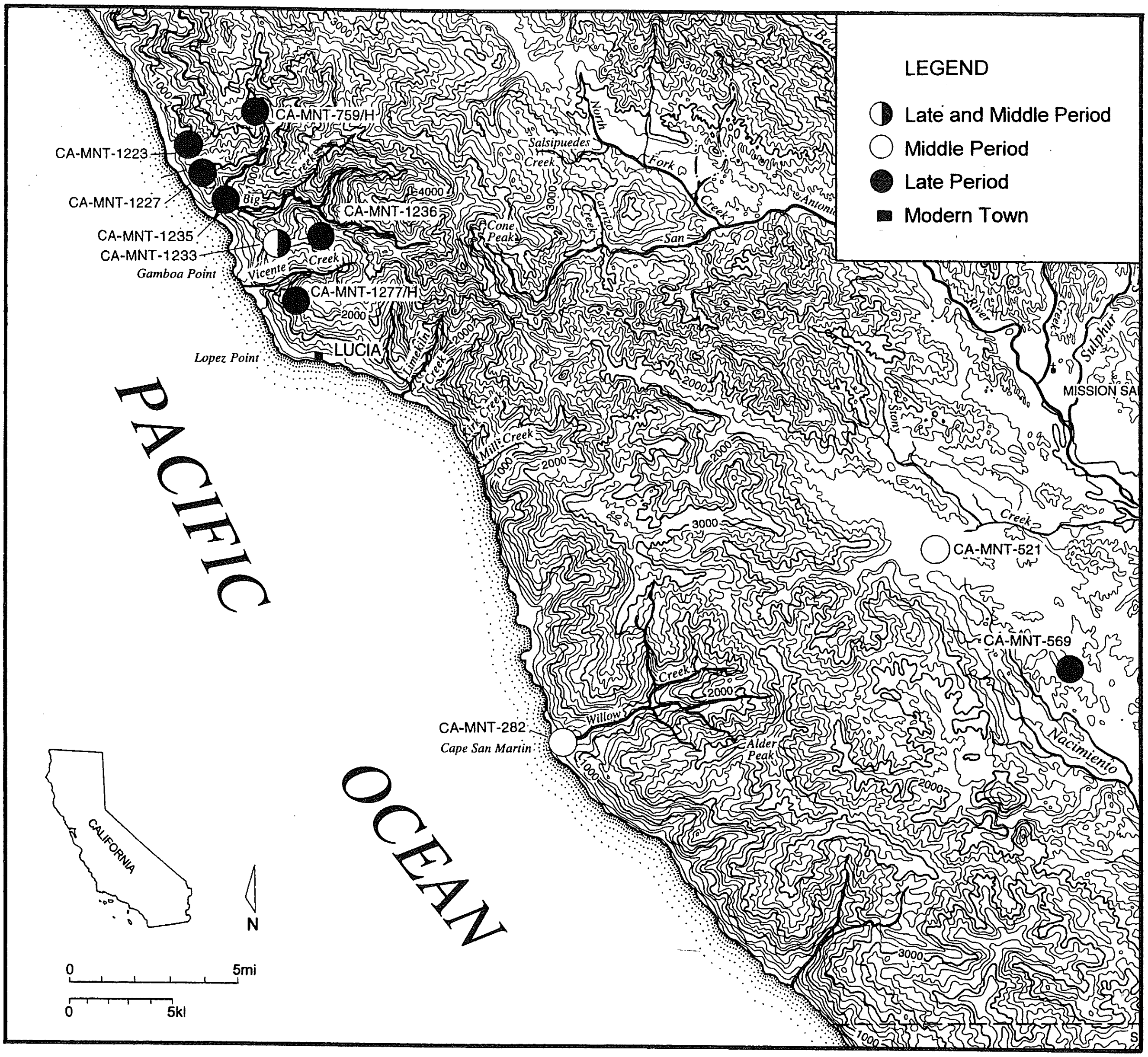


Figure 12.13 Big Sur locality of the Central California Coast: Middle and Late period site locations

and it should be no surprise that the Central Coast data at present do not show well-delineated patterns. Some trends are apparent nonetheless. Recent excavations by Breschini and Haversat at SCR-44 near Watsonville produced a suite of grave-related bone whistles and abalone ornaments that clearly reflect stylistic ties to the Costanoan or Ohlone territory of San Francisco Bay (figure 12.21). Directly dated to the Late period, these artifacts may reflect the Ohlone village of Tiuvta, described in the ethnohistoric record. Artifacts of this type have not been found in areas inhabited by Salinan, Esselen, or Chumash speakers. Research in the area held by the Esselen speakers (for example, MNT-798, MNT-799, MNT-800 [Edwards et al. 2000], and MNT-376 [T. Jones 1995, 2003]) has not revealed distinctive traits. Late period sites in the Salinan area share with Costanoan and Esselen a dominance of desert side-notched type projectile points. These points are much less common in the area inhabited by Chumash speakers, and are wholly absent from southern San Luis Obispo County, where arrow points are dominated by small leaf and triangular-shaped types. Hints of Chumash bead industries are reported from SLO-214 in the form of distinctive microblade drills (Bertrando 1997). The Chumash area is also distinguished by a profusion of estuarine-focused Late period sites, which differs from the situation at Elkhorn Slough for the same time period.

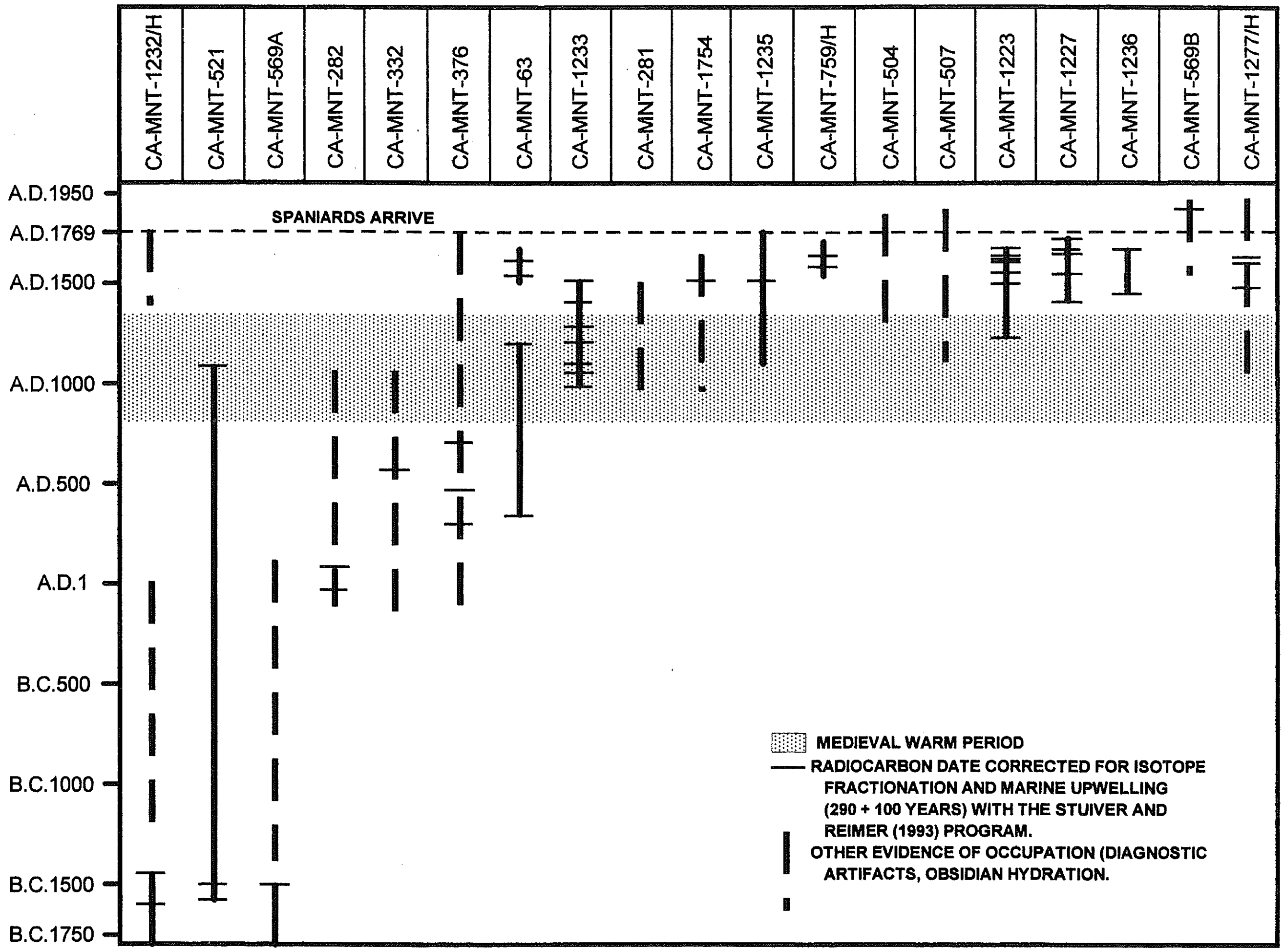


Figure 12.14 Occupational histories of Big Sur locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly

CULTURAL COMPLEXITY

For hunting and gathering populations, archaeological expressions of sociocultural complexity rely heavily on findings from burial populations that have the potential to illuminate the nature and quantity of political statuses (T. King 1978), equality in the distribution of resources (O'Shea 1984), and degree of gender parity (Hollimon 1990). The small Central Coast burial sample limits inferences about possible changes in complexity during the Late Holocene. The historic record suggests a modest level of cultural sophistication at the time of contact, and the limited archaeological record suggests nothing more or less elaborate earlier in time. The most substantial archaeological data come from Middle period cemeteries at MNT-229, MNT-282, SLO-175, SLO-2, and SLO-406. At most of these locations, the majority of graves had no accompaniments, a few had a modest number, and one or two per cemetery had exorbitant quantities of goods. Most of the individuals with large numbers of grave goods were older males, and it is reasonable to assume that these remains represent individuals who acquired some political or social status during their lives, and that this achieved status ended with death. In other words, these graves probably represent typical tribal chiefs. An exception to this pattern was found at SLO-406, where several infants were interred with large quantities of grave goods, suggesting the possibility of ascribed political status. As Hildebrandt and Levulett point out in chapter 16 (this volume), such a situation could also reflect the accumulation of wealth by an adult during his or her lifetime and his or her donation to a child's grave offering. At SLO-2, a presumed Middle period cemetery, bone whistles were found in equal distribution among men, women, and children (Greenwood 1972). No substantial Late period burial populations allow comparison between the two time periods. The ethnohistoric record, however, suggests that ascribed statuses existed at the time of contact, so there seems to have been no major change in political or social organization during the Late Holocene.

DISCUSSION

Late Holocene archaeological and paleoenvironmental records from the Central Coast suggest two intervals of relative

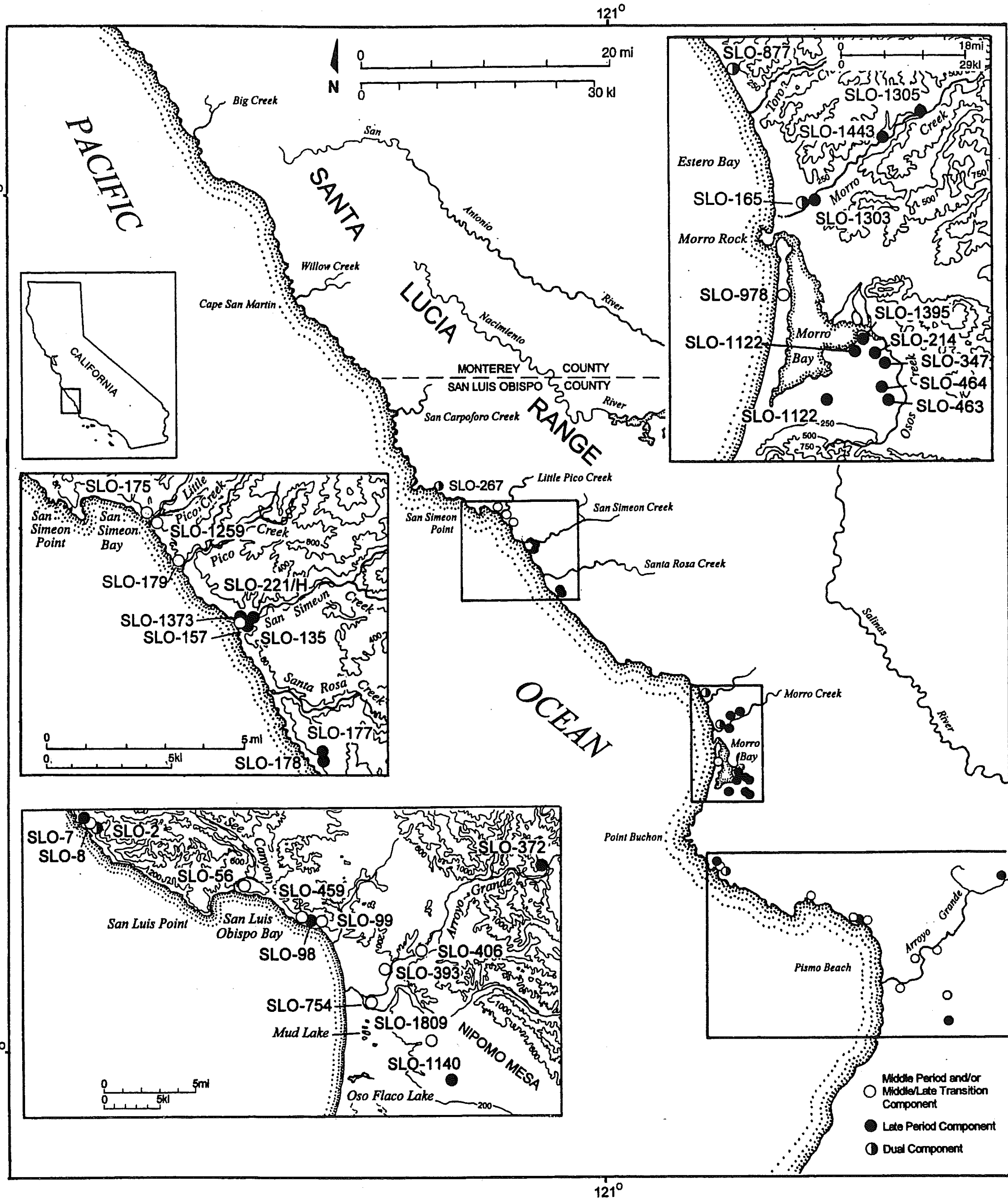


Figure 12.15 Southern localities of the Central California Coast: Middle and Late period site locations

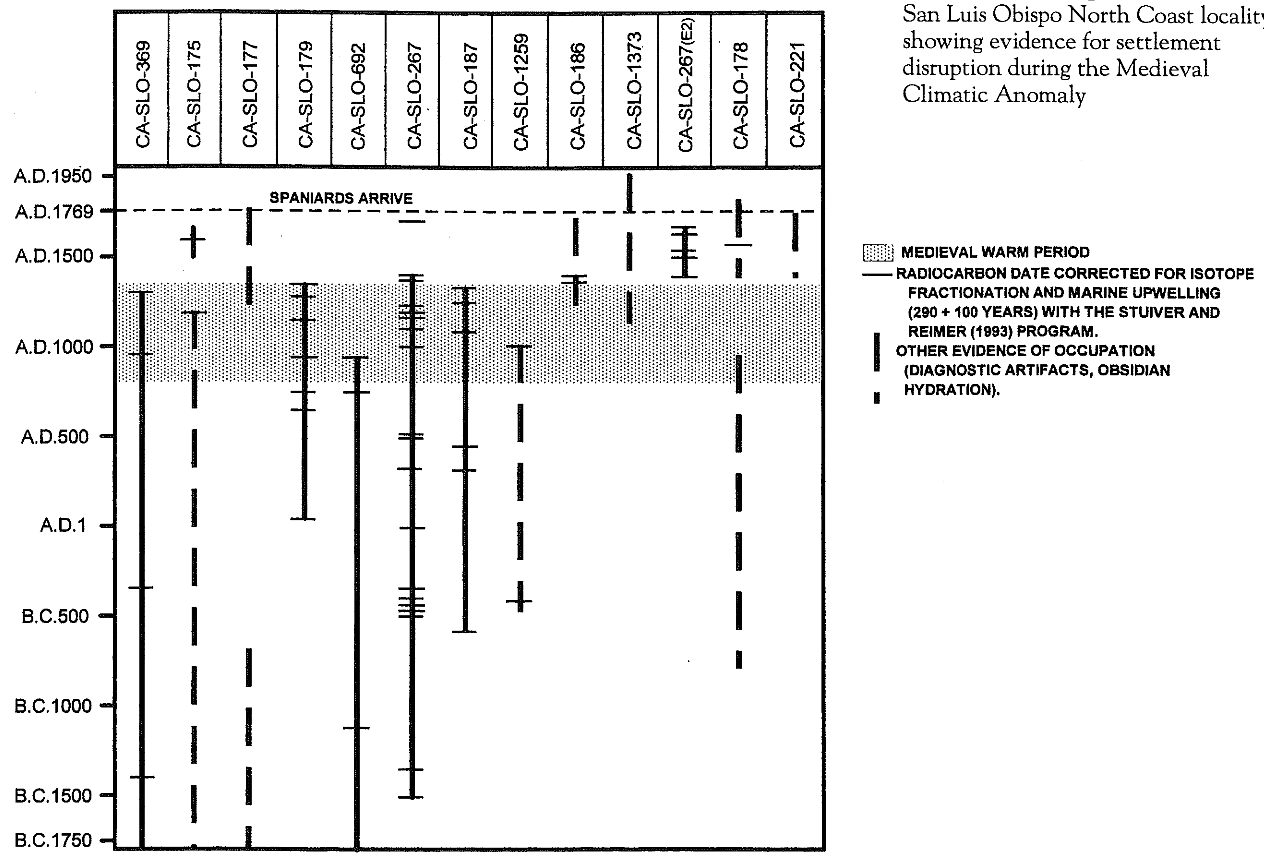


Figure 12.16 Occupational histories of San Luis Obispo North Coast locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly

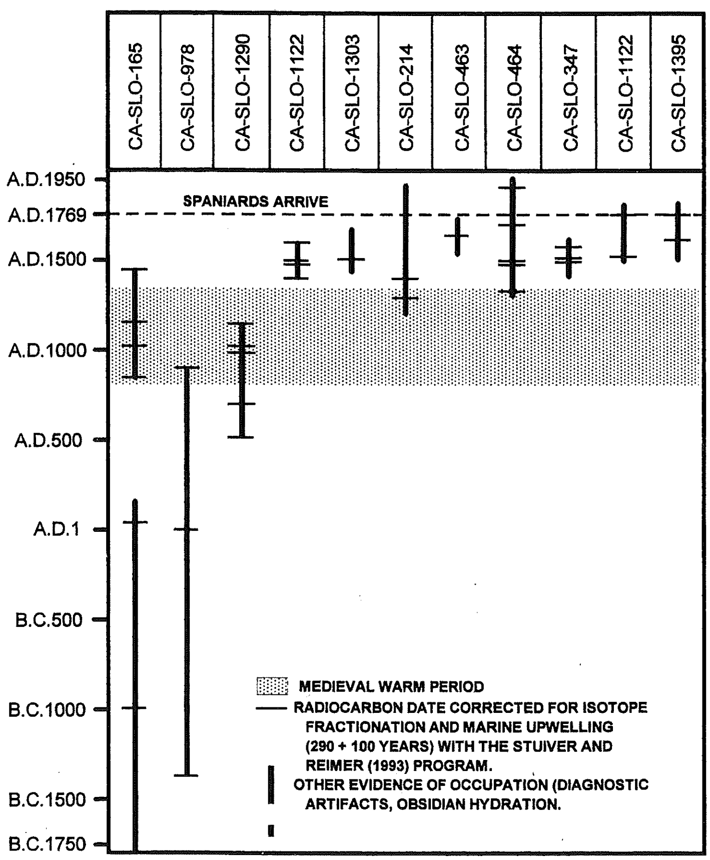
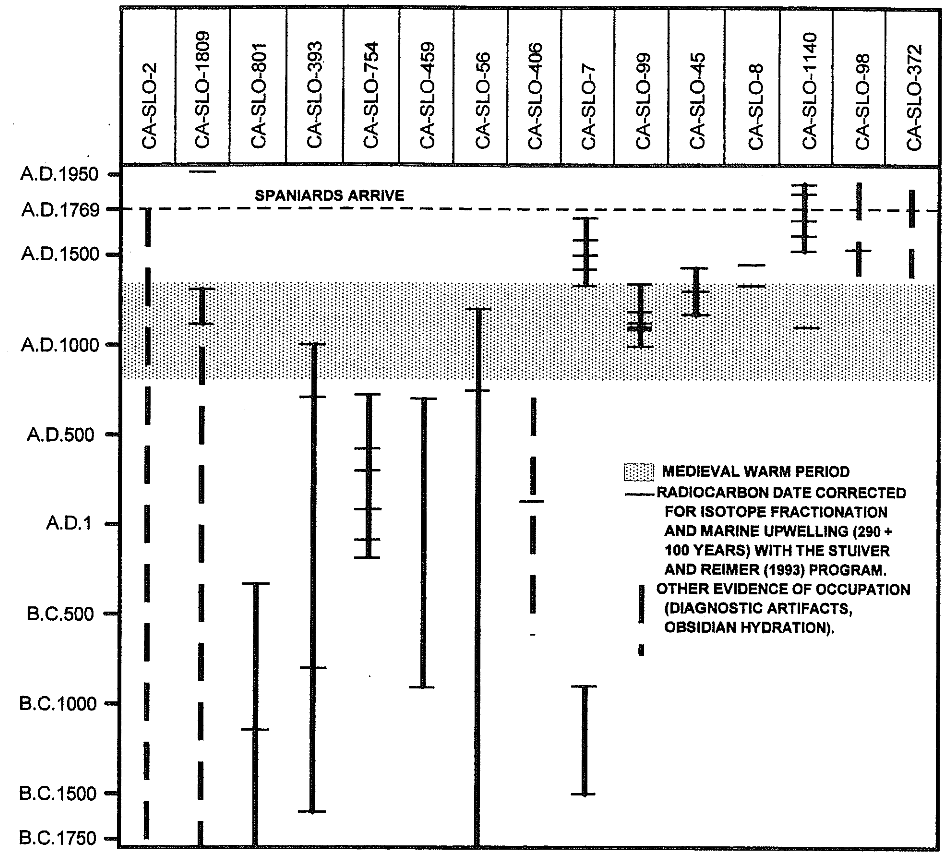


Figure 12.17 Occupational histories of Morro Bay locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly

Figure 12.18 Occupational histories of Pismo Beach locality, showing evidence for settlement disruption during the Medieval Climatic Anomaly



cultural and environmental stability (the Middle period up to circa AD 1000 and the Late/Protohistoric period circa AD 1400 to 1769) with an intervening period of instability and change (the Middle-to-Late Transition). During the terminal Middle period, the region was inhabited by people whose tool assemblage included large stemmed projectile points, bowl mortars, and *Olivella* saucer beads. The lifeway associated with this assemblage seems to have been marine-focused, with shoreline residential settlements and a heavy reliance on fish. Deer and sea otters were also exploited. Acorns were collected and stored, but full sedentism was not achieved, as inland groups made forays to the coast and coastal dwellers probably made seasonal movements. Interregional exchange networks linked the Central Coast to obsidian sources 200 to 400 km distant. With the beginning of the Middle-Late Transition, there are signs of major changes in settlement, diet, and exchange. Most apparent is a widespread disruption in settlement when many Middle period sites up and down the coast were abandoned. With the onset of the Late period, terrestrial resources and inland site locations seem to have become more important, with the possible exception of the Morro Bay locality. This shift is associated with the appearance of a new tool assemblage, one emphasizing desert side-notched and other arrow points, bedrock mortars, and lipped *Olivella* and steatite thin disk beads. Obsidian is no longer common in sites after about AD 1000.

Early interpretations of the changes accompanying the Middle Late Transition (for example, Dietz and Jackson 1981) emphasized culture and adaptation, albeit within a different chronological framework than is emphasized here. More recent interpretations, including models proposed by one of us (T. Jones 1992; Hildebrandt and Jones 1992) related events of the Late Holocene to a trajectory of linear subsistence intensification. The shift in favor of terrestrial resources during the Late period was seen as a reflection of the limitations of Central Coast marine habitats (Jones and Hildebrant 1992:388). In contrast with the Santa Barbara Channel, fisheries and other marine resources of Central California were argued to have less potential for intensification, and as a consequence, growing populations of foragers were forced to turn to inland resources to meet increasing subsistence demands. While an apparent emphasis on seeds and nuts during the Late period is consistent with this intensification model, it fails to account for the widespread abandonment of Middle period Hunting Culture sites along the Central Coast and the apparent decline in interregional exchange marked by the disappearance of obsidian. Optimal foraging theory suggests that new foods should be added to diets to

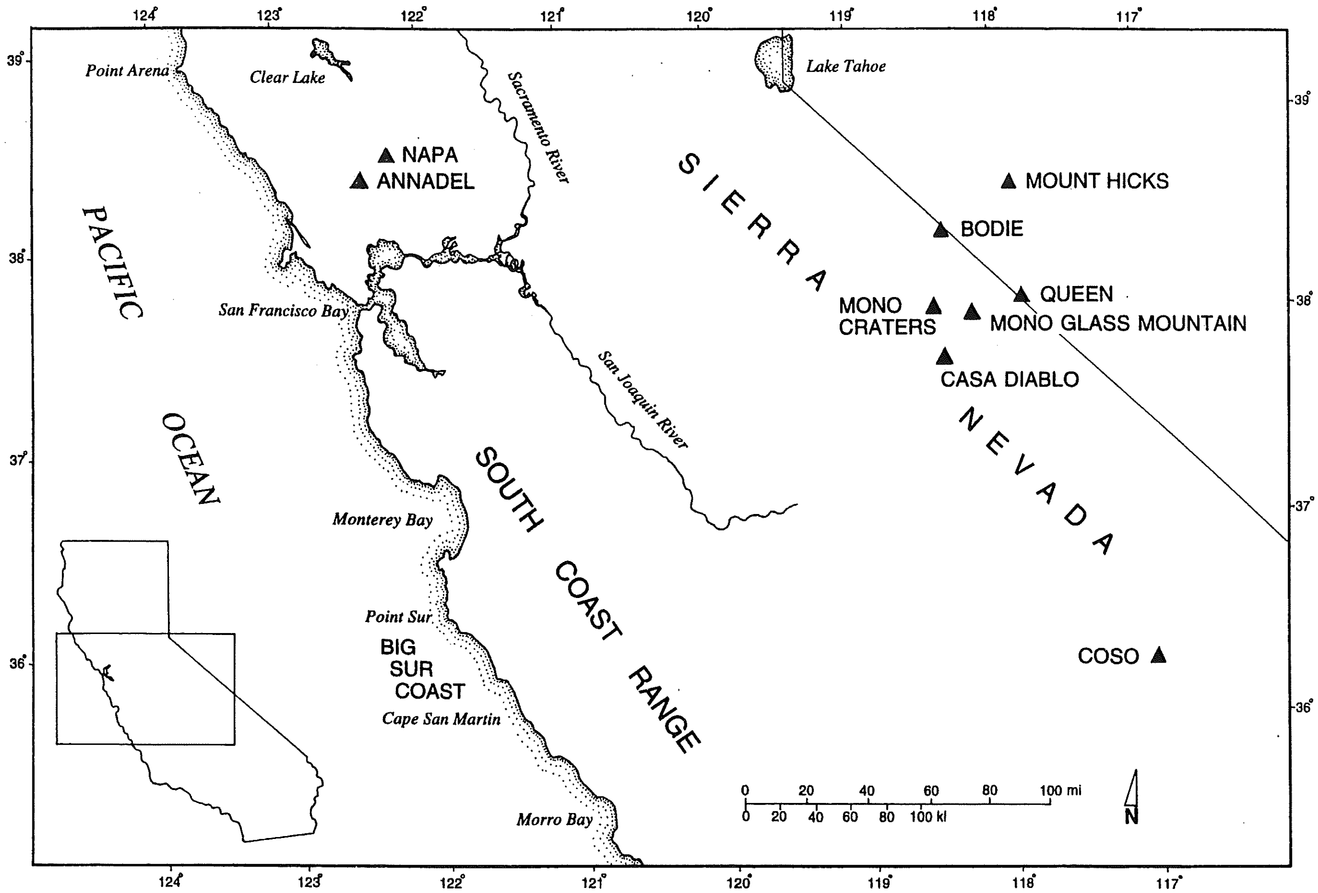


Figure 12.19 Obsidian sources represented on the Central California Coast

accommodate subsistence stresses; it does not suggest that some foods should be dropped in favor of others. To match the predictions of intensification and optimization, it would be reasonable to expect continued heavy exploitation of Central Coast fisheries into the Late period, supplemented with increased use of seeds and nuts. The abandonment of sites like MNT-229 adjacent to the rich fishery at Elkhorn Slough during the Middle-to-Late Transition is difficult to reconcile within a framework of relentless population-driven intensification. The appearance of many new sites along the shoreline of Morro Bay during the Late period is seemingly more consistent with marine intensification, but a disruption in settlement is evident there as well.

In light of the discrepancy between the predictions of simple intensification and actual patterns in the archaeological record, we argue that shifts in diet, settlement, and exchange during the Middle-to-Late Transition along the Central Coast may be more effectively characterized as signs of deintensification, as human populations were impacted by the severe droughts during the Medieval Climatic Anomaly (figure 12.20). People moved in various directions throughout Central California in response to declining water supplies and decreased terrestrial productivity. The Anomaly (AD 800 to 1350) was marked by two intervals of prolonged drought: the first circa AD 900 to 1100, and a second circa AD 1200 to 1350. Some portions of the coast such as Elkhorn Slough show evidence of settlement disruption early in the Anomaly, but most areas show stronger signs that settlement was disrupted and interregional exchange declined between AD 1200 and 1400. During this time, the Hunting Culture, present on the Central Coast since 3500 BC, came to an end. Wholly different artifact assemblages appear, possibly reflecting the arrival of new groups into the region, including the Utian-speaking peoples into the Monterey Bay area. Despite the arrival of new peoples, overall population may have been lower during the final interval of stability (AD 1400 to 1769) than it was during the terminal Middle period. During the last centuries before European contact, when sea temperatures were colder and more stable and California's climate seems to have been slightly cooler and wetter (the Little Ice Age), the Central Coast may have experienced lower population density than previously. This demographic shift may reflect a process of deintensification that began with climate-induced stresses of the Medieval Climatic Anomaly and was subsequently exacerbated by the arrival of European diseases soon after AD 1500. Global evidence of the Medieval Climatic Anomaly continues to accumulate (see Li et al. 2000; Crowley and Lowery 2000; and others), as do signs of coincident cultural upheavals (for example, Binford et al. 1997; Hodell, Curtis,

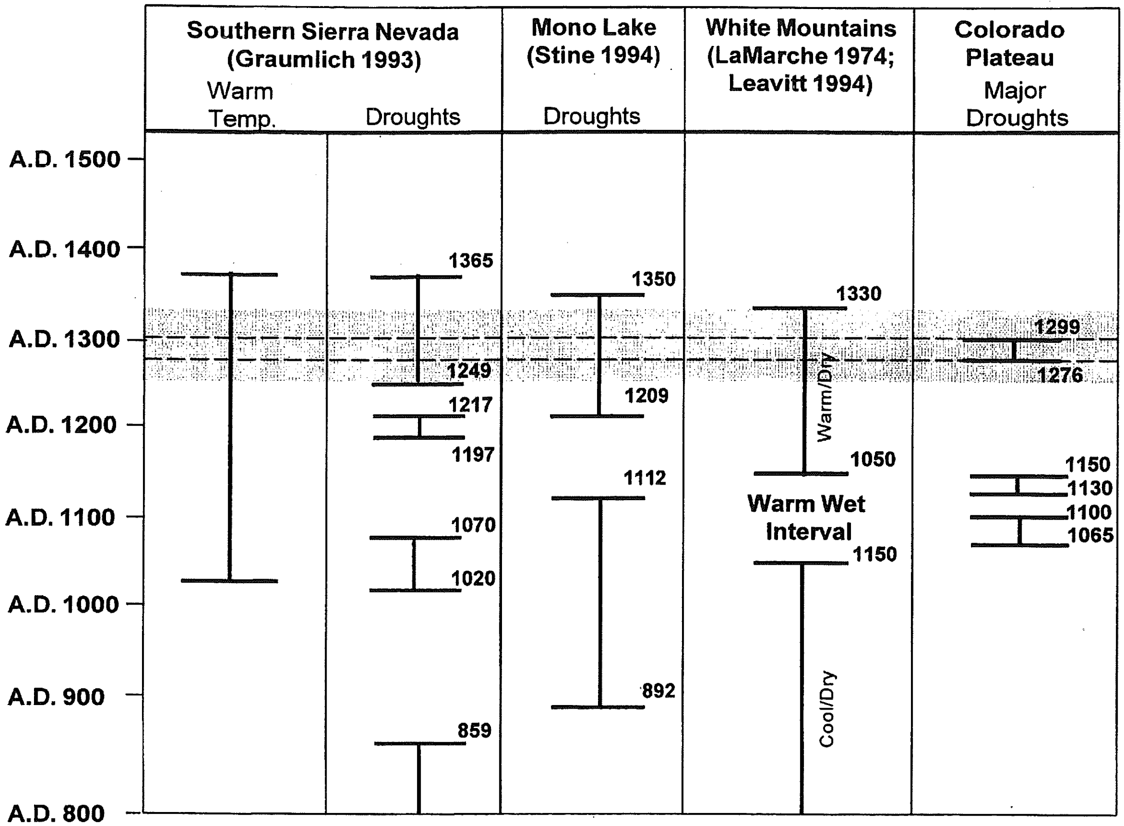


Figure 12.20 Intervals of drought and warm temperatures in western North America during the Medieval Climatic Anomaly

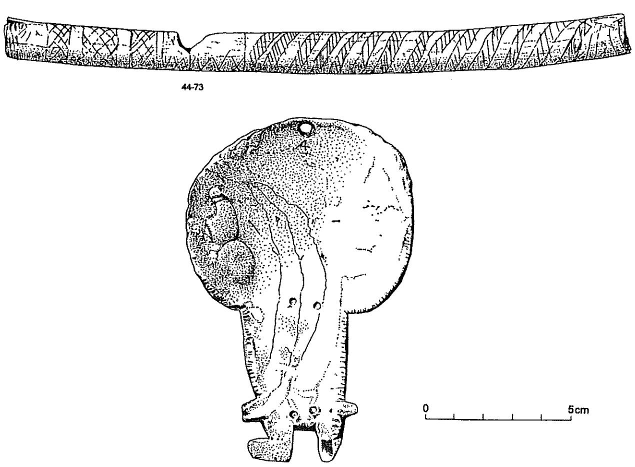


Figure 12.21 Grave-related bone whistle and abalone ornament from SCR-44 near Watsonville

and Brenner 1995; Nunn 2000; Robertshaw and Taylor 2000) elsewhere in the world. Settlement disruption along the Central Coast of California seems more in line with these broad-scale patterns than with uninterrupted adaptation, intensification, and population growth.

Acknowledgments. We thank Jon Erlandson for his patience and ongoing commitment to good scholarship. We also thank Marilyn Beaudry-Corbett and anonymous reviewers from UCLA for comments made on earlier drafts of the manuscript. We thank Rusty van Rossman for figures 12.1, 12.2, 12.8, 12.9, 12.10, 12.13, 12.15, and 12.19; Steve Dietz for figure 12.3; Jerry Doty for figure 12.5; and Tammara Ekness for figures 12.6 and 12.7.

Notes

1. A Protohistoric period (AD 1500 to 1769) is generally recognized in the regional culture history, but chronological resolution is so poor that this period has not distinguished itself in the empirical record.
2. Despite marked improvements in calibration in the last decade, radiocarbon dates from the Central Coast show chronological precision only to within one to two centuries. Dates returned on shell beads from the same grave cache at MNT-229 were more than 700 years different (Jones 1993:12). Shells directly associated with one another from features at MNT-113 (Dietz and Jackson 1981) and MNT-170 (Dietz 1991) produced dates 100 to 200 years apart.
3. The stone used for these beads was formerly referred to as talc/schist, but steatite is now considered a more accurate classification.
4. Dating of bedrock mortars is not firm on the Central Coast, but the features are most commonly found at sites with Late period components and are thought to date accordingly.

CHAPTER 13

Tidal Marsh, Oak Woodlands, and Cultural Florescence in the Southern San Francisco Bay Region

Mark G. Hylkema

The landscape of the southern San Francisco Bay area, a scene of dynamic change during the Early and Middle Holocene, achieved a measure of equilibrium at the onset of the Late Holocene, about 1500 BC. This relative environmental stability allowed for dramatic cultural developments by Native peoples, culminating after AD 700 in a trend toward more complex social organization. This date marks the beginning of a period of cultural transition when earlier artifact assemblages were replaced by new ones, many of which served as markers of wealth and specialized societal membership. While archaeological findings suggest that a cultural florescence transpired among the people of the southern San Francisco Bay, neighboring people of the Peninsula Coast maintained an older adaptive pattern that did not change until after AD 1200.

PRECURSORS TO LATE HOLOCENE PREHISTORY

Paleoenvironment

The paleoenvironmental history of San Francisco Bay and adjoining regions has been summarized in detail by Atwater et al. (1977, 1979), Bickel (1978), Erlandson (1997a:1–10), and Moratto (1984), among others. Sediment profiles from deep borings in the South Bay indicate that between 17,000 and 7000 years ago, post-Pleistocene warming caused a rapid rise in sea level as glacial ice melted (Atwater, Helley, and Hedel 1977; Atwater et al. 1979). By 10,000 years ago, the progressively rising seas began to encroach up through the deeper stream channels of what was to become San Francisco Bay. The gentle slope of the valley floors within the future bay and the level coastal terrace terrain that once extended considerably farther offshore were progressively submerged until sea level reached its present height by Middle Holocene times, some 6000 years ago (Bickel 1978; J. Brown 1978).

With the stabilization of sea level, tidal marsh habitats formed around the bay margins, creating a diversified regional ecology. Within the delta region, where numerous drainages feed into San Francisco Bay, tidal marshlands became established as early as 6000 years ago, but similar habitats did not develop in the central region of the bay until the Late Holocene when the accumulated sediments exceeded the sea level around 3000 years ago, and as recently as 2000 years ago along the shoreline of southern San Francisco Bay (Bickel 1978).

Archaeological Patterns: Early and Middle Holocene

The earliest archaeological manifestations in the region show an expression of the California Milling Stone culture as represented at sites SCL-65 (Fitzgerald 1993; Fitzgerald and Jones 1999) (figure 13.1) and SCL-178 (Hildebrandt 1983) in the Santa Clara Valley, which produced substantial numbers of milling slabs, hand stones, core, and flake tools. During the Middle Holocene, stone mortars and pestles appear, suggesting that acorns increased in importance as a dietary staple, augmenting an earlier reliance on hard seeds. Access to productive grasslands and oak woodlands seems to have been a critical factor in the subsistence economy of both Early and Middle Holocene populations.

On the Peninsula Coast of Santa Cruz County, the Sand Hill Bluff shellmound, SCR-7, is one of the larger Middle Holocene archaeological deposits. Samples from various portions of the site have produced six radiocarbon dates, ranging from 4100 to 1400 BC (Jones and Hildebrandt 1990; Smith and Breschini 1987). The site assemblage includes cobble choppers, bi-pitted stones, handstones, and large corner- and side-notched projectile points (Hylkema

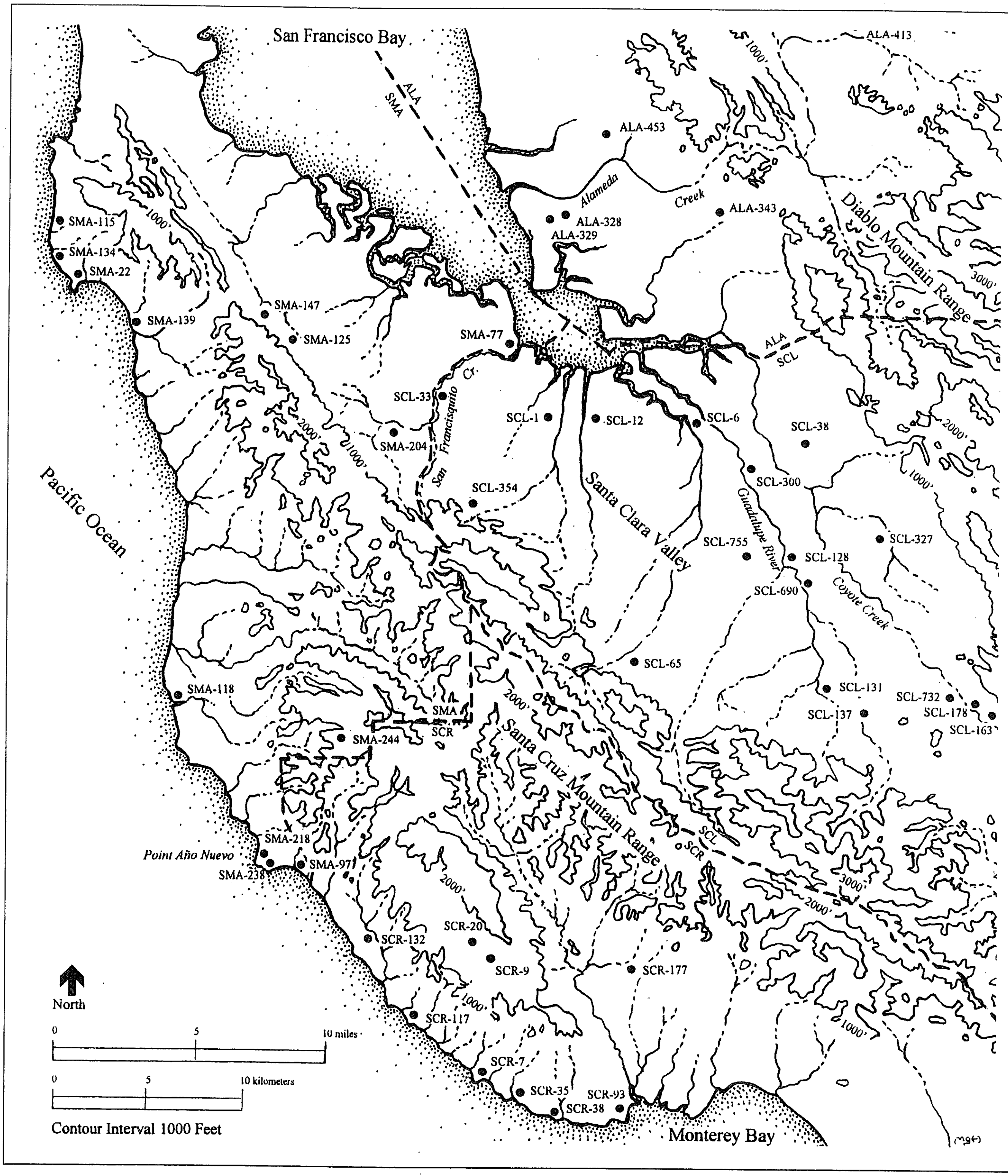


Figure 13.1 Selected archaeological site locations from the southern San Francisco Bay and Peninsula Coast

1991:123-140). Of the latter, 33% were made from nonlocal Franciscan chert, which is abundant only in the Santa Clara Valley, 40 km east, suggesting a close relationship between the inhabitants of SCR-7 and the southern San Francisco Bay Area. During the Late Holocene, chipped stone tools made from Franciscan chert are nearly absent at open coastal peninsula sites in Santa Cruz and San Mateo Counties. By the end of the Middle Holocene, the overall artifact assemblage, along with a combined dietary focus on ocean mussels, pinnipeds, and terrestrial ungulates, represents the precursors to a consistent reliance on coastal resources that continued through most of the Late Holocene.

On the other side of the Santa Cruz Mountains, along the bay shore/valley zone of the peninsula, three finds provide intriguing clues to Middle Holocene adaptations. The first, from the City of Sunnyvale, consisted of the skeletal remains of a woman dated to 3250 BC (Bickel 1978). The second and third, commonly known as Stanford Man I and II, were burials recovered from the banks of San Francisquito Creek in Palo Alto (SCL-33 [Garaventa and Anastasio 1983]). The Stanford Man II burial, dated 3240 to 3070 BC (Gerow 1974a:241), was associated with three large side-notched projectile points.

With the establishment of tidal marshlands around 2000 years ago, a profusion of sites was established along the bay shore, many of which would develop into large shell mounds after years of repetitive use during the Late Holocene. The number of these mounds that began to form during the Middle Holocene cannot be precisely quantified, but existing data suggest a correlation between tidal marsh development and increasing reliance on this habitat (Lightfoot 1997).

HISTORIC ENVIRONMENT

The southern San Francisco Bay Area and Peninsula Coast represent a landscape of great ecological diversity. This setting brought together marine, sandy beach, rocky shore, tidal and freshwater marsh, grassland prairie, oak grassland savanna, riparian, chaparral, mixed hardwood, and evergreen forest habitats that frequently converged in geographically narrow areas. The mosaic distribution of productive biological communities presented Native populations with a variety of potential subsistence options that included long-term storage, and exchange, both of which were well documented historically. Biotic productivity was also enhanced through the application of fire and institutionalized leadership roles, and kinship and alliance systems that ameliorated episodes of scarcity and the effects of resource overexploitation (Basgall 1987:21–52; Bean and Lawton 1976:v-xlvii; Bean and King 1974; Blackburn and Anderson 1993; Chagnon 1970; Fages 1937; King 1994b; Lewis 1973; Milliken 1983; Simons 1992:73–103).

Southern San Francisco Bay

The southern San Francisco Bay and northern Santa Clara Valley supported large populations of people who established residential communities in three principal environmental zones: tidal marshland, grassland prairie, and oak woodland. Riparian corridors meandered through these ecological communities, enhancing an already exceptionally productive environment.

Tidal Marshlands. The protected waters of the San Francisco Bay estuary provided habitat for a variety of fish, birds, and sea mammals that the ancestral Ohlone procured through the use of tule balsa boats (Harrington 1942; Heizer and Massey 1953:285–312; Santa Maria [1775] 1971; Vancouver 1798:2:23; and others). An extensive network of sloughs and tidal mudflats marked the southern San Francisco Bay where it intruded into the northern Santa Clara Valley. Freshwater from a multitude of rivers, streams, and rivulets met with saltwater, creating a vast, brackish tidal marshland that provided such resources as salt, waterfowl, eggs, meats, and tule reeds. Elk waded among the vast thickets of reeds that ringed the marshlands and interior fresh water marshes, while the reeds themselves were used for building structures, boats, rope, duck decoys, basketry, clothing, and matting (Harrington 1942). Pollen and roots from tule reeds were converted into food (Bocek 1984:240–245).

Shore birds, including gulls, pelicans, cormorants, rails, egrets, great blue herons, and many others, populated the bay marshlands, along with great numbers of migratory ducks and geese (Beechey 1941:36; Schoenherr 1992). Waterfowl were obtained through the use of decoys and nets (Juan Crespi [Brown 1994:15]). At low tide, the mud flats would team with shorebirds dining on snails, crabs, and other invertebrates. Within the sloughs, leopard sharks (*Triakis semifasciata*), Pacific herring (*Clupea harengus*), Pacific sardine (*Sardinops sagax*), sturgeon (*Acipenser* sp.), bat rays (*Myliobatus californica*), and a host of other estuarine fish formed a productive biological zone. Sea otters, sea lions, and harbor seals subsisted on the abundant fish, and in turn, became prey to the ancestral Ohlone. The California horn snail (*Cerithidea californica*) was particularly abundant, and its presence, along with bay mussel (*Mytilus edulis*), oyster (*Ostrea lurida*), and clams (*Macoma nasuta* and *Tivela stultorum*) at local prehistoric sites, attests to the importance of this habitat for food (Cartier, Bass, and Ortman 1993:168–171; Gerow 1968). Numerous archaeological sites cluster along the South Bay tidal marsh. Residential use over time has resulted in great accumulations of soil and dietary shell, which created topographic high points or mounds.

Grassland and Oak Woodland. Grassland formerly surrounded the perimeter of the bay marshland. A range of plant species within this zone provided food for the local inhabitants and browse for the game they hunted. Large earthen mounds, both natural and anthropogenic (see Leventhal 1993; Lightfoot 1997:129–141; Meighan 1987:28–36), provided dry ground during the winter when high tides, stream overflow, and ground saturation created a network of mires and vernal pools (Bolton 1933:353; Roop, Gerike, and Flynn 1981). Dense thickets of willows grew along the margin between the tidal marsh and grasslands, where fresh water streams became lost in a maze of sloughs (Brown, 1994:35; Mayfield 1978:32). Spanish explorers frequently commented on the seasonal wetlands of Santa Clara Valley and the difficulty they had crossing them (Bolton 1926:3:263, 1933:353–355; Stanger and Brown 1969:106). The soil was black in color, and grasses were burned in late summer to increase seed productivity (Fages 1937; Mayfield 1978:84–94). Lewis (1973) noted that fire enhanced grass seed harvests and improved the browse available for elk, deer, and pronghorn. Large herds of elk and pronghorn once existed on the Santa Clara Valley plains (Dane 1935:103–104; Fages 1937), and wolves and coyotes were also present (Mayfield 1978:66; Pinart 1952).

The grassland prairie zone rises progressively at greater distances from the bay, and vegetation communities graded into a wooded savanna setting that consisted of widely spaced, tall, broad-leafed deciduous oak, laurel, and madrone trees, with an understory of bunch grasses, forbes, and shrubs (Kuchler 1977). This community gave way to an extensive thicket of mixed hardwood, greasewood, toyon, chemise, and coyote brush that formed a belt along the lower foothills of Santa Clara Valley (Bolton 1926:3:263, 1930:1:410).

The valley oak woodland zone was particularly suitable for an acorn-based economy, and most archaeological sites recorded in the South Bay occur here. The use of acorns as a dietary staple and various archaeological implications have been extensively described in the ethnographic literature (Basgall 1987:21–52; Gifford 1971:301–305). The valley oak savanna was burned annually after the acorn harvest to prevent the accumulation of excessive fuel that would otherwise burn too hot and destroy the acorn-producing oaks. Burning had the added benefit of removing the lower shoots from the oaks, thereby encouraging the tree to produce more acorns (Lewis 1973:19). European visitors commented on the "park like" appearance of the Santa Clara Valley and the many extraordinarily large oak trees (Bolton 1926:423; Vancouver 1798:2:132).

Riparian Corridors. The numerous creeks and rivers that cross through these ecological zones offer distinctive riparian habitats. Silt deposits from episodic river overflow along the banks of meandering streams in the Santa Clara Valley created topographic high points that were attractive to prehistoric settlement (Roop, Gerike, and Flynn 1981). Schoenherr (1992:153) noted that these riparian corridors create an ecotonal edge effect where the density and diversity of species are greater than in any other California community. The characteristics of a given ecotonal edge changed as drainages cut across different environmental zones. Larger creeks and rivers supported populations of Pacific pond turtles (*Clemmys marmorata*), brackish water crabs (*Rhithropanopeus harrisi*), fresh water clams, and mussels (*Anodonta nuttalliana* and *Margaritifera margaritifera*), and during the first seasonal rains, spawning runs of anadromous steelhead or rainbow trout (*Salmo gairdneri*) (Baumhoff 1978; Bolton 1933:355). The remains of steelhead and other freshwater fish, such as Sacramento sucker (*Catostomus occidentalis*), splittail, hitch, thicktail chub, and other carps and minnows (*Cyprinidae*), have been identified in archaeological contexts, along with marine fishes from the saltwater estuaries along the bay shore (Gobalet 1992:72–84).

Peninsula Coast

On the Peninsula Coast, the most important ecological zones included littoral and nearshore habitat, grassland, and upland meadows in the Santa Cruz Mountains. Very narrow, moderately level sections of coastal terrace parallel the Peninsula Coast. Intermittent extensions of flat terrace penetrate inland between the coniferous forest slopes of the Santa Cruz Mountains at places like Half Moon Bay, Point Año Nuevo, San Gregorio, and Pescadero Valleys. Shrubs and grasses dominate the terrace habitat (Kuchler 1977), and this community supported a range of land mammals that were trapped, snared, or felled by projectiles (Harrington 1942). A variety of sea birds, migratory ducks, and geese was available, and historic accounts state that large numbers of waterfowl congregated in seasonal wetland basins on the coastal terrace (Stanger and Brown 1969). The mountains are dominated by unproductive evergreen forest, with sporadic patches of economically important grass meadows and oak trees dispersed within mixed hardwood forest.

Although inhabitants of the Peninsula Coast did not develop a maritime tradition, offshore marine resources were exploited. Most open coastal sites contain the remains of mollusks, fish, a variety of sea mammals, and ocean going sea birds such as cormorant, pelican, tufted puffin, marbled murelet, and others (Hylkema 1991; Hylkema and Hall 1985). At least eighteen different species of marine fishes have been reported from coastal sites, including herring (*Clupeidae*), silversides (*Atherinidae*), rockfishes (*Sebastes spp.*), and surfperches (*Embiotocidae*).

Shellfish habitat included both sandy beaches and rocky shores. Most important to the native diet were abalone (*Haliotis rufescens* and *cracherodii*), California mussel (*Mytilus californianus*), turban snail (*Tegula funebralis*), urchins (*Strongylocentrotus purpuratus*), barnacles (*Balanus* sp.), gumboot chiton (*Cryptochiton stelleri*), limpets (*Collisella* sp.

and *Notoacmea* sp.), and clams (*Protothaca staminea*, *Macoma nasuta*, *Saxidomus nuttalli*, and *Tresus nuttalli*). Olive snail shells (*Olivella biplicata*) and abalone shells were important as the raw material from which beads were made. Coastal sites frequently yield fragments of abalone pry bars made from polished split whale ribs with fire hardened, pointed tips. Divers swimming down to submerged rocks may have used them to obtain larger mollusks. Examples of auditory hyperosteosis, or diver's ear, have been confirmed from burials at SCR-35 and SCR-7 (Gifford and Marshall 1984).

Nearshore habitats also supported large rookeries of marine mammals that were hunted with clubs, harpoons, spears, and darts. The largest present-day rookery is situated at Año Nuevo, where northern elephant seals (*Mirounga angustirostris*) have been breeding on land since 1977. Elephant seals are absent from the archaeological record at Año Nuevo, but large numbers of northern fur seal bones have been recovered (Hylkema 1991:291-292). Sea otters were another shoreline resource, the exploitation of which is documented in the archaeological record.

CULTURAL CHRONOLOGY

The seminal cultural sequences developed for Central California (for example, Lillard et al. 1939) define three discrete temporal periods marked by changes in settlement, subsistence orientation, and distinct artifact types. Referred to as the Early, Middle, and Late (see Beardsley 1954; Bennyhoff 1978; Bennyhoff and Hughes 1987; Fredrickson 1974a; Lillard et al. 1939; Milliken and Bennyhoff 1993), temporal definitions of these periods have long been based on findings from northern San Francisco Bay and the Sacramento-San Joaquin Delta region. The southern San Francisco Bay and Peninsula have traditionally been interpreted within these sequences as part of a generalized bay culture region (Elsasser 1986a, 1986b), despite limited data from the actual areas. A plethora of new archaeological findings from these areas, many resulting from CRM activities of the last decade or so, reveal a prehistory of much greater complexity. My focus in this chapter is the three localities within Fredrickson's (1994a) Alameda district of the San Francisco Bay region: Newark, Santa Clara Valley (treated here together as the southern San Francisco Bay Area), and the Peninsula (table 13.1). In the process, I synthesize this profusion of new data, develop cultural historical frameworks that distinguish these areas as distinctive localities, and integrate them in a more meaningful way into the broader time-space framework of Central California prehistory. I emphasize sites where radiocarbon dates are associated with diagnostic artifacts. All ^{14}C dates have been calibrated using Stuiver and Reimer's (1993) CALIB program. Corrected ^{14}C dates were converted to a range of absolute dates (table 13.2). The median age within the range was used to plot temporal placement for sites on the coast (figure 13.2) and the bay shore and valley (figure 13.3).

Table 13.1 List of sites surveyed for this study

SITE	LOCATION	SETTING
Southern San Francisco Bay		
ALA-328	Patterson Mound	Bay tidal marsh
ALA-329	Ryan Mound	Bay tidal marsh
SCL-6*	Lick Mill	Bay tidal marsh
SCL-38	Elmwood Mound	Valley grassland
SCL-131	Alamitos Creek	Valley oak woodland
SCL-137	Snell Road	Valley oak woodland
SCL-178	Metcalf Road	Valley riparian
SCL-300**	Wade Ranch	Valley riparian
SCL-354	El Monte Road	Valley foothill
SCL-690	Tamien Station	Valley riparian
SCL-732	Three Wolves	Valley riparian
SCL-755	Santa Clara University	Valley oak woodland
SMA-77	University Village	Bay tidal marsh
Peninsula Coast		
SCR-9	Ben Lomond	Coastal uplands
SCR-20	Ben Lomond	Coastal uplands
SCR-38***	Wilder Ranch	Coastal terrace
SCR-93	Santa Cruz	Coastal terrace
SCR-117	Davenport	Coastal terrace
SCR-132	Scott Creek	Coastal drainage
SMA-97	Año Nuevo Creek	Coastal terrace
SMA-115	Montara Beach	Coastal terrace
SMA-118	Bean Hollow Beach	Coastal terrace
SMA-134	Seal Cove	Coastal terrace
SMA-218	Año Nuevo Reserve	Coastal terrace
SMA-238	Año Nuevo Reserve	Coastal terrace
SMA-244	Gazos Creek	Coastal uplands

*Site is affiliated with SCL-6E and SCL-447
**Site is affiliated with SCL-302
***Site is affiliated with SCR-39, SCR-40, and SCR-123

Southern San Francisco Bay Area

The taxonomic sequences developed by Bennyhoff and Hughes (1987) and a subsequent revision by Milliken and Bennyhoff (1993:386) provided the temporal framework for the overviews presented here. These schemes define four general temporal periods (figure 13.4): the Early period, originating during the Middle Holocene and continuing to approximately 500 BC; the Middle period when populations appear to have expanded their resource base and aggregated into semisedentary residential communities; the Middle-Late Transition, AD 700 to 1200, highlighted by intensified socioeconomic systems and retention of older Middle period artifact traits, and the Late period, when many Middle period traits gave way to social characteristics consistent with the ethnographic record (Bennyhoff 1994a:73). Changes in bead types that define these periods are summarized in figure 13.5.

Table 13.2 Radiocarbon dating of selected sites

SAMPLE	LAB NO.	ASSOCIATION	MEAS. ^{14}C AGE (YEARS BP)	CORR. $^{13}C/^{12}C$* (YEARS BP)	CALIB. RANGE CAL. YEARS (2 σ) **
SCL-6					
Cerithidea		Burial 1	1000 ± 60	1410 ± 60	AD 1070 (1247) 1320
Cerithidea		Burial 26	1190 ± 60	1600 ± 60	AD 900 (1034) 1190
Cerithidea		Burial 64	1520 ± 60	1930 ± 60	AD 590 (690) 840
Cerithidea		Burial 66	1450 ± 80	1860 ± 80	AD 620 (766) 970
Cerithidea		Burial 71	1340 ± 70	1740 ± 70	AD 710 (894) 1040
Cerithidea		Burial 99	1330 ± 80	1740 ± 80	AD 700 (901) 1050
Cerithidea		Burial 130	1140 ± 60	1550 ± 60	AD 970 (1066) 1250
Cerithidea		Burial 134	1440 ± 90	1850 ± 90	AD 610 (776) 1000
Misc. shell		0-10 cm	880 ± 90	1290 ± 90	AD 1170 (1312) 1460
Misc. shell		80-90 cm	950 ± 90	1360 ± 90	AD 1060 (1279) 1420
Misc. shell		40-50 cm	1140 ± 90	1550 ± 90	AD 900 (1066) 1280
SCL-38					
Charcoal	WSU-4878	Burial 144	230 ± 50	245 ± 50	AD 1512 (1652) 1950
Charcoal	WSU-4879	Burial 171	340 ± 300	355 ± 30	AD 1442 (1492) 1641
Charcoal	WSU-4849	Burial 51	440 ± 160	455 ± 160	AD 1260 (1436) 1950
Charcoal	WSU-4876	Burial 64	440 ± 230	455 ± 230	AD 1045 (1436) 1950
Charcoal	WSU-4870	Burial 13	450 ± 50	465 ± 50	AD 1331 (1433) 458
Charcoal	WSU-4872	Burial 40	470 ± 220	485 ± 220	AD 1041 (1427) 1950
Charcoal	WSU-4850	Burial 93	620 ± 60	635 ± 60	AD 1260 (1372) 1420
Bone	WSU-4895	Animal burial	680 ± 70	890 ± 70	AD 1000 (1158) 1280
Charcoal	WSU-4896	Burial 91	690 ± 220	705 ± 220	AD 890 (1280) 1650
Charcoal	WSU-4877	Burial 107	735 ± 85	750 ± 85	AD 1042 (1268) 1393
Charcoal	WSU-4902	Feature 814-2	830 ± 70	845 ± 70	AD 1020 (1210) 1280
Charcoal	WSU-4871	Burial 21	860 ± 150	875 ± 150	AD 783 (1179) 1394
Charcoal	WSU-4880	Burial 178	880 ± 280	895 ± 280	AD 601 (1157) 1621
Charcoal	WSU-4856	Burial 167	1130 ± 170	1145 ± 170	AD 560 (891) 1255
Charcoal	WSU-4875	Burial 63	1160 ± 150	1175 ± 150	AD 579 (787) 1187
Charcoal	WSU-4900	Feature 814-1	1250 ± 130	1265 ± 130	AD 540 (725) 1018
Charcoal	WSU-4852	Burial 230	1210 ± 120	1225 ± 120	AD 600 (794) 1021
Charcoal	WSU-4897	Burial 117	1540 ± 180	1555 ± 180	AD 70 (473) 860
Charcoal	WSU-4851	Burial 179	1710 ± 200	1725 ± 200	172 BC (AD 293) AD 670
Charcoal	WSU-4902	Feature 850	1790 ± 180	1805 ± 180	346 BC (AD 190) AD 637
Charcoal	WSU-4899	Burial 240	2190 ± 170	2205 ± 170	790 BC (218 BC) AD 130
SCL-137					
Charcoal	Beta-21923	Burial 20-89	2070 ± 90	2085 ± 90	390 BC (156 BC) AD 80
Charcoal	Beta-12682	Unit (?) 90-100 cm	2000 ± 80	2015 ± 80	347 BC (61 BC) AD 130
Charcoal	Beta-12683	Unit (?) 100-110 cm	2060 ± 120	2075 ± 120	400 BC (95 BC) AD 210
Charcoal	Beta-21923	Unit (?) 160-170 cm	2670 ± 90	2685 ± 90	1072 (830) 596 BC
Charcoal		Burial 62-90	2130 ± 90	2145 ± 90	400 BC (187 BC) AD 50
Mytilus edulis		Burial 55-90	2470 ± 100	2880 ± 100	740 BC (378 BC) 120 BC
Charcoal		Burial 59-90	2800 ± 120	2815 ± 120	1374 BC (974 BC) 790 BC
SCL-300					
Cerithidea	RL-1019	Burial 1	1760 ± 120	2170 ± 120	AD 140 (AD 453) 710
Cerithidea	RL-1020	Unit 17 60-70 cm	2460 ± 130	2870 ± 130	760 BC (373 BC) AD 40
Cerithidea	RL-1021	Unit 17 80-90 cm	2290 ± 130	2700 ± 130	480 BC (166 BC) AD 150
Cerithidea	RL-1022	Unit 17 90-100 cm	2080 ± 120	2490 ± 120	200 BC (AD 88) AD 390
Cerithidea	RL-1023	Unit 12 60-70 cm	2010 ± 110	2450 ± 110	AD 140 (130) 410
Cerithidea	RL-1024	Unit 12 80-100 cm	1930 ± 120	2340 ± 120	30 BC (AD 257) AD 560
Cerithidea	RL-1025	Unit 12 40-50 cm	2310 ± 130	2720 ± 130	510 BC (185 BC) AD 130
Charcoal	RL-1027	Burial 2	1480 ± 140	1495 ± 140	AD 230 (561) 800

continued

Table 13.2 Radiocarbon dating of selected sites, *continued*

SAMPLE	LAB NO.	ASSOCIATION	MEAS. 14C AGE (YEARS BP)	CORR. 13C/12C* (YEARS BP)	CALIB. RANGE CAL. YEARS (2 σ) **
SCL-354					
Cerithidea	UCR-0419	91 cm	2680 ± 170	3090 ± 170	1610 (1221) 790 BC
Faunal bone	UCR-0419	91 cm	3260 ± 170	3470 ± 170	2880 (1846) 1420 BC
SCL-690					
Charcoal	Beta-44249	U-33 Feature 3	680 ± 50	695 ± 50	AD 1227 (1281) 1392
Human bone	Beta-46644	Burial 55	700 ± 60	780 ± 60	AD 1072 (1259) 1280
Human bone	Beta-46643	Burial 41	720 ± 60	800 ± 60	AD 1041 (1243) 1280
Human bone	Beta-46646	Burial 78	840 ± 60	920 ± 60	AD 990 (1122) 1256
Olivella A1 beads	Beta-44244	Burial 24	840 ± 60	1250 ± 60	AD 1260 (1342) 1450
Olivella A1 beads	Beta-44248	Burial 92	870 ± 60	1280 ± 60	AD 1240 (1318) 1440
Charcoal	Beta-44246	Burial 31	900 ± 70	915 ± 70	AD 990 (1124) 1260
Human bone	Beta-46641	Burial 31	940 ± 80	1020 ± 80	AD 782 (999) 1206
Olivella A1 beads	Beta-46645	Burial 55	1040 ± 50	1450 ± 50	AD 1050 (1207) 1290
Olivella D1 beads	Beta-44250	Burial 39	1050 ± 60	1460 ± 60	AD 1030 (1194) 1300
Human bone	Beta-44642	Burial 39	1100 ± 60	1180 ± 60	AD 680 (816) 990
Olivella M1a beads	Beta-44247	Burial 41	1160 ± 50	1570 ± 50	AD 960 (1051) 1210
Olivella G1a beads	Beta-44245	Burial 31	1230 ± 70	1640 ± 70	AD 830 (1010) 1170
SCL-732					
Bone	WSU-4604	Animal burial 1	150 ± 80	360 ± 80	AD 1410 (1490) 1950
Charcoal	WSU-4608	Rock feature 1	160 ± 80	175 ± 80	AD 1524 (1806) 1950
Charcoal	WSU-4611	House floor 1	210 ± 70	225 ± 70	AD 1494 (1662) 1950
Charcoal	WSU-4567	House floor 1	230 ± 60	245 ± 60	AD 1490 (1652) 1950
Charcoal	WSU-4605	Animal burial 1	270 ± 80	285 ± 80	AD 1440 (1641) 1950
Charcoal	WSU-4607	Feature 2	410 ± 80	425 ± 80	AD 1328 (1442) 1650
Animal bone	WSU-4563	Burial 6	1770 ± 90	1980 ± 90	342 BC (AD 20) AD 230
Animal bone	WSU-4566	Burial 59	1780 ± 90	1990 ± 90	346 BC (AD 10) AD 226
Animal bone	WSU-4565	Burial 39	1840 ± 60	2015 ± 60	198 BC (60 BC) AD 126
Animal bone	WSU-4555	Burial 19	1980 ± 80	2190 ± 80	400 (229) 4 BC
Animal bone	WSU-4535	Burial 35	2010 ± 70	2220 ± 70	410 (274) 90 BC
Animal bone	WSU-4554	Burial 9	2010 ± 190	2220 ± 190	800 BC (274 BC) AD 208
Charcoal	WSU-4553	Burial 96	2020 ± 90	2035 ± 90	355 BC (70 BC) AD 130
Charcoal	WSU-4541	Burial 87	2080 ± 90	2095 ± 90	390 BC (144 BC) AD 70
Charcoal	WSU-4549	Burial 54	2100 ± 90	2115 ± 90	390 BC (139 BC) AD 60
Animal bone	WSU-4557	Burial 100	2210 ± 320	2420 ± 320	1374 BC (430 BC) AD 230
Animal bone	WSU-4556	Burial 88	2240 ± 305	2450 ± 305	1374 BC (463 BC) AD 208
Mytilus edulis	WSU-4560	Burial 69	2270 ± 70	2680 ± 70	360 BC (142 BC) AD 50
Charcoal	WSU-4552	Burial 90	2280 ± 60	2295 ± 60	508 (392) 210 BC
Mytilus edulis	WSU-4558	Burial 17	2300 ± 60	2710 ± 60	360 BC (175 BC) AD 0
Mytilus edulis	WSU-4559	Burial 56	2340 ± 80	2750 ± 80	400 BC (218 BC) AD 10
Charcoal	WSU-4540	Burial 66	2720 ± 180	2735 ± 180	1410 (862) 410 BC
SCL-755					
Human bone	WRC-3146	Burial 1	1275 ± 47	1385 ± 47	AD 595 (653) 686
Human bone	WRC-3167	Burial 2	1193 ± 49	1273 ± 49	AD 650 (746) 890
Human bone	WRC-3173	Burial 3	1311 ± 59	1399 ± 59	AD 550 (648) 690
Olivella A1 beads	WRC-3216	Burial 3	1819 ± 86	2229 ± 86	AD 160 (406) 610
ALA-328					
Misc. shell	I-08085	D-5 II: 254 cm	2330 ± 90	2740 ± 90	400 BC (210 BC) AD 10
Charcoal	C-0690	A-5 I: 335 cm	2339 ± 150	2354 ± 150	820 (401) 90 BC
ALA-329					
Human bone	WSU-3367	Burial 48	250 ± 50	330 ± 50	AD 1440 (1590) 1660
Human bone	WSU-3369	Burial 177	300 ± 60	380 ± 60	AD 1420 (1476) 1650
Human bone	I-07895	Burial 130	430 ± 80	510 ± 80	AD 1280 (1418) 1615

continued

Table 13.2 Radiocarbon dating of selected sites, *continued*

SAMPLE	LAB NO.	ASSOCIATION	MEAS. ^{14}C AGE (YEARS BP)	CORR. $^{13}C/^{12}C$* (YEARS BP)	CALIB. RANGE CAL. YEARS (2 σ) **
ALA-329, *continued*					
Human bone	WSU-3368	Burial 125	460 ± 50	540 ± 50	AD 1297 (1410) 1441
Charcoal	I-07896	Burial130	520 ± 80	535 ± 80	AD 1280 (1411) 1490
Human bone	WSU-4359	Burial 34	530 ± 80	610 ± 80	AD 1260 (1367) 1440
Human bone	WSU-3370	Burial 227	650 ± 50	730 ± 50	AD 1210 (1278) 1386
Human bone	WSU-3371	Burial 239	700 ± 55	780 ± 55	AD 1134 (1259) 1280
Human bone	WSU-3846	Burial 49	835 ± 90	915 ± 90	AD 980 (1124) 1280
Olivella beads	I-07887	Burial 130	980 ± 80	1390 ± 80	AD 1090 (1300) 1450
Human bone	WSU-4361	Burial 143	1220 ± 90	1300 ± 90	AD 570 (682) 944
Human bone	WSU-3848	Burial 265	1235 ± 65	1315 ± 65	AD 602 (674) 871
Human bone	WSU-3847	Burial 244	1400 ± 110	1480 ± 110	AD 264 (578) 770
Human bone	WSU-4360	Burial 104	1690 ± 90	1770 ± 90	AD 31 (245) 526
Human bone	WSU-4362	Burial 257	1690 ± 80	1770 ± 80	AD 60 (245) 430
Human bone	WSU-4363	Burial 273	2080 ± 90	2160 ± 90	400 BC (325 BC) AD 46
SMA-77					
Charcoal	UCR-0957	Burials 24 and 25	2630 ± 150	2645 ± 150	1212 (807) 400 BC
Charcoal	UCR-0956	Burials 24 and 25	2700 ± 150	2715 ± 150	1312 (879) 413 BC
Ostrea lurida	UCR-0958	Burials 24 and 25	2900 ± 150	3310 ± 150	1310 (894) 530 BC
Human bone	UCR-0959	Burial 36	2920 ± 70	3000 ± 70	1430 (1281) 1013 BC
Charcoal	L-0187A	Burials 23-35, 37-38	2950 ± 350	2965 ± 350	2111 (1200) 380 BC
Human bone	UCR-0953	Burial 19	3000 ± 90	3080 ± 90	1579 (1330) 1053 BC
Ostrea lurida	I-07591	Pit 4, upper lens	3050 ± 85	3460 ± 85	1360 (1092) 850 BC
Charcoal	UCR-0960	Burial 36	3060 ± 160	3075 ± 160	1725 (1331) 900 BC
Human bone	UCR-0955	Burial 36	3070 ± 160	3150 ± 160	1857 (1434) 975 BC
Charcoal	UCR-0954	Burial 19	3200 ± 240	3215 ± 240	2135 (1495) 841 BC
Ostrea lurida	I-07592	Pit 4, lower lens	3265 ± 85	3675 ± 85	1590 (1387) 1140 BC
Charcoal	L-0187B	Burials 24-25, pit 4	3400 ± 300	3415 ± 300	1877 (1702) 1626 BC
Ostrea lurida	UCR-0961	Burial 36	3460 ± 150	3870 ± 150	1990 (1599) 1250 BC
SMA-97					
Haliotis rufescens	WSU-3232	U-4 20-30 cm	1040 ± 70	1450 ± 70	AD 1030 (1207) 1310
SMA-115					
Mytilus californianus	WSU-3104	U-7N/6W 120-130 cm	705 ± 130	1115 ± 130	AD 1230 (1428) 1660
SMA-118					
Human bone	WSU-3102	Burial 1	380 ± 45	460 ± 45	AD 1334 (1435) 1490
Charcoal	WSU-3103	Feature 2	635 ± 70	650 ± 70	AD 1235 (1375) 1420
SMA-134					
Mytilus californianus	Beta-74111	U-12-14E 20-30 cm	900 ± 50	1310 ± 50	AD 1230 (1302) 1410
Mytilus californianus	Beta-74112	U-15-17E 20-30 cm	920 ± 60	1330 ± 60	AD 1180 (1292) 1410
Mytilus californianus	Beta-74110	U-14-15E 20-30 cm	910 ± 70	1320 ± 70	AD 1180 (1297) 1430
Mytilus californianus	Beta-74109	U-14-15E 20-30 cm	1000 ± 60	1410 ± 60	AD 1070 (1247) 1320
Mytilus californianus	Beta-74113	U-15-17E 50-60 cm	1000 ± 60	1410 ± 60	AD 1070 (1247) 1320
SMA-218					
Mytilus californianus	WSU-3425	Unit 3 20-30 cm	2880 ± 75	3290 ± 75	1080 (870) 760 BC
SMA-244					
Charcoal	WSU-3424	Unit 420-40 cm	635 ± 70	650 ± 70	AD 1235 (1375) 1420
SMA-238					
Mytilus californianus	WSU-3510	U-7 burial 1	1150 ± 80	1560 ± 80	AD 910 (1059) 1270

continued

Table 13.2 Radiocarbon dating of selected sites, *continued*

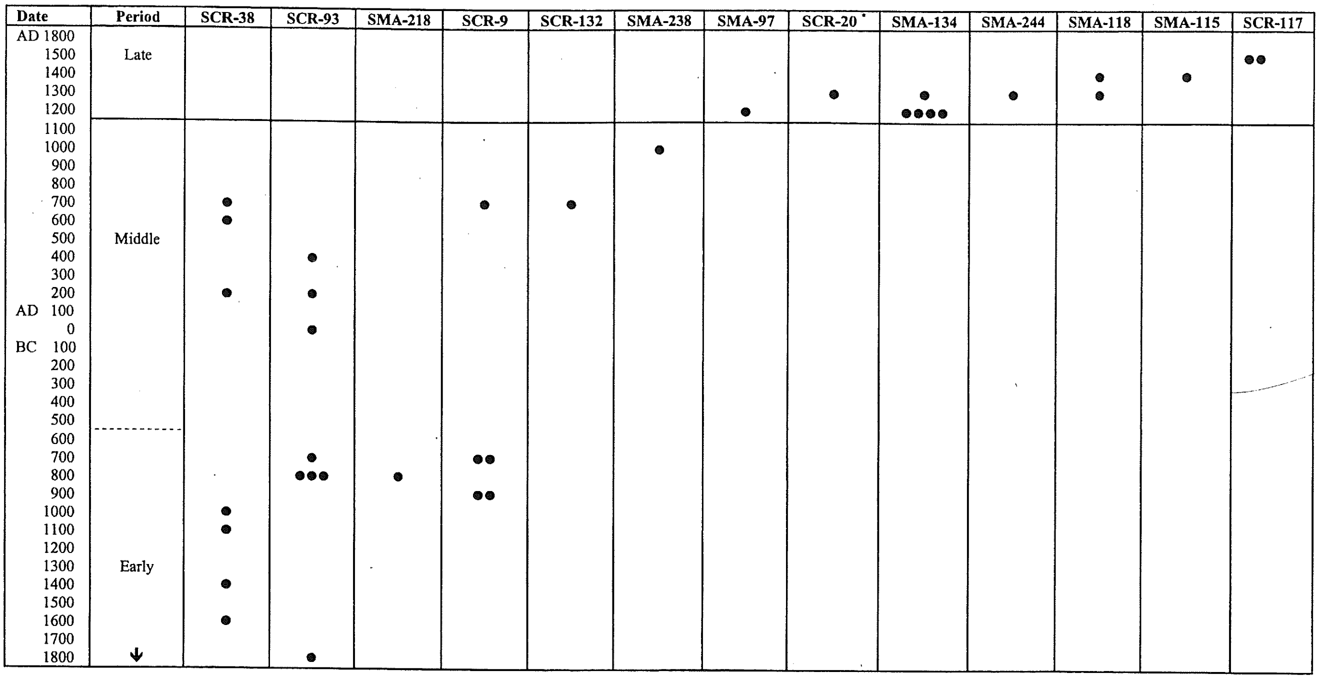
SAMPLE	LAB NO.	ASSOCIATION	MEAS. ^{14}C AGE (YEARS BP)	CORR. $^{13}C/^{12}C$* (YEARS BP)	CALIB. RANGE CAL. YEARS (2 σ) **
SCR-9					
Mytilus californianus	WSU-3230	Unit 1 20-30 cm	1480 ± 65	1890 ± 65	AD 620 (723) 900
Charcoal	WSU-3171	Unit 2 190-200 cm	2790 ± 85	2805 ± 85	1287 (958) 800 BC
Mytilus californianus	WSU-3170	Unit 2 200 cm	2940 ± 60	3350 ± 60	1140 (932) 800 BC
Mytilus californianus	WSU-3203	Unit 4 130-140 cm	2790 ± 60	3200 ± 60	920 (794) 700 BC
Mytilus californianus	WSU-3204	Unit 5 140-150 cm	2730 ± 60	3140 ± 60	850 (763) 520 BC
SCR-20					
Charcoal	Beta-06459	Burial	550 ± 50	565 ± 50	AD 1280 (1341) 1430
SCR-38					
Mytilus californianus	WSU-3532	Unit 3 40-50 cm	1600 ± 60	2010 ± 60	AD 480 (643) 750
Mytilus californianus	WSU-3533	Unit 3 40-50 cm	1920 ± 110	2330 ± 110	AD 10 (264) 550
Mytilus californianus	WSU-3534	Unit 3 110-120 cm	3010 ± 110	3420 ± 110	1370 (1027) 790 BC
Mytilus californianus	WSU-3535	Unit 3 110-120 cm	3370 ± 50	3780 ± 50	1630 (1491) 1370 BC
Mytilus californianus	WSU-3536	Unit 3 160-170 cm	3480 ± 120	3890 ± 120	1930 (1620) 1360 BC
Mytilus californianus	WSU-3537	Unit 3 160-170 cm	3060 ± 85	3470 ± 85	1370 (1107) 860 BC
Mytilus californianus	WSU-3538	Unit 4 100-110 cm	1470 ± 70	1880 ± 70	AD 620 (735) 920
SCR-93					
Mixed shell	WSU-3450	Unit 1 10-20 cm	1760 ± 70	2170 ± 70	AD 270 (453) 640
Mytilus californianus	WSU-3451	Unit 1 40-50 cm	1960 ± 70	2370 ± 70	AD 50 (233) 420
Charcoal	WSU-3179	Unit 1 0-10 cm	2055 ± 105	2070 ± 105	390 BC (94 BC) AD 130
Mytilus californianus	WSU-2552	Unit 1 100-110 cm	2720 ± 90	3130 ± 90	900 (759) 410 BC
Charcoal	WSU-3178	Feat. 2 105-110 cm	2725 ± 75	2740 ± 75	1188 (858) 790 BC
Mixed shell	WSU-3177	Feature 1	2830 ± 75	3240 ± 75	1010 (815) 720 BC
Mixed shell	WSU-2551	Unit 1 160-170 cm	3210 ± 100	3620 ± 110	1140 (830) 580 BC
Mytilus californianus	WSU-3452	Unit 1 90-100 cm	3700 ± 60	4110 ± 60	2100 (1893) 1710 BC
SCR-117					
Ostrea lurida	Beta-099035	Unit 1 90-100 cm	420 ± 60	830 ± 60	AD 1560 (1692) 1950
Protothaca staminea	Beta-103371	Unit 1 140-150 cm	610 ± 70	1020 ± 70	AD 1420 (1512) 1680
SCR-132					
Haliotis cracherodii	WSU-3231	Feature 1 30-40 cm	1900 ± 50	2310 ± 50	AD 630 (714) 860

* Estimated $^{13}C/^{12}C$ fractionation correction values derived from Beta Analytic (after Stuiver and Polach 1977; Stuiver and Reimer 1993): +410 for marine shell; +210 for bone apatite (C3 diet); +80 for bone collagen (C3 diet); and +15 for charcoal.
** 2 σ, 95% probability: absolute date range after correction for atmospheric variation (shell has been adjusted -225 ± 35 years for reservoir effect).

Sources: Bellifemine 1997; Bocek 1988; Breschini et al. 1996; Cambra et al. 1996; Cartier, Bass, and Ortman 1993; Fitzgerald and Ruby 1997; Hylkema 1991, 1994, 1998; T. Jones 1993; Leventhal 1993; Skowronek 1998.

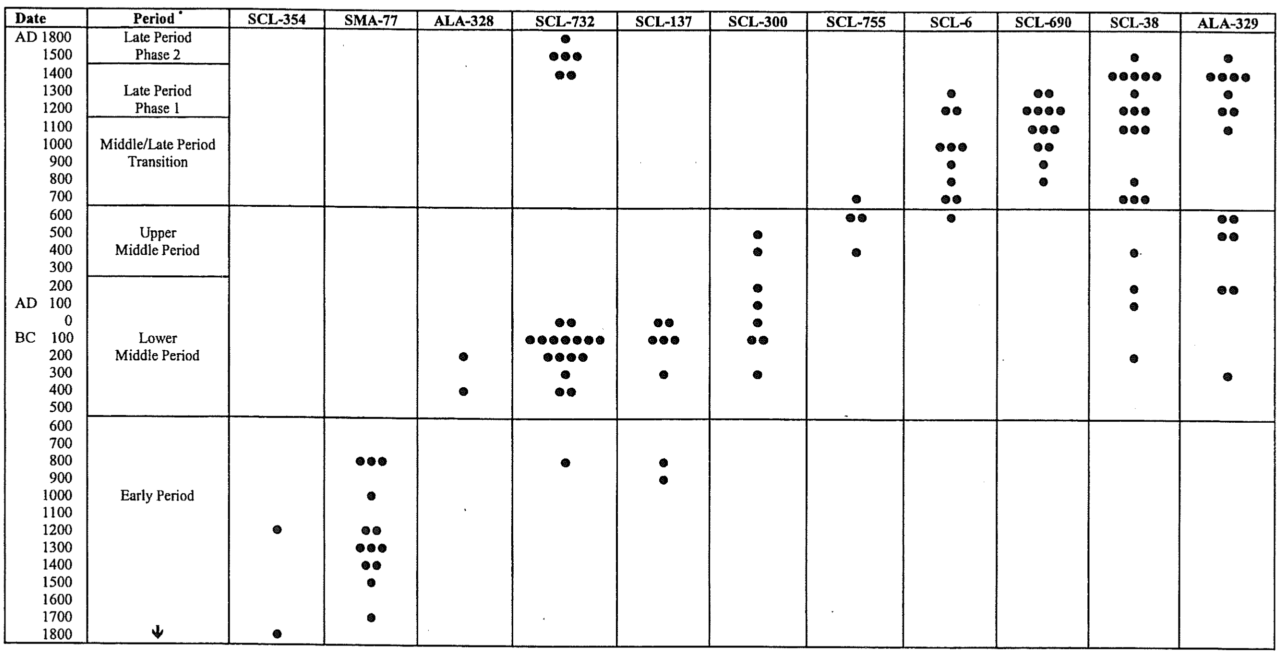
The cultural patterns proposed by Fredrickson (that is, Windmiller, Berkeley, and Augustine), Gerow (Early Bay), and Bennyhoff (Meganos) are applicable to South Bay sites and have been adapted to the discussion below.

Early Bay/Windmiller Pattern (Early period 2000 to 500 BC). The Windmiller culture was first identified in the Sacramento-San Joaquin Delta as the oldest of three archaeological complexes (originally referred to as the Early horizon) (Lillard et al. 1939; Ragir 1972). Windmiller is marked by a distinctive suite of traits, including ventrally extended burials, westerly orientation of graves, perforated and phallic charmstones, large obsidian concave base and stemmed projectile points, and rectangular *Olivella* beads. When it was first defined, Windmiller was thought to occur over much of Central and southern Central California (Heizer 1949). Radiocarbon dates later revealed that the culture dated circa 3000 to 500 BC in the Sacramento-San Joaquin Delta (Fredrickson 1974b; Ragir 1972).



●= Absolute date after correcting and adjusting radiocarbon years BP (results generated through the Stuiver and Reimer [1993] calibration method). * Obsidian hydration readings and temporally diagnostic artifact types indicate that this site also contains a Middle period component. Sources: Breschini, Haversat, and Erlandson (1990); Fitzgerald and Ruby (1997); Hylkema (1991); Hylkema (1998); Jones (1993); Jones and Hylkema (1988).

Figure 13.2 Comparative chronology for selected coastal sites from San Mateo and Santa Cruz counties



●= Absolute date after correcting and adjusting radiocarbon years BP (results generated through the Stuiver and Reimer [1993] calibration method). * Period definitions after Milliken and Bennyhoff (1993:381-395).
Sources: Bellifemine (1997); Breschini, Haversat, and Erlandson (1990); Cambra et al. (1996); Cartier, Bass, and Ortman (1993); Gerow (1968); Hylkema (1994); Leventhal (1993); Skowronek (1998).

Figure 13.3 Comparative chronology of selected sites from the southern San Francisco Bay area

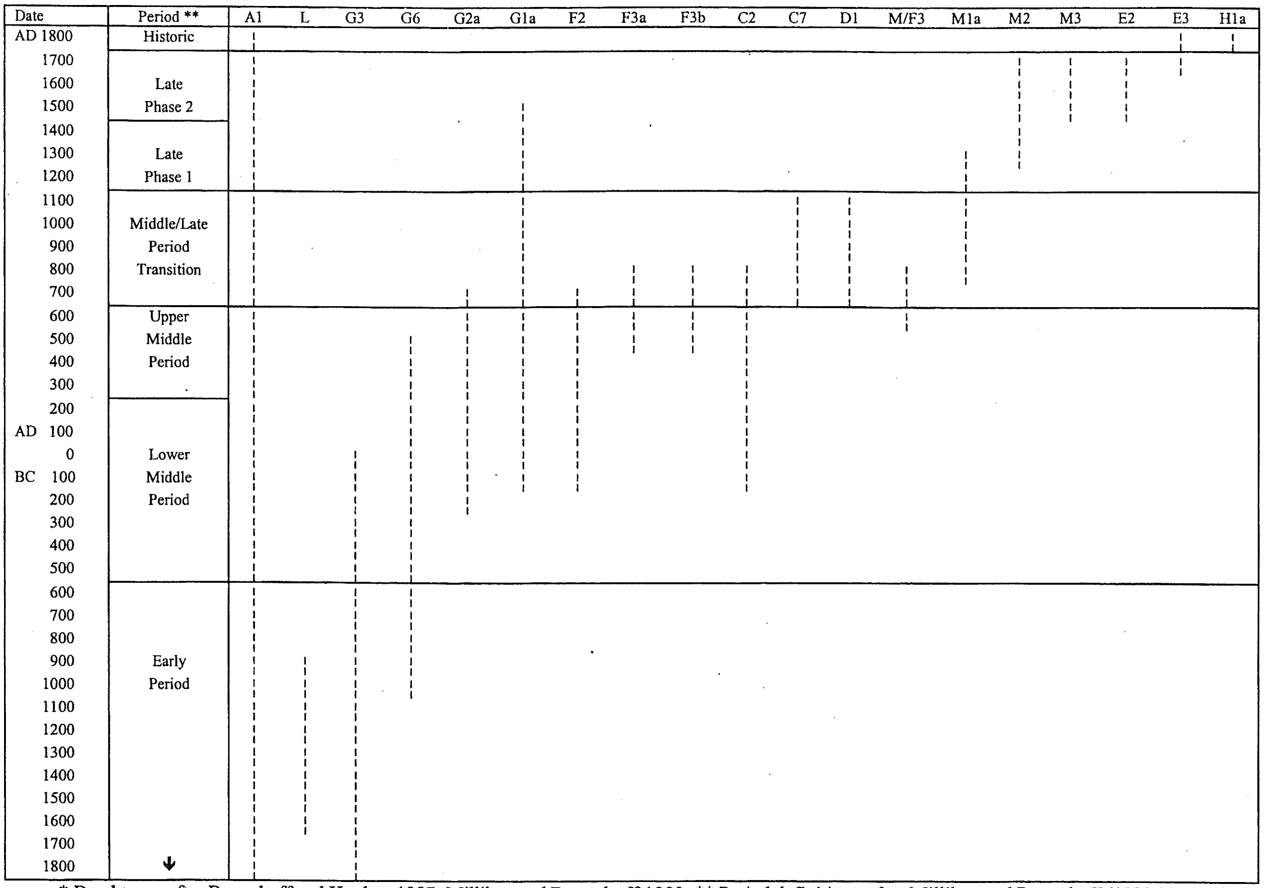
Date	Bennyhoff & Hughes 1987*	Milliken & Bennyhoff 1993
	Historic Period	Historic Period
AD 1800	Late Period Phase 2-B	Late Period Phase 2
AD 1700	Late Period Phase 2-A	
AD 1500	Late Period Phase 1-C	Late Period Phase 1
AD 1300	Late Period Phase 1-B	
AD 1100	Late Period Phase 1-A	Middle/Late Period Transition
AD 900	Middle/Late Period Transition	
AD 700	Middle Period Terminal Phase	Upper Middle Period
AD 500	Middle Period Late Phase	
AD 300	Middle Period Intermediate Phase	Lower Middle Period
AD 100	Middle Period Early Phase	
200 BC	Early/Middle Period Transition	
500 BC	Early Period Terminal Windmiller	Early Period
1100 BC	Early Period Late Windmiller	
1600 BC	Early Period Middle Windmiller	
2000 BC	Early Period Early Windmiller	
3000 BC		

* Dating scheme B1.

Figure 13.4 Late Holocene chronology of the San Francisco Bay region

Gerow (1968) was the first to report assemblage patterns that conflicted with Windmiller based on findings from SMA-77, the University Village site (figure 13.1). This site showed a mortuary complex with grave goods coeval with the Early horizon (Windmiller), but burials were in flexed rather than extended position. The flexed graves also showed no distinctive compass orientations and frequent use of powdered red pigments. Radiocarbon dates obtained later from this site and a comparable component at the West Berkeley site, ALA-307 (Wallace and Lathrap 1975), suggested an age between about 2000 and 700 BC. The assemblage from SMA-77 also showed that bone implements, such as whistles, serrated scapula saws, and elk antler wedges, became popular sometime during this period and continued throughout the Middle period/Berkeley pattern.

Anthropometric comparisons led Gerow to conclude that the people who occupied University Village and the lower levels of West Berkeley had different physical characteristics then the inhabitants of Windmiller in the delta. Through a comparison of cranial measurements, Gerow (1974b:1–25) determined that lower vaulted coastal people were distinct from larger and higher-vaulted interior populations. Based on artifactual and physical anthropological variation between these sites and Windmiller, Gerow proposed an Early Bay culture within the broadly defined "Early horizon." He further suggested that Early Bay held more in common with cultures of the Southern California Coast and that two opposing cultural traditions coexisted in Central California (Early Bay and Windmiller) during the Early horizon. Gerow (1974b) proposed that these co-traditions merged through



* Bead types after Bennyhoff and Hughes 1987; Milliken and Bennyhoff 1993. ** Period definitions after Milliken and Bennyhoff (1993:381-395).

Figure 13.5 Southern San Francisco Bay *Olivella* bead chronology

time, but Moratto (1984) and others argued that Windmiller and Early Bay shared enough in common to represent a single ethnolinguistic cultural group.

Early period assemblages from SCL-354 in the foothills of Los Altos also yielded Monterey chert long-stemmed points like those from SMA-77 (figure 13.6, bottom row). Other similarities included flexed burials, numerous whole *Olivella* beads, mortars and pestles, manos and milling slabs, perforated charm stones, quartz crystals, red pigment, and small paint mortars. At SMA-77, powdered red pigment was especially abundant in association with many badger bones. This pigment was probably cinnabar, available from the Almaden Hills near San Jose (Heizer and Treganza 1944:311). Some artifact traits found at SCL-354 differ, however, from SMA-77 (for example, SCL-354 had polished stone wedges, *Olivella* G3b large ring beads, and perforated grizzly bear fibula pendants), but the two sites have produced coeval ^{14}C dates and are within ten miles (16 km) of each other. Both show that, by the terminal phase of the Early period, burials on the bay side of the peninsula were clustered together and placed within residential deposits.

Much of SCL-354 was destroyed by housing construction in the early 1970s, but field notes suggest that some burials were placed in the extended position. The presence of extended burials, along with polished stone wedges or chisels, implies that some Windmiller traits were present on the peninsula. Both SCL-354 and SMA-77 had mixed milling assemblages that included mortars, pestles, manos, and milling slabs. Both sites produced perforated charm stones; but those from SMA-77 (symmetric spindle type IIB after Beardsley 1954:114) were stylistically different from those at SCL-354. The latter had knobbed distal and proximal ends, while those from SMA-77 did not. The differences in assemblages from these two sites may indicate a succession of cultural traits during the Early period that were either replaced by, or incorporated into, the Berkeley pattern.

Berkeley Pattern (Middle Period 500 BC to AD 700). The Berkeley pattern was proposed by Fredrickson (1974b) on the basis of trends observed in the northern San Francisco Bay Area, where an intensive tidal marsh economy was evident. The earliest manifestations are contemporaneous with Early Bay/Windmiller, but traits defining the earlier pattern faded as many bay shore sites developed into large mounds of shell and earth. Large and small cobble mortars and various pestle types are commonly found in Middle period assemblages, suggesting increasing reliance on acorns. Bennyhoff and Fredrickson (1994:22) considered manos and milling slabs rare, but these implements are often present in

Middle and Late period assemblages from the South Bay, suggesting that the milling of hard seeds continued to supplement the acorn diet.

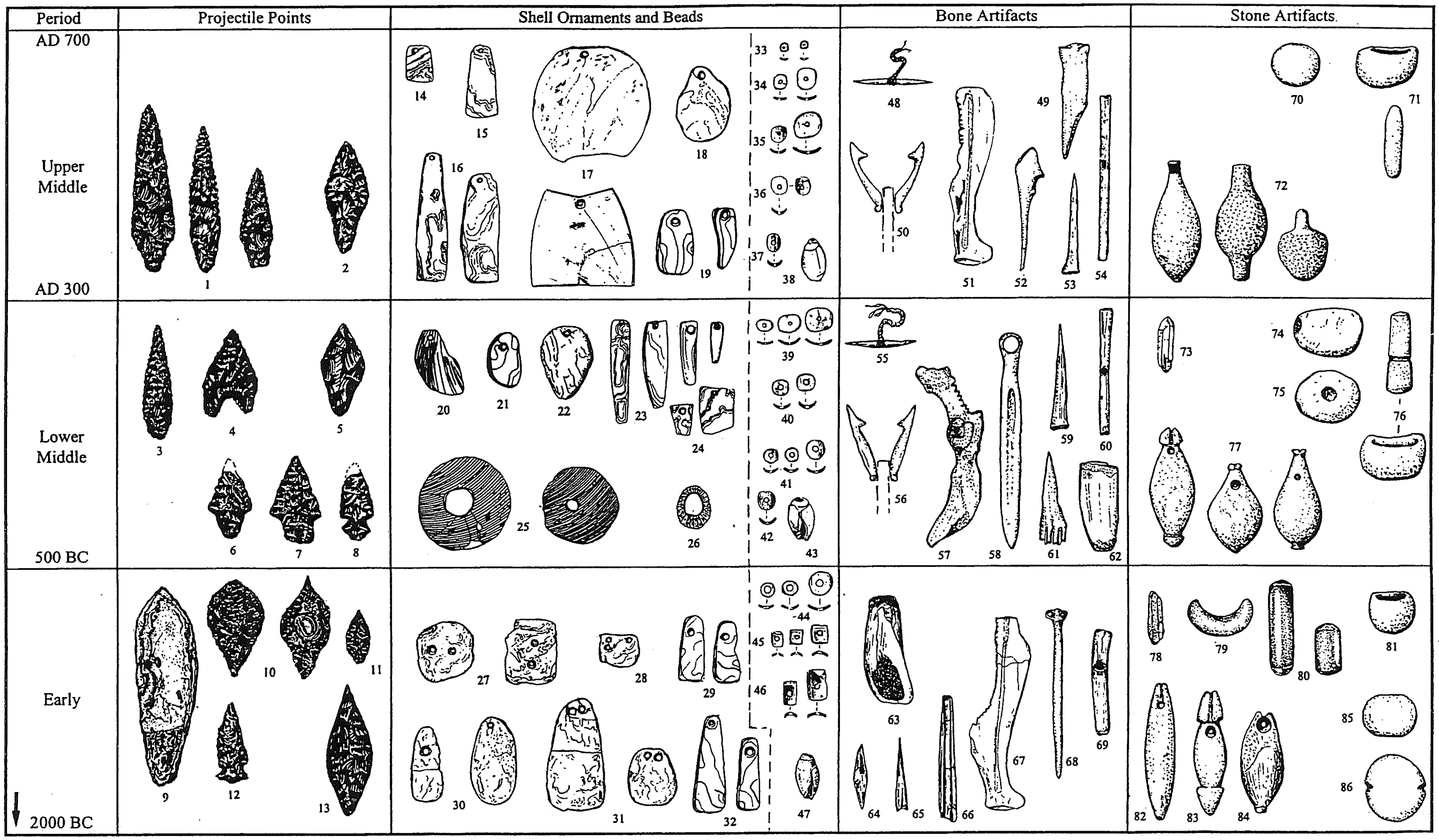
Berkeley pattern sites exhibit a low frequency of projectile points, with contracting-stemmed and lanceolate (Excelcior) forms being most common (figure 13.6). Bone implements are abundant in Berkeley pattern components including double-pronged fish spears (figure 13.6) that are especially useful as time diagnostics (Bennyhoff 1950). Serrated bone scapulas and innominates increased in numbers compared to Early period sites, as did beveled elk antler wedges. Flexed burials with no patterned orientation, randomly interred in residential middens accompanied by fewer artifacts (with little emphasis on wealth), and occasional expressions of cosmological beliefs in the form of animal burials, charm stones, quartz crystals, and bone whistles characterize the pattern. Two subphases are distinguished in the Middle period: Lower (500 BC to AD 300) and Upper (AD 300 to 700).

Lower Middle Period. SCL-137 and SCL-732 are representative of the lower Middle period in the southern San Francisco Bay Area. Both sites are in an oak woodland environment, and both produced large numbers of burials (88 at SCL-137 and 102 at SCL-732). At SCL-732, very few graves had associated artifacts, but among those with grave goods 13% had mortars, 6% had manos, and 9% had Olivella G2 or G3 saucer beads (for a combined total of only 1033 beads). A total of 5% of the burials produced *Haliotis* pendants, most of which were the J2a series ring form (E. Gifford 1947) (figure 13.6 specimen 25). One dated burial (number 35) produced 6 type I limpet shell (possibly *Lottia gigantea*) ring ornaments, more than 16 *Haliotis cracherodii* J2a ring pendants, 34 *Olivella* G2 round saucer beads, and one bird bone whistle. This site also produced a variety of cobble artifacts, although few of these were directly associated with burials. They included 14 manos (several with shallow, circular depressions pecked into one grinding surface), 35 pestles, and 34 mortars (3 of which were small paint mortars). Projectile points were rare, although Franciscan chert debitage was common. Rock-lined ovens and several animal burials (elk and wolf) were also uncovered. A large number of ^{14}C dates (table 13.2) place the site in the lower Middle period. A cluster of Late period dates also came from several burned earth features, but these are not thought to relate to the Middle period cemetery (Cambra et al. 1996).

At SCL-137, approximately 17% of the burials yielded *Olivella* beads, including examples of types G3, G5, and F3, which totaled only 1516 specimens. Only one burial produced a single *Haliotis* pendant. This site also produced 26 manos (several with dimple surfaces like those from SCL-732), 25 pestles, and 41 mortars (Cartier, Bass, and Ortman 1993). Projectile point types included two square-stemmed examples and one contracting-stemmed. These types were common throughout the Monterey Bay area (T. Jones 1993) and the Diablo Range during the same time period (Hylkema 1993).

Upper Middle Period. Between AD 300 and 700, the delta and tidal marshlands of the lower Guadalupe River and Coyote Creek were intensively occupied. Construction activities in this region have exposed scattered clusters of burials. Important findings come from SCL-131, SCL-300/302, and SCL-755. At SCL-131 in the Almaden Valley, a sample of 64 burials did not include a single interment with associated *Olivella* beads. Indeed, only six individuals had grave-associated artifacts; five were interred with mortars or pestles, and one elderly female retained a quartz crystal. Two caches of obsidian projectile points reflect use of the lanceolate type, typical of the Berkeley pattern (Pastron and Walsh 1989:74–88). SCL-300/302 produced mortars, pestles, manos, charm stones, and bone awls, as well as a number of burials. Episodes of construction and the variation in field and reporting strategies archaeologists used at this site have made it difficult to quantify burial findings, but it is estimated that 42 graves have been uncovered (Bard et al. 1984:5–6). Cartier, Bass, and Ortman (1993:68) presented comparative data from 28 graves. Bead types represented included examples of A1, F3b, F3b2, and G2a. In addition to the ^{14}C dates, the *Olivella* F3a and F3b2 beads place the site at the end of the Middle period. Twenty-five upper Middle period burials were recovered from SCL-755, of which 48% had associated beads; types included A1, C2, F3a, F3b, and G2a, which are similar to those from SCL-300.

Meganos Culture. Sometime during the Middle period, people with cultural traits distinctly different from the Berkeley pattern appeared along the southeastern margin of San Francisco Bay. The roots of what appears to have been a population movement can be seen at sites around the sloughs and mouth of the San Joaquin River in the Stockton district, where many cultural traits of the earlier Windmiller pattern appeared south of their earlier place of origin in the lower Sacramento Valley. ALA-413 in the Livermore Valley demonstrated that the Meganos culture had spread into the interior valleys of the northern Diablo Range by the early Middle period (Bennyhoff 1994b:81–89; Wiberg 1984). During the upper Middle period, Meganos extended onto the Fremont plain and northern Santa Clara Valley. An amalgamation of some San Francisco Bay traits and those carried in by the intruding group developed into a cultural complex Bennyhoff (1994b) defined as the Meganos aspect. This aspect is characterized by ventrally and dorsally extended burials without specific compass orientation, co-occurrence of flexed burials, and very few grave-associated artifacts. Bennyhoff (1994b:82) viewed Meganos as "a hybrid of a Windmiller population intermarrying with Berkeley neighbors." Meganos appeared to have been at a border with Berkeley pattern cultural groups of the southeast bay,



Key (*Haliotis* effigy pendant nomenclature after Gifford [1947], other *Haliotis* and *Olivella* bead types after Bennyhoff and Hughes [1987]): **1**- Obsid. lanceolates (3), SCL-131; **2**- Mont. chert long-stemmed point, SCl-178; **3**- Obsid. lanceolate point, SCL-131; **4**- Obsid. concave base point, ALA-328; **5**- Mont. chert long-stemmed point, ALA-328; **6**- Franc. chert contracting-stemmed point, SCL-137; **7**- Franc. chert square-stemmed point, SCL-137; **8**- Chalcedony side-notched point, SCL-12; **9**- Mont. chert knife, SMA-77; **10**- Mont. chert long-stemmed points (2), SMA-77; **11**- Obsid. long-stemmed point, SMA-77; **12**- Mont. chert side-notched point, SMA-77; **13**- Mont. chert contracting-stemmed point, SCL-354; **14**-*Haliotis* BA3 pendant, ALA-328; **15**- *Haliotis* FB3 pendant, ALA-328; **16**- *Haliotis* pendants (2), ALA-328; **17**- *Haliotis* "shield" ornaments (2), ALA-328; **18**- *Haliotis* AF4a (Gifford 1947) pendant, SCL-6; **19**- *Haliotis* FB3 and EB3 pendants (2), ALA-328; **20**- *Haliotis* AB1aI pendant, SCL-732; **21**- *Haliotis* AA2aIII pendant, SCL-732; **22**- *Haliotis* pendant, SCL-732; 23- *Haliotis* pendants (4), ALA-328; **24**- *Haliotis* pendants (2), ALA-328; **25**- *Haliotis* J2aI pendants (2), SCL-732; **26**- *Lottia gigantea* ornament, SCL-732; **27-32** *Haliotis* pendants (11), SMA-77; **33**- *Olivella* F3b2 beads, SCL-300; **34**- *Olivella* F3a beads, SCL-755; **35**- *Olivella* F2b beads, ALA-328; **36**- *Olivella* C2 beads, SCL-755; **37**- *Olivella* C3 bead, SCL-755; **38**- *Olivella* A1 bead, SCL-732; **39**- *Olivella* F2a beads, SCL-732; **40**- *Olivella* F1 beads, SCL-732; **41**- *Olivella* G2 beads, SCL-732; **42**- *Olivella* C3 beads, ALA-328; **43**- *Olivella* A1 bead, SCL-732; **44**- *Olivella* G3 beads, SCL-354; **45**- *Olivella* L2 beads, SMA-77; **46**- *Olivella* L1 beads, SMA-77; **47**- *Olivella* A1 bead, SMA-77; **48**-Bone fishing gorge, ALA-328; **49**- Antler wedge, ALA-328; **50**- Bone fish spear, ALA-328; **51**- Serrated scapula saw, ALA-328; **52-53** Bone awls, ALA-328; **54** Bird bone whistle, SCL-300; **55**- Bone fishing gorge, ALA-328; **56**- Bone fish spear, ALA-328; **57**- Serrated bone innominate saw, ALA-328; **58**- Elk bone spatula, ALA-328; **59**- Bone awl, ALA-328; **60**- Bird bone whistle, SCL-732; **61**- Bone awl, ALA-328; **62**- Antler wedge, SCL-732; **63**- Antler wedge, SMA-77; **64-66** Bone awls, SMA-77; **67**- Serrated scapula saw, SMA-77; **68**- Fibula pendant (*Ursus horibilus*), SCL-354; **69**- Mammal bone whistle (type FF1a after Gifford 1940:181), SMA-77; **70**- Handstone, SCL-300; **71**- Mortar/pestle, SCL-300; **72**- Charmstone group (3), ALA-328; **73**- Quartz crystal, SCL-131; **74-75** Handstones, SCL-732; **76**- Mortar/pestle, ALA-328; **77**- Charmstone group (3), ALA-328; **78**- Quartz crystal, SMA-77; **79**- Crescentic stone, SMA-77; **80**- Pestles (2), SMA-77; **81**- Mortar, SMA-77; **82**- Perforate charmstone, SMA-77; **83**- Perforate phallic charmstone, SCL-354; **84**- Perforate charmstone; SMA-77; **85**- Handstone, SCL-354; **86**- Notched stone, SMA-77.

Figure 13.6 Early Bay and Berkeley pattern artifact assemblages. *Chart illustrated by Mark Hylkema and Glen Wilson 1998 (Artifacts not drawn to scale).*

and Bennyhoff felt that by the final centuries of the Middle period, they withdrew progressively toward the San Joaquin River Delta, with the Stockton district becoming their cultural center (see Bennyhoff 1994b:84-87). Several sites in the South Bay exhibit Meganos traits, including ALA-453 in Union City, ALA-343 in Fremont (Hall, Jurmain, and Nelson 1988:321-334), and SCL-327 in San Jose (Cartier 1988:355-366).

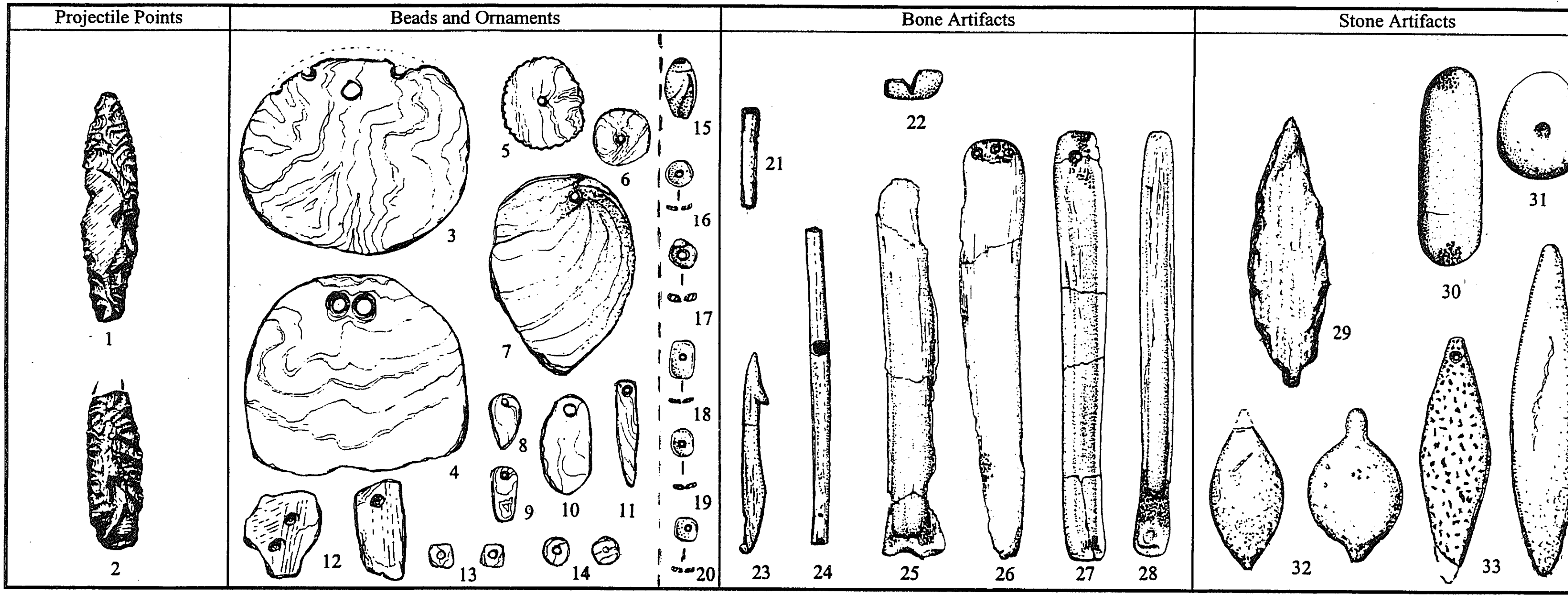
At ALA-343, 75 burials were identified of which 20% of the individuals were estimated to have been less than sixteen years of age. Nearly 39% of the burials were either tightly or semiflexed, and the rest were dorsally or ventrally extended. Burial-associated artifacts included *Haliotis* pendants, *Olivella* beads (F3b, F3a, G1, G2a, A1, and C2 types), phylite and mica pendants, and long, very polished elk tibia bone spatulates with perforated ends, some of which had remnants of asphaltum with imprints of *Olivella* bead appliqué (figure 13.7). The assemblage also included two-pronged bone fish spears, bird bone whistles, red pigment, charm stones (piled types), and evidence of charm stone manufacturing, mortars, pestles, and other oddly unique artifact forms. Large "shield-like" *Haliotis* pendants described by Bennyhoff (1994b:88) for nearby ALA-328, along with other similar artifacts, suggest that the Berkeley pattern and Meganos people coexisted along the southeast bay margins. Some burials from both sites exhibited evidence of violent trauma. Temporally diagnostic *Olivella* bead types F3a and F3b (square saddles) suggest a time frame of AD 500 to 700 (Bennyhoff and Hughes 1987:106). Many bead specimens exhibited qualities resembling the sharply rectangular M1a type, which is a hallmark of the subsequent Middle/Late Transition period, but the diagnostic corners were still slightly rounded. This peculiar bead type led Milliken and Bennyhoff (1993) to propose a new type, M/F3. The M/F3 bead type has been identified in grave lots at Middle/Late Transition period site SCL-690, along with the classic M1a, which suggests that M/F3 *Olivella* beads occurred as late as AD 800. Given the absence of the M1a type at ALA-343, it is likely that the site was abandoned sometime between AD 600 and 800.

Augustine Pattern (Middle/Late Transition and Late Periods, AD 700 to 1769). The Augustine pattern of the Late period is divided into three phases: Middle/Late Transition, Phase 1, and Phase 2, which delineate a progressive intensification of localized economic systems and greater distinctions in social ranking. Bennyhoff (1993:298–356) summarized grave-associated artifacts from 284 burials at ALA-329. These, along with 139 burials at Stanford University, produced a remarkably rich assemblage that has facilitated seriation of Augustine pattern artifact forms. This site, along with SCL-38 and SCL-690, established the basis for the illustrations of artifacts representing the South Bay Augustine pattern (figure 13.8).

Middle/Late Transition Period. With the beginning of the Middle/Late Transition, artifact assemblages and burial arrangements show signs of significant social changes. The early years of this period included a transitional interval when burials with earlier Berkeley pattern traits show a greater emphasis on wealth. *Olivella* shell beads gained greater significance, and mixed assemblages of rectangular M1a series sequin, F3a square saddle, and D1 split-punched beads were popularized. Long tubular stone tobacco pipes appeared (with collared mouthpieces as opposed to later flanged forms). The double-pronged bone fish spears (type 003) that were coeval with newly introduced bone and elk antler serrated harpoons were gradually replaced during the subsequent Late phase 1 by the harpoon types represented at SCL-38 and ALA-329 (figure13.8). Edge incised *Haliotis* pendants became popular, particularly circular CA3 and CA5 forms, and the first banjo pendant forms appear.

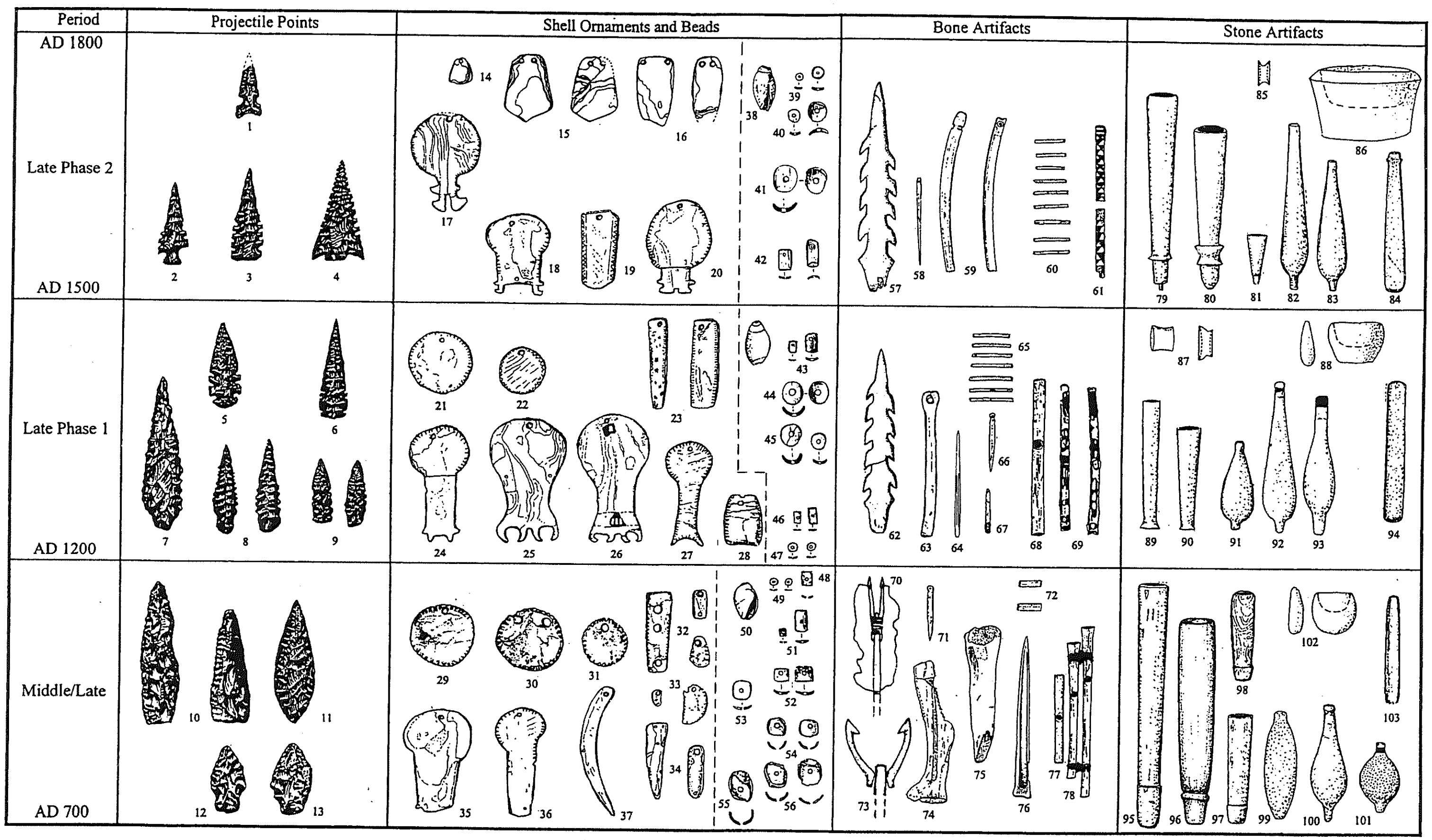
At SCL-690, ^{14}C dates suggest a lengthy occupation during the Middle/Late Transition, accounting for the large number of *Olivella* M1a beads, but also identify a Phase 1 component. The absence of end-perforated rectangular M2a beads, however, suggests that Phase 1 occupation was brief. One adolescent burial (number 24) contained a single lot of nearly 2000 beads of types A1, C7, D1, G1, M1a, and M/F3, along with six *Haliotis* pendants (five BB8a types and one WLj). *Haliotis* pendants were widely distributed in the cemetery, particularly the circular CA3 and CA5 types. Only one individual had three *Haliotis* banjo pendants in association, and these were of an early type N4 form (Gifford 1947). Many burials from SCL-690 were associated with mortars, pestles, manos, pipes, charm stones, scapula saws, elk antler wedges and long, polished bone awls or hairpins. A total of 18 whistles were found with five burials, one of which had at least seven whistles. Obsidian projectile points from North Coast Range sources included thick lanceolate forms with multiple small serrations along the blade margins. Several Stockton serrated obsidian points were also recovered which date to the transition into Phase 1 of the Late period.

Late Period Phases 1 and 2. Elaboration of grave-associated ceremonial regalia mark Phases 1 and 2 as a time of significant social transformation. Bennyhoff and Fredrickson (1994:23) defined the Augustine pattern to include well-shaped mortars and pestles, many of which were very large in size. ALA-329 and SCL-38 produced many "flower pot" shaped mortars that exhibit fine workmanship, and some of these showed *Olivella* G1 bead appliqué on the rims. Tubular, polished stone tobacco pipes changed from collared to flanged mouthpieces (some with bone stem inserts), and charm stones included older piled forms with the addition of new forms with long, tapered proximal ends (figure 13.8). Other traits included greater numbers of small obsidian Stockton serrated points, marking the introduction of bow and arrow technology. Other newly introduced artifact types included Northern



KEY: (*Haliotis* pendants and *Olivella* bead types after Bennyhoff and Hughes 1987): 1- Obsid. lanceolate; 2- Obsid. lanceolate; 3- *Haliotis* CA5j "shield" pendant; 4- *Haliotis* FF5a "shield" pendant; 5- *Haliotis* CA2f pendant; 6- *Haliotis* RB4bf pendant; 7- *Haliotis* E2F3b gorget; 8- *Haliotis* EA3j pendant; 9- *Haliotis* E2A3j pendant; 10- *Haliotis* SC3j pendant; 11- *Haliotis* E2B3j pendant; 12- Mica pendants; 13- *Haliotis* square beads (H4 type after Gifford 1947); 14- *Haliotis* CA2j bead; 15- *Olivella* A1 bead; 16- *Olivella* G2a bead; 17- *Olivella* G5 bead; 18- *Olivella* M/F3 bead; 19- *Olivella* F3b2 bead; 20- *Olivella* F3b bead; 21- Bird bone tube; 22- Atlatl spur; 23- Fish spear; 24- Bird bone whistle; 25-28 Elk bone spatulates; 29- Phylite lanceolate; 30- Pestle; 31- Bi-pitted stone; 32-33 Charmstones (4).

Figure 13.7 Meganos tradition artifact assemblage from ALA-343. *Chart by Mark Hylkema 1998 (Artifacts not drawn to scale).*



KEY (*Haliotis* effigy pendant nomenclature after Gifford [1947], other *Haliotis* and *Olivella* bead types after Bennyhoff and Hughes [1987]):
1- Franc. chert Desert side-notched point, SCL-178; **2**- Obsid. Expanding-stemmed serrate, ALA-329; **3**- Obsid. serrate, ALA-329; **4**- Obsid. serrated triangulate point, ALA-329; **5**- Obsid. Stockton serrate, SCL-690; **6**- Obsid. Stockton serrate, SCL-38; **7**- Obsid. serrated lanceolate, SCL-38; **8**- Obsid. stemmed serrates (2), ALA-329; **9**- Obsid. serrates (2), SCL-690; **10**- Obsid. slightly serrated lanceolates (2), SCL-690; **11**- Obsid. lanceolate, SCL-6; **12**- Franc. chert side-notched point, SCL-690; **13**- Mont. chert contracting-stemmed point, SCL-690; **14-16** *Haliotis* pendants, SCL-30/H Mission Santa Clara; **17**- *Haliotis* N1bIII effigy pendant, ALA-329; **18**- *Haliotis* N6bIII effigy pendant, SCL-38; **19**- Incised *Haliotis* pendant, SCL-38; **20**- *Haliotis* N1bIII effigy pendant, SCL-128; **21**- *Haliotis* CA3a pendant, ALA-329; **22**- *Haliotis* CA3a pendant, SCL-38; **23**- *Haliotis* incised rectangular pendants (2), SCL-38; **24**- *Haliotis* N1bII effigy pendant, ALA-329; **25-26** *Haliotis* N6bIII effigy pendants (2), ALA-329; **27**- *Haliotis* N5 effigy pendant; **28**- Incised *Haliotis* pendant, SCL-690; **29**- *Haliotis* CA3g pendant, SCL-690; **30**- *Haliotis* CA5g pendant, SCL-690; **31**- *Haliotis* CA3h pendant, SCL-690; **32**- *Haliotis* BB1O6, BB8 and FA3h pendants, SCL-690; **33**- *Haliotis* OJ3 and TA3h pendants, SCL-690; **34**- *Haliotis* EB3a and BB8a pendants, SCL-690; **35**- *Haliotis* N1aII effigy pendant, SCL-690; **36**- *Haliotis* N4 effigy pendant, SCL-690; **37**- *Haliotis* crescent (type AP after Gifford 1947), SCL-38; **38**- *Olivella* A1 bead (all sites); **39**- *Olivella* H1a beads, SCL-30/H Mission Santa Clara cemetery; **40**- *Olivella* E2 beads, ALA-329; **41**- *Olivella* E3b beads, ALA-329; **42**- *Olivella* M3 beads, SCL-38; **43**- *Olivella* M2 beads, SCL-38; **44**- *Olivella* E2a beads, ALA-329; **45**- *Olivella* E3 beads, ALA-329; **46**- *Olivella* M1c beads, SCL-38; **47**- *Olivella* G1 beads, ALA-329; **48**- *Olivella* M/F3 beads, SCL-690; **49**- *Olivella* G1 beads, SCL-690; **50**- *Olivella* A1 beads, (all sites); **51**- *Olivella* M1a beads, SCL-690; **52**- *Olivella* M1d beads, ALA-329; **53**- *Olivella* F3a bead, SCL-755; **54**- *Olivella* C7 beads, SCL-690; **55**- *Olivella* D1 beads, SCL-690; **56**- *Olivella* C6 beads, SCL-690; **57**- Serrated antler harpoon, ALA-329; **58**- Batray spine, ALA-329; **59**- Elk rib strigils, SCL-38; **60**- Bird bone beads, SCL-38; **61**- Incised bird bone whistle, SCL-38; **62**- Serrated antler harpoon, SCL-38; **63**- Perforate bone, ALA-329; **64**- Batray spine, SCL-38; **65**- Bird bone beads, ALA-329; **66**- Bone needle, ALA-329; **67**- Bone point with asphaltum, SCL-38; **68**- Whistle, SCL-38: **69**- Whistles with *Olivella* M1a bead appliqu , SCL-38; **70**- Bone tipped fish spear with asphaltum, SCL-690; **71**- Bone needle, SCL-38; **72**- Bone tubes, SCL-690; **73**- Bone fish spear, SCL-1; **74**- Serrated scapula saw, SCL-690; **75**- Antler wedge, SCL-690; **76**- Bone pin, SCL-690; **77**- Whistle, SCL-690; **78**- Whistles adhered together with asphaltum, SCL-690; **79-81** Tobacco pipes, ALA-329; **82-83** Charmstones, ALA-329; **84**- Flanged pestle, ALA-329; **85**- Ear spool, ALA-329; **86**- "Flower pot" mortar, ALA-329; **87**- Ear spools (2), ALA-329; **88**- Mortar and pestle, SCL38; **89-90** Tobacco pipes, ALA-329; **91-93** Charmstones, SCL-38; **94**- Long pestle, SCL-38; **95**- Tobacco pipe, ALA-329; **96**- Tobacco pipe, SCL-690; **97-98** Tobacco pipes SCL-38; **99-100** Charmstones, SCL-690; **101**- Charmstone, SCL-38; **102**- Mortar and pestle, SCL-690; **103**- Long pestle, SCL-690.

Figure 13.8 Southern San Francisco Bay area Augustine pattern artifact assemblages. *Chart illustrated by Mark Hylkema and Glen Wilson 1998 (Artifacts not drawn to scale).*

California style bone and antler harpoons, along with more elaborate *Haliotis* banjo pendant forms (N series; see Gifford 1947:21-23). These traits led Bennyhoff (1994a) to suggest an influx of populations from north of San Francisco Bay following withdrawal of the Meganos culture.

Phase 1 is also marked by combinations of *Olivella* M1a and M2a beads within individual burial lots and greater elaboration of banjo pendant forms. At ALA-329, burial 95 had combinations of M1a and M2a beads along with 11 banjo pendants. *Haliotis* ornaments with V-shaped surface edge incisions also became more popular as evidenced by numerous specimens from ALA-329 and SCL-38. By Phase 2, M2a *Olivella* beads had replaced the M1a sequin type, and some bird bone whistles began to exhibit elaborate geometric designs incised into their surfaces (figure 13.8). Smaller serrated obsidian points with expanding stems may represent the development of sinew backed bows. Some sites contain an occasional Desert side-notched (DSN) point, but these are much less common than serrated types.

Peninsula Coast

Although research on the peninsula was undertaken as early as 1915 at SMA-22 by archaeologists from University of California, Berkeley, serious investigation of local culture history was not completed until 1991 when I reported on results of excavations from a series of sites in Santa Cruz and San Mateo Counties (Hylkema 1991). My work showed that Late Holocene sites maintained a strong affinity with earlier patterns developed during the later stages of the Middle Holocene. Working with a tentative chronology established by Jones and Hylkema (1988), I concluded that a generalized foraging adaptive strategy prevailed throughout the Early and Middle periods. Artifact assemblages showed greatest similarity with sites farther south in the Monterey area, and the only noticeable shift in artifact types (principally projectile points) occurred after AD 1200.

Because of the long use-life of many artifact types and subsistence practices, it is difficult to assign discrete temporal phases to assemblages from sites along the San Mateo and Santa Cruz County Coast. Indeed, the locally manufactured Año Nuevo long-stemmed projectile point (Jones and Hylkema 1988), the most dominant form in this area, can be found throughout the Early, Middle, and possibly Late periods. Similarly, manos and milling slabs, cobble choppers, pitted, grooved, and incised stones (of undetermined function) also exhibit a long duration of use (figure 13.9). Rather than identifying a precise point distinguishing the Early and Middle periods, a gradual replacement and addition of some artifact forms is apparent. The most abundant types during the Early period include Rossi square-stemmed and large side-notched projectile points, and *Olivella* L1 rectangular beads. The last is one of the few reliable Early period markers on the coast. The Middle period is denoted by the appearance of *Olivella* G2 and G3 saucer beads and continued use of contracting-stemmed and Año Nuevo long-stemmed projectile points. Large side-notched and Rossi square-stemmed types disappeared, replaced later in the Middle period by shouldered lanceolates (fig 13.9).

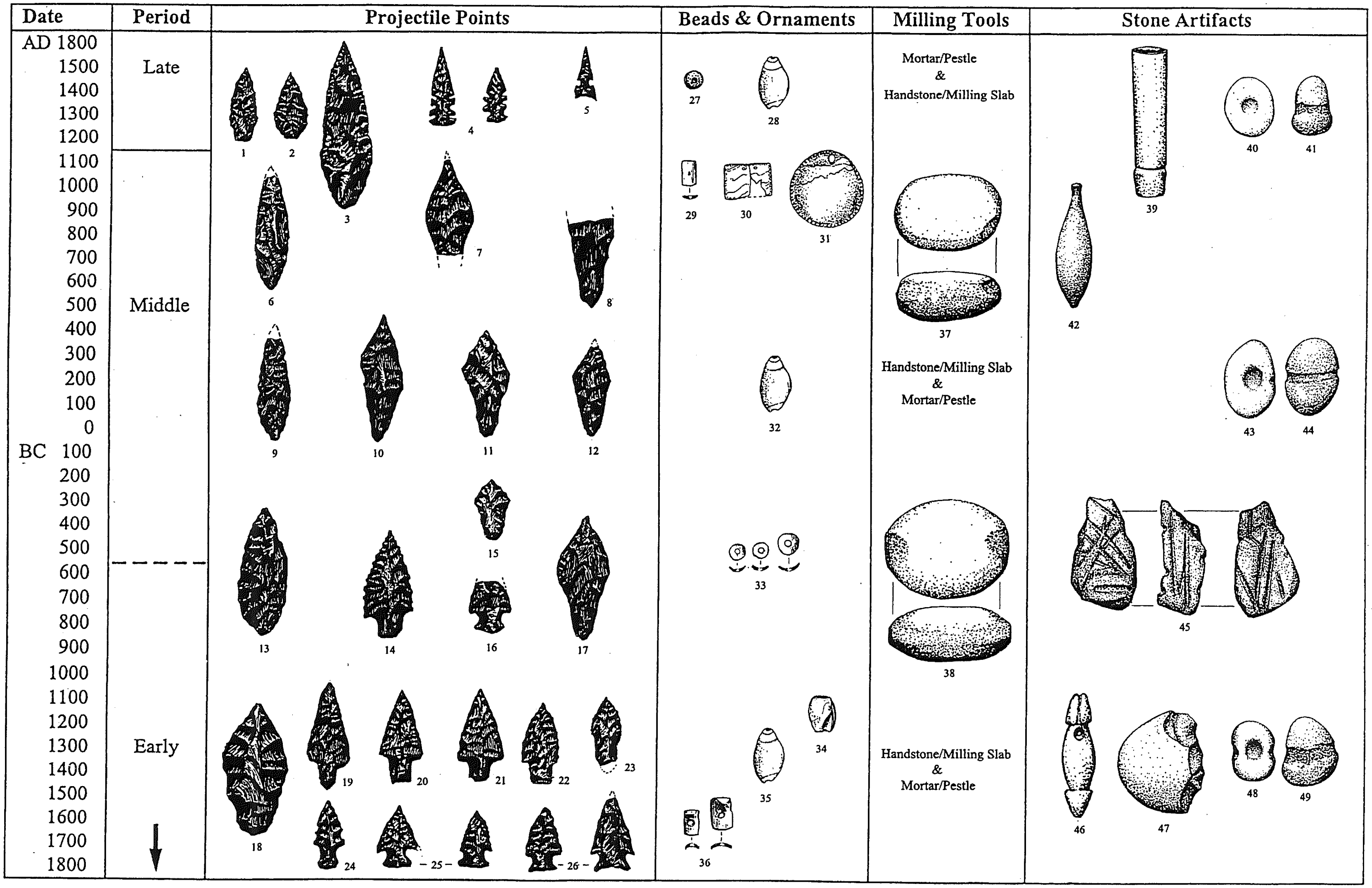
Late period components are less abundant in the peninsula area, but the few identified to date show changes in the assemblage after about AD 1200. Projectile points include examples of the Stockton serrated (inevitably made of obsidian) DSN (commonly made of local Monterey chert) types. At SMA-244, five Stockton serrated points were found associated with numerous talc-schist/steatite disk beads that are also Late period markers. The serrated points, all from the Napa Valley, produced hydration readings between 1.3 and 1.7 microns. Three Stockton serrated points from SCR-20 in the Santa Cruz Mountains, also from the Napa Valley source, produced hydration readings between 1.2 and 1.4 microns. These points were recovered from the same stratigraphic context as the more numerous DSN points. SCR-20 produced 29 DSNs (Roop 1976). In general, Stockton serrated points seem to be more common in the northern peninsula area (San Mateo County), while DSNs dominate in the south.

SMA-125, SMA-204, SMA-244, and SMA-301 produced Stockton serrated points. Of these, SMA-301 produced only one DSN and five Stockton serrated points. The northernmost site producing a substantial number of DSNs is SCR-20, which seems to represents a boundary between the distribution of the two forms. This diffusional boundary appears to extend inland as well, since Stockton serrated points were common at ALA-329, SCL-38, SCL-128, and SCL-690 but are not present in the southern Santa Clara Valley. Conversely, south of SCL-178, DSNs are the dominant type among Late period components. SCL-178 contained one Stockton serrated example (Napa Valley source) and one Monterey chert DSN, while just 8 km south at SCL-106 and SCL-341, 10 chert DSNs were reported but no Stockton serrated (Cartier 1980:39-44).

Although obsidian hydration has been useful in corroborating some aspects of Late period assemblages on the Peninsula Coast, it has not been entirely satisfactory for earlier components. Frequently, obsidian pieces with thin hydration rims are found in older contexts. At SCR-9, for example, 23 Napa Valley obsidian specimens produced readings of 1.8 microns or less, while five ^{14}C dates and a cohesive artifact assemblage suggest occupation between about 900 BC and AD 800.

SETTLEMENT AND SUBSISTENCE

Not surprisingly, the southern San Francisco Bay and Peninsula Coast show varied trajectories of settlement and subsistence change over the Late Holocene.



KEY: 1- Obsid. lanceolate, SMA-97; 2- Obsid. lanceolate, SMA-134; 3- Large obsid. lanceolate, SMA-97; 4- Obsid. Stockton serrates, SMA-244; 5- Mont. chert DSN, SCR-20; 6- Obsid. lanceolate, SMA-97; 7- Mont. chert Ano Nuevo long-stemmed, SMA-97; 8- Mont. chert Ano Nuevo long-stemmed base, SCR-132; 9- Obsid. lanceolate, SCR-9; 10, 11 & 12- Mont. chert Ano Nuevo long-stemmed, SCR-9; 13- Mont. chert lanceolate, SCR-38/40; 14- Franc. chert Rossi square-stemmed, SCR-9; 15- Obsid. Ano Nuevo long-stemmed, SCR-9; 16- Mont. chert corner-notched, SCR-9; 17- Mont. chert Ano Nuevo long-stemmed, SMA-218; 18- Mont. chert Ano Nuevo long-stemmed, SCR-38/40; 19- Mont. chert shouldered contracting-stemmed, SCR-38; 20- Mont. chert Rossi square-stemmed, SCR-7; 21- Franc. chert Rossi square-stemmed, SCR-7; 22- Mont. chert Rossi square-stemmed, SCR-38; 23- Obsid. Ano Nuevo long-stemmed, SCR-9; 24- Mont. chert serrated expanding-stemmed, SCR-7; 25 & 26- Franc. chert corner-notched, SCR-7; 27- Talc-schistose disc bead, SMA-244; 28- *Olivella* A1 bead, SMA-244; 29- *Olivella* M1 bead, SCR-20; 30- Incised *Haliotis* pendant, SMA-238; 31- Incised *Haliotis* circular pendant, SMA-22; 32- *Olivella* A1 bead, SCR-9; 33-*Olivella* G3 and G6 beads, SMA-22, SCR-9 & SMA-218; 34- *Olivella* B2 bead, SCR-38; 35- *Olivella* A1 bead, SCR-38; 36- *Olivella* L1 beads, SCR-93; 37- Handstone, SCR-132; 38- Handstone, SCR-9; 39- Smoking pipe, SCR-117; 40- Bi-pitted cobble, SMA-134; 41- Grooved sinker, SMA-115; 42- Piled charmstone, SCR-132; 43- Bi-pitted cobble, SCR-132; 44- Grooved sinker, SCR-132; 45- Incised sandstone cobble, SCR-9; 46- Perforate charmstone, SCR-93; 47- Cobble chopper, SCR-9; 48- Bi-pitted cobble, SCR-7; 49- Grooved sinker, SCR-38.

Figure 13.9 Artifacts characteristic of Late Holocene coastal sites of San Mateo and Santa Cruz Counties. *Chart by Mark Hylkema 1998 (Artifacts not drawn to scale).*

Southern San Francisco Bay Area

Trends in subsistence through time in the southern Bay Area are reflected by vertebrate and shellfish assemblages, artifacts, and site location patterns. Changes in settlement accompanying the transition from the Middle to the Late period are dealt with at length by Lightfoot and Luby (chapter 14, this volume), while dietary and artifact trajectories are discussed here. Some diachronic trends in the latter are consistent with models of economic intensification in that increased use of smaller, more labor-intensive resources is evident. Others, however, seem to reflect cultural and/or environmental influences.

One of the strongest patterns in the artifactual record is the decline in manos and milling slabs relative to mortars and pestles through the Late Holocene, generally interpreted as a reflection of intensified use of acorns (Hildebrandt 1983). Grass seeds and herbs were not abandoned entirely, however, as ethnohistoric accounts indicate that the "meadow lands" between Coyote Creek and the Guadalupe River was an area where Native people collected herbs and grass seeds (Milliken 1991:132-134). Also in the 1770s, Spanish explorers frequently were provided with gifts of "black-colored tamales" made from grass seeds (Stanger and Brown 1969).

Acorns were abundant in the oak woodland habitats of the South Bay, but their seasonal availability and storage requirements would have constrained group mobility during winter months (Basgall 1987). In locations like the Santa Clara Valley, where oak groves were well established, acorns were readily gathered during the fall season and stored in granaries (Harrington 1942). Communal acorn storage and redistribution probably involved the organization of social institutions with ranked membership and the delineation of leadership roles (Bean and Lawton 1976:v-xlvii; Bean and Blackburn 1976). The numerous mortars and pestles from Middle and Late period bay shore and valley sites, often in association with burials, attest to the value people of this region placed on acorns. At SCL-690, mortars were inverted over the heads of two female burials, five burials had pairs of very long pestles (averaging 50 to 60 cm long), while eight others had short pestles with mortars alongside (four burials had manos, one of which, burial 7, also had a milling slab).

Archaeological findings show that a variety of other plant resources was exploited as well, including grass and cattail seeds and hazel nuts (table 13.3). Botanical residues obtained from a rock feature at SCL-178 showed that soaproot (*Chlorogalum pomeridianum*) bulbs were also important in the diet. Ethnographic accounts indicate that these bulbs required roasting in an earth oven for over 36 hours to become edible (Barrett and Gifford 1933:139; Bolton 1926:423; Harrington 1942; Heizer 1941:43-44). The ovens used for roasting were made of large numbers of fist-sized cobbles. The extensive layers of burned rocks reported at many Bay Area sites (for example, SCL-178, SCL-690, and SCL-732) may reflect this function.

Shellfish exploitation also shows evidence of change through time. Most southern bay mounds show horn snail (*Cerithidea californica*), oyster (*Ostrea lurida*), and bay mussel (*Mytilus trossulus*) as the principal dietary shellfish. Sites along the west bay shore of San Mateo County and the east bay shore of Alameda County record greater emphasis on bay mussels, oyster, and clams (*Macoma nasuta, Tivela stultorum*). Several of the large shell mounds from both the west and east bay shore margins reveal temporal changes in target species in the same site (Gerow 1968; Gifford 1916; Greengo 1951, 1975; Nelson 1909, 1910; Schenk 1926; Uhle 1907; and others). East Bay sites with stratified components dating to the Middle and Middle/Late Transition periods typically contain a deeper deposit of oysters overlain by layers of clams. In contrast, Early and Middle period sites along the west bay shore contain deeper deposits, with horn snails replacing oysters in upper levels dating from the Middle/Late Transition to Late period. In the South Bay, Cartier, Bass, and Ortman (1993:168-171) found that sites predating the Middle/Late Transition contained greater volumes of mussel, while later sites showed increased frequencies of horn snails. Horn snails are a tiny, labor intensive resource with very low dietary value. Their exploitation may reflect their seasonality as they are optimal during summer months when mussels are not safe to eat (Schoenherr 1992:678).

Middle period Berkeley pattern sites show an emphasis on tidal marsh and oak woodland settings. It is unclear whether this dichotomous pattern is a reflection of seasonal residential relocation or coexistence of two discrete adaptive modes. Cartier, Bass, and Ortman (1993) suggested that the pattern reflects alternating exploitation of fresh water marshes and brackish water tidal marshes.

Vertebrate remains also suggest economic intensification from the Middle through Late periods, with some equivocal patterns. Early and Middle period sites show high frequencies of canid (dog, wolf, or coyote), elk, and deer bones, with lesser amounts of sea otter (table 13.4) (Simons 1992:73–103). Conversely, during the Late period, there is a substantial decline in canid and elk bones and an increase in sea otter bones. The contribution of deer relative to elk is high during the Early period, declining during the Middle period and rising again during the Late period. The declines in elk and increase in otter are consistent with intensification, but the apparent rebound in deer during the Late period, as reflected by findings from ALA-328 and SCL-38, is somewhat antithetical to intensification. Simons (1992:88) suggested that shifting of target species was likely caused by "interannual unpredictability due to short-term climatic events, and resource depression resulting from over hunting of other marine (that is, pinnipeds) and terrestrial (that is, artiodactyls)

Table 13.3 Comparative floral species from features at SCL-690 and SCL-732

COMMON NAME	TAXON	SCL-732	SCL-690	PART IDENTIFIED	USE
Brome grass	*Bromus* sp.	+	+	u-s	S
Filaree*	*Erodium* spp.	+		u	
Bedstraw	*Galium* sp.		+	s	
Needlegrass	*Stipa* sp.	+		u	
Pigweed	*Amaranthus* sp.	+	+	u	
Purslane	*Portulaca* sp.	+		u	
Thistle	*Cirsium* sp.	+		u	
Wild geranium	*Geranium* sp.	+		u	
Bluegrass	cf. *Posa* sp.	+		s	S?
Fescue grass	*Festuca or Vulpia* sp.		+	s	S
Borage	*Amsinka-Cryptantha-Plagiobothrys*	+		s	
Chia	*Salvia* spp.	+		s	S
Clover	*Trifolium* sp.	+		s	G
Deer vetch	*Lotus* sp.	+	+	s	G
Dock*	*Rumex* sp.	+		u-s	G
Lupine	*Lupinus* sp.	+	+	s	G
Miner's lettuce	*Claytona perfoliata*	+		u-s	G
Miner's lettuce	*Montia perfoliata*		+	s	G
Cattail/tule	*Typha-Cyperus-or Scirpius*	+	+	r-m	R-P-G-U
Spanish clover	*Lotus* cf. *Pushianus*	+		s	G
Farewell-to-spring	*Clarkia* sp.	+		s	S
Maygrass	*Phalaris* sp.	+	+	s	S
Bentgrass-type	*Agrostis or Muhlenbergia* sp.	+	+	s	S
Goosefoot	*Chenopodium* sp.	+	+	s	S-G
Large goosefoot	*Chenopodium* cf. *Berlanieri*		+	s	S-G
Hairgrass	*Deschampsia* sp.	+	+	s	S
Lovegrass	*Eragrostis* sp.	+		s	S
Reedgrass-type	cf. *Calamagrostis* sp.	+	+	s	S
Ryegrass	*Elymus* sp.	+	+	s	S
Tarweed	*Madia or Hemizonia*	+	+	s	S
Wild buckwheat	*Eriogonum* sp.	+	+	s	S-M
Willow	*Salix* sp.		+	w	W-U
Hazelnut	*Corylus cornuta var. californicum*	+	+	s	N-W
Valley oak	*Quercus lobata*	+	+	s-w	N-U-W
Live oak	*Quercus wislizenii or agrifolia*	+	+	s-w	N-U-W
Cottonwood	*Populus* spp.	+	+	w	W
Sycamore	*Platanus racemosa*		+	w	W
Pine	*Pinus* sp.		+	w	W
Coyote brush	*Baccharis pilularis var. consanguinea*	+		w	W
Manzanita	*Arctostaphylos* sp.	+		w	F-W
Saltbush-type	*Atriplex*	+		w	S-W
Sumac family	*Rhus* sp.	+		w	U-M
Toyon	*Heteromeles arbutifolia*	+		w	F-W

cf. = compares favorably to; G=edible greens; * =some species native; M=medicinal; r =rhizome fragment; N= edible nut; u = uncarbonized seed; P= edible pollen; s =carbonized seed; R= edible root; m = miscellaneous parts; S= edible seeds; w = wood charcoal; U= utilitarian (fiber, basketry); F = edible fruit; W = wood; + = present
Sources: Miksicek (1993b), personal notes of author

mammals." He also proposed that increased human population pressure during the Late period may account for a greater focus on estuarine habitats around the bay, necessitating a co-harvesting strategy emphasizing predation of sea otters and deer along with waterfowl and fish. Simons concluded that deer served as a secondary alternative to sea otters when the latter became less available during brief episodes of depletion. Faunal remains from Late period site SCL-38 show that elk and deer continued to dominate some assemblages (table 13.5), although this site was 15 km from the bay shore. Also antithetical to intensification is the high frequency of rabbit bones in a Middle/Late Transition component at SCL-690. The high frequency of this low ranking resource and extremely low representation of deer and elk could reflect dry

Table 13. 4 Comparative percentages of economically significant species from South Bay and valley sites

		ALA-328	ALA-328	SCL-690	ALA-329	SCL-38
COMMON NAME	TAXON	MIDDLE	LATE	MIDDLE/LATE	LATE	LATE
Dog/wolf/coyote	*Canis* sp.	31.6	11.8	4.2	7.8	4.6
Elk	*Cervus nannodes*	19.8	4.9	3.1	3.0	20.5
Deer	*Odocoileus hemionus*	19.8	10.6	19.5	24.7	12.1
Pronghorn	*Antlicapra americana*	1.8	0.7	5.5	2.5	1.3
Rabbits	Lagomorphs	0.0	0.0	43.0	0.0	7.0
Sea otter	*Enhydra lutris*	16.7	58.8	0.0	41.1	7.8
Harbor seal	*Phoca vitulina*	3.7	5.6	0.0	3.0	0.0
Miscellaneous other		6.6	7.6	24.7	17.9	46.7*
TOTAL		100.0	100.0	109.0	100.0	100.0

*Includes 21.6% avian and 19.9% unidentified "large herbivore" remains.
Sources: Bellifemine (1997); Simons (1992); Hylkema (n.d.).

Table 13.5 Faunal assemblage from SCL-38

COMMON NAME	TAXON	NISP	%	WEIGHT (G)
Grizzly bear*	*Ursus horribilus*	4	0.8	222.0
Black bear	*Ursus americanus*	2	0.4	45.4
Tule elk*	*Cervus nannodes*	105	20.5	3735.7
Black-tailed deer	*Odocoileus hemionus*	62	12.1	1941.3
Pronghorn	*Antilocapra americana*	7	1.4	201.1
Large herbivore	Artiodactyla	105	20.5	1781.3
Mountain lion	*Felis concolor*	1	0.2	2.1
Raccoon	*Procyon lotor*	2	0.4	9.6
Gray fox	*Urocyon cinereoargenteus*	2	0.4	10.1
Coyote	*Canis latrans*	6	1.2	42.7
Dog/wolf/coyote	*Canis* sp.	18	3.5	108.6
Rabbit	*Sylvilagus bachmanii*	6	1.2	7.2
Jackrabbit	*Lepus californicus*	37	7.2	79.2
Bobcat	*Lynx rufus*	1	0.2	11.3
Skunk	*Mephitus mephitus*	2	0.4	7.6
California sea lion	*Zalophus californianus*	1	0.2	7.5
Sea otter	*Enhydra lutris*	40	7.8	571.2
Goose	*Chen* sp.	50	9.8	112.0
Duck	*Anas* sp.	9	1.8	19.5
Geese/ducks	*Anseriformes*	1	0.2	5.0
Crane	*Grus* sp.	20	3.9	272.4
Hawk	*Buteo* sp.	23	4.5	63.0
Eagle	*Aquila* sp.	1	0.2	2.2
Loon	*Gavia* sp.	3	0.6	5.0
Pelican	*Pelicanus* sp.	2	0.4	4.8
Western grebe	*Aechmorphus occidentalis*	1	0.2	0.1
Cormorant	*Phalacrocorax* sp.	1	0.2	2.2
TOTAL		512	100.0	9,270.1

* Other elements from articulated grizzly bear and elk burial features were not included in this summary to avoid bias of the comparative effort.
NISP= Number of identified specimens. Source: Bellifemine 1997

conditions associated with the Medieval Climatic Anomaly (see chapter 12, this volume).

Peninsula Coast

In tandem with temporal changes in artifact types, subsistence patterns on the Peninsula Coast show strong continuity from the Early through Middle, and many changes from the Middle through Late periods (after AD 1200). Volumetrically controlled faunal assemblages from Early and Middle period sites suggest a generalized hunting adaptation that included both terrestrial and marine mammals (table 13.6) but with a terrestrial emphasis (table 13.7). During the Late period, a significant decrease in terrestrial game is evident (table 13.8), along with a concurrent increase in marine species (particularly sea otters) and birds.

Table 13.6 Early and Middle period vertebrate faunal remains from San Francisco Peninsula coastal sites*

COMMON NAME	TAXON	SCR-93 (1.1 M³)		SMA-218 (3.8 M³)		SCR-9 (6.0 M3)		SCR-132 (4.0 M³)	
		N	Wt (g)	N	Wt (g)	N	Wt (g)	N	Wt (g)
Terrestrial mammals									
Grizzly bear	*Ursus horribilus*	0	0	2	19.9	5	11.9	0	0
Tule elk	*Cervus nannodes*	3	36.2	1	2.2	23	605.1	0	0
Black-tailed deer	*Odocoileus hemionus*	41	220	20	131.4	499	2458.2	12	62.1
Large herbivore	Artiodactyla	0	0	0	0	1	1.8	0	0
Mountain lion	*Felis concolor*	0	0	0	0	2	11.9	0	0
Dog/coyote	*Canis* sp.	0	0	0	0	6	21.1	2	2
Rabbit	*Sylvilagus bachmanii*	13	4.9	26	16.3	0	0	2	0.6
Jackrabbit	*Lepus californicus*	2	12	0	0	0	0	0	0
Bobcat	*Lynx rufus*	0	0	0	0	4	14.1	0	0
Gray squirrel	*Sciurus griseus*	0	0	0	0	0	0	2	0.4
Gopher	*Thomomys bottae*	0	0	30	10.8	0	0	15	12.2
Skunk	*Mephitus mephitus*	0	0	0	0	55	20.2	0	0
SUBTOTAL		59	273.1	79	180.6	595	3144.3	33	77.3
Marine mammals									
Northern fur seal	*Callorhinus ursinus*	2	2.2	142	752.4	13	35.1	1	27.2
California sea lion	*Zalophus californianus*	1	28	0	0	2	4.9	1	40.4
Stellar sea lion	*Eumetopias jubatus*	0	0	0	0	0	0	1	39
Harbor seal	*Phoca vitulina*	0	0	1	3.4	11	60.6	3	10.4
Sea otter	*Enhydra lutris*	6	10.5	5	6.4	2	2.8	3	5
SUBTOTAL		9	40.7	148	762.2	28	103.4	9	122
Other									
Birds	Aves	4	8.8	21	26.3	50	24.7	3	0.8
Fish	Ichthys	396	37.8	46	10.5	21	3.6	8	1.5
Unidentifiable		1343	758	2277	1652.3	8171	6268.8	111	106.8
TOTAL		1811	1118.4	2571	2631.9	8865	9544.8	164	308.4

* Bone specimens derived from volumetrically controlled excavations (expressed as m3). Cetaceae and most Rodentia not included.

On the east side of the Santa Cruz Mountain ridge crest, SMA-204, SMA-125, and nearby SMA-147 represent Middle/Late and Late period upland sites, where the occupants successfully integrated both coastal and bay resources into the local economy (Bocek 1987; Galloway 1976; Salzman 1984). On the west side, within the upland meadows interspersed along Ben Lomond Ridge above Santa Cruz, archaeological deposits do not reveal any reliance on interior bay resources. Two large residential sites, SCR-9 and SCR-20 (Hylkema 1991; Roop 1976), yielded substantial volumes of deer and elk bone, and dense shell lenses (predominantly California mussel) together with artifacts and burials in deeply stratified deposits. Evidently, upland meadow habitats were important to the coastal subsistence economy throughout the Middle and Late periods. It is likely that the meadows concentrated terrestrial game into narrow resource patches, and repetitive seasonal use of the uplands accounts for the substantial midden depths of these sites. At SCR-9, infant and juvenile deer bones dominated the faunal assemblage, suggesting that seasonal foraging in the uplands took place during the summer months (Ingles 1979:428). In contrast, at contemporaneous SMA-218 abundant adult and juvenile northern fur seal bones point to winter occupation of the coastal terrace.

Throughout the Early, Middle, and Late periods, milling tool assemblages included mixed sets. SCR-9, an upland Middle period site, produced 21 mortars or pestles and 19 manos or milling slabs. Late period sites on coastal terraces, SMA-118 and SMA-134, produced five manos, while SMA-97 produced seven mortars and pestles and one milling slab. The rugged terrain and dispersal of oak forest seem to have effectively constrained access to acorns (Hylkema 1991:40–46). Sporadic distributions of bedrock mortar milling stations along the upper ridgelines and slopes of the interior Santa Cruz Mountains attest to the laborious extremes that coastal people underwent to add acorns to their diet. Botanical residues derived from oven features at SCR-38 (Middle period) (Miksicek 1993) and SMA-134 (Late period) (Miksicek 1998) provide evidence for exploitation of a variety of other economically useful plants (table 13.9). A greater variety of taxa was represented at SCR-38.

Table 13.7 Comparative percentages of vertebrate remains from Early/Middle and Late period coastal sites

COMMON NAME	TAXON	EARLY/MIDDLE PERIOD* (13.9 M³)		LATE PERIOD** (47.5 M³)	
		N	%	N	%
Terrestrial mammals					
Grizzly bear	*Ursus horribilus*	7	0.7	0	0
Tule elk	*Cervus nannodes*	27	2.7	8	1.2
Black-tailed deer	*Odocoileus hemionus*	572	58.2	65	9.4
Large herbivore	*Artiodactyla*	1	0.1	16	2.3
Mountain lion	*Felis concolor*	2	0.2	0	0
Raccoon	*Procyon lotor*	0	0	1	0.1
Gray Fox	*Urocyon cinereoargenteus*	0	0	1	0.1
Dog/coyote	*Canis* sp.	8	0.8	7	1
Rabbit	*Sylvilagus bachmanii*	41	4.2	48	7.0
Jackrabbit	*Lepus californicus*	2	0.2	0	0
Bobcat	*Lynx rufus*	4	0.4	9	1.3
Gray squirrel	*Sciurus griseus*	2	0.2	0	0
Gopher	*Thomomys bottae*	45	4.6	2	0.3
Skunk	*Mephitus mephitus*	0	0	4	0.6
SUBTOTAL		711	72.3	161	23.4
Marine mammals					
Northern fur seal	*Callorhinus ursinus*	158	16.1	41	5.9
Southern fur seal	*Arctocephalus townsendi*	0	0	1	0.1
Fur seal		0	0	29	4.2
California sea lion	*Zalophus californianus*	4	0.4	38	5.5
Stellar sea lion	*Eumetopias jubatus*	1	0.1	12	1.7
Sea lion		0	0	22	3.2
Harbor seal	*Phoca vitulina*	15	1.5	99	14.4
Sea otter	*Enhydra lutris*	16	1.6	158	23.0
SUBTOTAL		194	19.7	400	58.1
Other					
Birds	Aves	78	7.9	127	18.5
TOTAL		983	99.9	688	100

* Early/Middle period sites: SCR-93, SMA-218, SCR-9, and SCR-132.
** Late period sites: SMA-97, SMA-134, SMA-244, SMA-118, and SMA-115.

Shellfish assemblages show remarkable consistency through time. California mussels dominate assemblages from Middle period sites SCR-38, SCR-9, SCR-132, and SMA-218, as well as Late period sites SMA-97, SMA-115, and SMA-244. Exceptions to this pattern included Late period sites SMA-118 and SMA-134, which showed higher frequencies of turban snails. For the most part, the overall contribution of mollusks to the diet seems to have remained constant over time (Hylkema 1991, 1998).

In conflict with the overall diachronic pattern are findings from SMA-218 where a large volume of marine mammal remains was recovered from an Early/Middle period context. Of particular note was the high frequency of northern fur seal bones (48% of the identifiable bone, 77% by weight). These remains are particularly interesting in light of the present day restriction of this species to pelagic settings (Hylkema 1991:291–292). During their migrations, females and pups generally remain 10 to 50 miles off the Central California Coast (Ingles 1979:401). Evidence of sophisticated maritime technology needed to hunt these animals at sea is lacking, and several authors have suggested that these animals may have had more of an onshore presence in the past (Burton 2000; Hildebrandt and Jones 1992; Jones and Hildebrandt 1995). Some northern fur seal bones were recovered from Late period sites SMA-97, SMA-115, SMA-118, and SMA-134 (and even SMA-204 on the bay side of the peninsula), but they clearly are less abundant than in Middle period contexts. Late period sites show much higher frequencies of sea otter and harbor seal, consistent with the overexploitation model Hildebrandt and Jones (1992) proposed.

PORTENTS OF COMPLEXITY: WEALTH AND INTERGROUP RELATIONS

Ethnohistoric sources, while limited and incomplete, show definite signs of incipient complexity among the Ohlone

Table 13.8 Late period vertebrate faunal remains from San Francisco peninsula coastal sites

COMMON NAME/TAXON		SMA-97 (4.2 M3)		SMA-134 (20.2 M3)		SMA-244 (2.75 M3)		SMA-118 (14.8 M3)		SMA-115 (5.5 M3)	
		N	WT (G)	N	WT (G)	N	WT (G)	N	WT (G)	N	WT (G)
Terrestrial mammals											
Tule elk	*Cervus nannodes*	2	23.2	0	0	0	0	1	20.9	5	69.5
Black-tailed deer	*Odocoileus hemionus*	24	313.8	11	105.4	17	69.6	3	131.9	10	99.3
Large herbivore	Artiodactyla	1	2.8	0	0	0	0	5	31.8	9	74.6
Raccoon	*Procyon lotor*	0	0	0	0	1	0.6	0	0	0	0
Gray fox	*Urocyon cinereoargenteus*	0	0	0	0	1	0.4	0	0	0	0
Dog/coyote	*Canis* sp.	3	5.3	1	2.6	0	0	1	1.9	2	23.1
Rabbit	*Sylvilagus bachmanii*	27	38.3	0	0	11	7.7	2	0.8	8	3.4
Bobcat	*Lynx rufus*	0	0	0	0	1	1	3	3	5	3.9
Gopher	*Thomomys bottae*	0	0	0	0	2	0.6	0	0	0	0
Skunk	*Mephitus mephitus*	2	3.3	0	0	2	2.7	0	0	0	0
SUBTOTAL		59	386.7	12	108	35	82.6	15	190.3	39	273.8
Marine mammals											
Northern fur seal	*Callorhinus ursinus*	24	217.8	14	114.1	1	1.4	1	14.8	1	4.1
Southern fur seal	*Arctocephalus townsendi*	0	0	0	0	0	0	1	11.4	0	0
Fur seal		0	0	0	0	0	0	27	253.6	2	10.2
California sea lion	*Zalophus californianus*	7	85.5	26	192.4	0	0	3	86.8	2	28.8
Stellar sea lion	*Eumetopias jubatus*	0	0	5	38.8	0	0	0	0	7	71.1
Sea lion		0	0	4	22.6	0	0	0	0	18	47.4
Harbor seal	*Phoca vitulina*	9	64.9	8	40	0	0	80	541	2	13
Sea otter	*Enhydra lutris*	8	18.3	65	187.4	1	11.8	9	16.3	55	347.4
SUBTOTAL		48	386.5	122	595.3	2	13.2	121	923.9	87	522
Other											
Birds	Aves	26	10.2	36	34.2	3	1.6	20	30	42	71.7
Fish	Ichthys	90	29.1	360	94.1	40	13.4	0	0	0	0
Unidentifiable		397	456.1	1011	1119.9	158	84.3	NA	643	NA	NA
TOTAL		620	1268.6	1541	1951.5	238	195.1	156+	1787.2	168+	867.5+

* Bone specimens derived from volumetrically controlled excavations (expressed as m3). Cetaceae and most Rodentia not included.
NA = not available.

people of the southern bay and peninsula. Social organization included lineages and moieties, warfare was common, war leaders had considerable political authority, mobility was low, and population densities were high in some areas (Harrington 1942; Levy 1978). The power of chiefs in regard to war activities comes through repeatedly in early historic accounts. A description by Father Vicente Santa Maria in AD 1775 is typical:

> There was an authority over all these Indians whose kingly presence marked his eminence above the rest. Our men made a landing, and when they had done so the Indian chief addressed a long speech to them....After the feast, and while we were having a pleasant time with the Indians, our men saw a large number of heathen approaching all armed with bows and arrows. It was a frightening sight to those of the longboat, the Indians' advantage for an attack was so great and the resistance so slight that could be made....This fear obliged the sailing master to make known by signs to the Indian chieftain the misgivings they had in the presence of so many armed tribesmen. The Themi, understanding what was meant, at once directed the Indians to loosen their bows and put up all their arrows, and they were prompted to obey. The number of Indians who had gathered together was itself alarming enough. There were more than four hundred of them, and all, or most of them were of good height and well built. (Galvin 1971:12)

Most sources suggest that chiefly power was limited to individual villages or lineages, but an AD 1775 description by Fages suggests the presence of paramount chiefs and political hierarchy:

> Besides their chiefs of villages, they have in every district another one who commands four or five subordinate villages together, the village chiefs being his subordinates. Each of

> them collects every day in his village tribute which the Indians pay him in seeds, fruits, game, and fish.... The subordinate captain is under obligation to give his commander notice of every item of news or occurrence, and to send him all offenders under proper restraint, that he may reprimand them and hold them responsible for their crimes.... Everything that is collected as the daily contribution of the villages is turned over to the commanding captain of the district, who goes forth every week or two to visit his territory. The villages receive him ceremoniously, make gifts to him of the best and most valuable things they have, and they assign certain ones to be his followers and accompany him to the place where he resides. (1937:73–74)

Another account indicates the presence of female leaders who controlled dances, the dance house, and all dance-related activities (I. Kelley 1991). The archaeological record shows increasing interest in individual wealth over time, increasing inequality in the distribution of wealth items, and signs of intergroup conflict. These developments are manifested in mortuary findings from the southern Bay Area and shifts in the importance of shell as an export commodity on the peninsula.

Southern San Francisco Bay Area

During the Early period, wealth does not seem to have been a factor in Native economies. Most burials from Early period sites, SCL-354 and SMA-77, lacked grave-associated artifacts, and those that retained grave goods showed ideotechnic kinds of objects. For example, at SCL-354, one individual was interred with three perforated grizzly bear fibula, while another had 12 identically made perforated charm stones (phallic type V; Beardsley 1954:114). One burial produced over 100 *Olivella* G3b beads. At SCL-354, differential treatment of some individuals suggests that markers indicating special statuses in society (for example, shaman or headman) were transmitted to the grave, but the accrual of great wealth and emblems reflecting special positions were not evident. This pattern is seen in lower Middle period cemeteries at SCL-102 and SCL-137, where very few graves had associated artifacts, again suggesting a fairly egalitarian social structure.

At SCL-732, another lower Middle period cemetery, 9% of graves were accompanied by *Olivella* saucer beads (for a combined total of only 1033 beads), and only 5% were associated with *Haliotis* pendants. Beads were not restricted to adults; a child of five to six years of age (burial 16) was interred with 443 *Olivella* G2 beads, 43% of the beads from this site. As noted earlier, one adult stood out as a person of special status: burial 35 had 6 limpet shell ring ornaments, more than 16 abalone ring pendants, 34 *Olivella* saucer beads, and a bird bone whistle (Cambra et al. 1996).

During the upper Middle period, a slight increase in the number of individuals with grave goods is evident, and more items are found in individual graves. At SCL-300/302, nearly 40% of the burials contained *Olivella* beads, over 21% contained *Haliotis* pendants, and over 14% contained obsidian tools. Only two individuals had substantial numbers of items. Burial 6, an adult male, was associated with 2219 beads and 17 pendants (Cartier, Bass, and Ortman 1993). Burial 7 from a previous investigation (Ogrey et al. 1981) was a single adult female interred with 3095 *Olivella* beads. Several other individuals with beads and pendants bring the site total to approximately 5700 *Olivella* beads and 25 *Haliotis* pendants. SCL-755, another upper Middle period grave site, showed similar patterns. A total of 48% of 25 burials produced *Olivella* beads (385 beads total), but the beads only averaged 32 per individual. Similarly, while 20% had *Haliotis* ornaments (18 specimens total), ten were from a single burial (number 3a). The patterns manifested in these recently reported burial assemblages from interior sites are similar to those shown at the large bayshore mounds investigated several decades ago. Relatively few burials from ALA-328, for example, exhibited qualities that might indicate an emphasis on wealth and greater social differentiation beyond the occasional shaman or head man.

Although many objects, such as feathers, cordage, and fancy basketry, described in the ethnographic record were associated with wealth and prestige, they are not preserved in the archaeological record. Consequently, interpretations of accrued wealth based solely on artifacts of shell, bone, and stone are likely to include false interpretations. Despite the absence of perishable wealth items, the increased use of shell beads, an accepted marker of wealth, blossomed during the Late period to a degree not previously seen (Milliken and Bennyhoff 1993; table 13.10). ALA-329, SCL-38, and SCL-690 produced large volumes of *Olivella* beads from mortuary contexts, and the ratios of beads per burial suggest that wealth was widespread during the Middle/Late Transition. At SCL-690, where 125 burials were recovered, an explosion in funerary artifacts is evident, particularly in the number of shell beads per individual (table 13.10). Over 76% of the burials had *Olivella* beads, and 22% had *Haliotis* pendants. The average yield of beads per grave was 263 (Milliken and Bennyhoff 1993:383). Eight graves from this site were among the 29 richest burials in Central California as inventoried by Milliken and Bennyhoff (1993). The distribution of beads was not gender or age specific; females and males received them, as did several juvenile burials. Evidence of ascribed ranking in the distribution of individuals within the cemetery was lacking, and bead wealth was shared among the many.

During Late period Phases 1 and 2 as represented at SCL-38, large bead lots are associated with fewer individuals,

Table 13.9 Comparative floral species from the Middle (SCR-38) and Late (SMA-134) periods

COMMON NAME	TAXON	SCR-38	SMA-134	PART IDENTIFIED	USE
Pigweed	*Amaranthus* sp.	+		u	
Pickle-weed type	*cf. Salicornia* sp.	+		s	S
Bluegrass	*cf. Posa* sp.	+		s	S?
Fescue grass	*Festuca or Vulpia* sp.	+		s	S
Chia	*Salvia* spp.	+		s	S
Clover	*Trifolium* sp.	+		s	G
Deer vetch	*Lotus* sp.	+		s	G
Lupine	*Lupinus* sp.	+		w-s	G-W
Miner's lettuce	*Claytona perfoliata*	+		u-s	G
Cattail/tule	*Typha-Cyperus-or Scirpius*	+		r-m	R-P-G-U
Spanish clover	*Lotus cf. Pushianus*	+		s	G
Monocot fiber	*cf. Chlorogalum pomeridianum*	+		m	R-U
Native barley	*Hordeum brachyantherum-type*	+		s	S
Farewell-to-spring	*Clarkia* sp.	+		s	S
Maygrass	*Phalaris* sp.	+		s	S
Bentgrass-type	*Agrostis or Muhlenbergia* sp.	+	+	s	S
Goosefoot	*Chenopodium* sp.		+	s	S-G
Hairgrass	*Deschampsia* sp.	+		s	S
Reedgrass-type	*cf. Calamagrostis* sp.	+		s	S
Panic Grass	*Panicum* sp.		+	s	S
Ryegrass	*Elymus* sp.	+		s	S
Tarweed	*Madia or Hemizonia*	+		s	S
Chamise	*Adenostoma fasciculatum*	+		s	S
Coyote tobacco	*Nicotiana* sp.	+		s	M
Sunflower family	Asteraceae		+	w	S
Buckthorn family	*Ceanothus or Rhamnus*		+	w	
Nightshade	*Solanum* sp.	+		s	M-U
Elderberry	*Sambucus mexicana*	+	+	u-s	F
Willow	*Salix* sp.	+	+	w	W-U
Hazelnut	*Corylus cornuta var. californicum*	+		s	N-W
Cypress	*Cupressus* sp.	+	+	w	W
Live oak	*Quercus wislizenii or agrifolia.*	+		s-w	N-U-W
Madrone	*Arbutus menziesii*	+		w	F-W
California bay	*Umbelluria californica*	+	+	w	N-M-W
Pine	*Pinus* sp.	+		w	W
Coyote brush	*Baccharis pilularis var. consanguinea*	+		w	W
Coastal sage	*Salvia* sp.	+		w	S-M-W
Manzanita	*Arctostaphylos* sp.	+		w	F-W
Coffeeberry	*Rhamnus* sp.	+		s-w	F-M-W
Coralline algae	*cf. Bossiella aborigiana*	+		m	U-M
Grass stems	Poaceae	+		m	U
Redwood	*Sequoia sempervirens*	+	+	w	W

cf = compares favorably to; G = edible greens; r = rhizome fragment; M = medicinal; u = uncarbonized seed; P = edible pollen; s = carbonized seed; R = edible root; m = miscellaneous parts; S = edible seeds; w = wood charcoal; U = utilitarian (fiber, basketry, etc.); F = edible fruit; W = wood.
Source: Miksicek (1993a, 1998)

Table 13.10 Comparative numbers of Late Holocene grave-associated shell beads and ornaments from southern San Francisco Bay sites

PERIOD	SITE	BURIALS	% w/*OLIVELLA*	BEADS/CEMETERY	% w/HALIOTIS	HALIOTIS /CEMETERY
Late Phases 1, 2	ALA-329	284*	42	43,179	19	288
Late Phases 1, 2	SCL-38	244	37	30,247	25	575
Middle-Late	SCL-690	125	76	32,875	22	165
Upper Middle	ALA-343	75	45	3,123	29	139
Upper Middle	SCL-755	25	48	385	20	18
Upper Middle	SCL-131	64	0	0	0	0
Lower Middle	SCL-137	88	17	1,516	1	1
Lower Middle	SCL-732	102	9	1035	5	24
Early	SMA-77	44	38	2726	34	63

* Sample includes materials housed only at San Jose State University; Stanford University collection not included.

suggesting some measure of socioeconomic inequality. Many Late period sites also produced burials with bundles of whistles. SMA-125 produced 164 whistles from among 46 burials; one individual had 127 (Morejohn and Galloway 1983). This site also produced large numbers of *Haliotis* CA3 and CA5 pendants, a form that frequently co-occurs with *Haliotis* banjo pendants. The extensive geographic distribution of such distinctive artifact types strongly suggests a shared system of cultural values. These traits and their association within mortuary contexts appear to be associated with an emerging differentiation of societal membership institutions like those described for ethnographic groups throughout Central California (Kroeber 1932; Loeb 1933).

Multivariate cluster analysis of burials and their artifacts at SCL-38 showed that this cemetery was highly organized in terms of gender, age, and wealth distinctions (Bellifemine 1997). Although SCL-38 also contained an older Middle period component, most of the 244 burials were clustered into groups exhibiting what has been interpreted as "high status artifact sets" (Bellifemine 1997:269). Artifacts associated with these burials were clearly of Late period vintage, while other burials, peripheral to these high-status individuals, had little in association. These latter burials may reflect an older Berkeley pattern component or possibly lower status individuals. These data suggest that material wealth was distributed unequally during the Late period, contrasting with a more egalitarian distribution during the Middle and Middle/Late Transition periods.

Signs of violence are also present among South Bay burial populations (Cartier, Bass, and Ortman 1993:65–67; Jurmain 1991). Examples of violence from Middle period contexts are known from ALA-328, ALA-343, ALA-453, SCL-137, SCL-732, and SCL-302, and the trend continued to the Middle/Late Transition at ALA-329, SCL-6, and SCL-690. This pattern is concordant with observations made at Middle period sites elsewhere in Central California, where it has been attributed to resource stress and increased territoriality (Chartkoff and Chartkoff 1984:236; Pastron 1973).

Kuksu—Catalyst to Cultural Complexity. The introduction and proliferation of *Haliotis* banjo pendants, which first appeared in the South Bay at SCL-690 during the Middle/Late Transition, provides insight into the mechanism of social change that differentiates the earlier Berkeley pattern from the Augustine pattern. Banjo pendants derived their name from their likeness to the silhouette of a stringed musical instrument. Gifford (1947:21) noted that they bore a resemblance to a human form, with projections conforming to a stylized image of feet, hands, and an enormous head. He credited this observation to R. F. Heizer, who suggested that banjo pendants might have represented the deity impersonated in ethnographic "Big-Head" performances of the Kuksu god-impersonating cult and membership society of Central California. Gifford wrote:

> In this performance the dancer wears a tule head-piece from which radiate sticks with feathers attached at distal ends. These project 2 to 3 feet from the head of the wearer. (1947:21)

Unfortunately, no direct ethnographic account has been found to prove these pendants represent *Kuksu* "Big-Head dancers." Further, it is difficult to determine the anthropomorphic image portrayed by those pendants exhibiting fishtailed or clawed distal ends.

The Kuksu initiation and membership cycle has been described in the ethnographic literature from much of Central California (for example, Baumhoff 1980:181; Fredrickson 1974b:64-65; Gifford 1947; Goldschmidt 1951b; Kroeber 1932:401–402; Loeb 1933:139-232). The ethnographic Pomo, Miwok, Patwin, and Nomlaki peoples north of the Carquinez Straits practiced Kuksu, but the Yokuts of the lower San Joaquin Valley did not, and its distribution among the Ohlone (or Costanoan) was not known (Kroeber 1923:306-309). J. Mason (1912) recorded that Kuksu was practiced by the Salinan on the Central California Coast, but his consultant told him a person had recently introduced it from Mission San Jose. Similar statements from the Marin Miwok indicated that they, too, had learned it from Ohlone people near Mission San Jose (Collier and Thalman 1996:232).

The distribution of banjo pendants from archaeological contexts coincides with ethnographic accounts of Kuksu membership. Furthermore, the accrual of beads coincident with sites that had banjo pendants accords with ethnographic descriptions ascribing wealth acquisition with Kuksu membership (Goldschmidt 1951b:339-340). Fredrickson (1974b:64) suggested that the accrual of bead wealth associated with the Kuksu tradition may have been related to membership emblems rather than wealth.

Bead accumulations at South Bay and valley sites involved men, women, and some children. Kuksu membership included a prominent role for women, and children were selected for membership at an early age (Kroeber 1932; Loeb 1933). At ALA-329, three females were found associated with 24 banjo pendants. At both SCL-38 and SCL-128, a banjo pendant was recovered from a female burial. At SCL-690, three were found with a burial of undetermined gender, and these are the earliest forms documented from the Santa Clara Valley. SCL-690 may represent the southernmost prehistoric expression of Kuksu. Phase 1 and 2 components at ALA-329 produced many elaborate banjo pendants with burials, but the 65 banjo pendants were associated with just 26 out of some 440 burials

Table 13.11 Distribution of grave-associated *Olivella* shell beads and *Haliotis*/Banjo pendants by component from ALA-329

	BURIALS	% w/OLIVELLA	OLIVELLA	% w/HALIOTIS	HALIOTIS	% w/BANJO	BANJO
Middle period	53	30	10,712	28	110	0	0
Late period Phase 1	140	53	28,114	22	233	6	31
Late period Phase 2	32	10	44,486	4	18	4	6

* Sample includes materials housed at San Jose State University only; Stanford University collection not included.
Source: Bennyhoff (1993:298-356)

(Coberly 1973; Leventhal 1993). Bennyhoff (1993:298-356) isolated the temporal distribution of "effigy" pendants from a sample of 284 burials (table 13.11). The ALA-329 pendants, as well as those from SCL-38, reveal stylistic changes that parallel those illustrated by Bennyhoff (1994a:68) for the Cosumnes district. At SCL-38 where 244 burials were recovered, 20 banjo pendants accompanied seven individuals in the high-status burial cluster (Bellifemine 1997).

Peninsula Coast

Burial populations comparable to those from the southern San Francisco Bay Area are lacking from the Peninsula Coast, so mortuary-based observations about wealth, violence, and inequality are not possible. Changes involve fluctuations in the frequency and inferred social importance of raw materials, *Olivella* and *Haliotis* shells, used to make beads and ornaments. Throughout the Early, Middle, and Late periods, *Olivella* shells found at coastal sites included a mixture of intact, broken, and ground spires (Hylkema 1991). A dearth of bead-making detritus suggests that the modification of raw shells into cut and ground beads was not a concern of the coastal shell suppliers (Hylkema 1991:423–432). Only SCR-20 has produced evidence of bead production. Nonetheless, the demand for these shells that developed during the Late period in the interior is reflected in the numbers of whole *Olivella* shells found in coastal sites. At Middle period coastal sites SCR-9 and SCR-132, *Olivella* shells were found at a rate of 4.3/m^3 of excavated site, while Late period sites SMA-97 and SMA-244 produced a combined total of 64/m^3. The increasing frequency of these nondietary shells at Late period coastal sites corresponds to their greatly increased presence in mortuary contexts at interior sites throughout Central California after AD 700. Formally shaped *Olivella* beads are nearly absent from coastal sites. To date, only sites SCR-93, SMA-22, and SCR-20 have produced notable numbers of formal beads. Similarly, pendants made from *Haliotis* shell are also underrepresented. It is likely that the demand for *Haliotis* shell from the interior gave them great export value.

CONCLUSIONS

Archaeological findings from Peninsula Coast sites show little change in adaptive mode over a long period of time. Throughout the Early and Middle periods small, mobile communities perpetuated a generalized subsistence economy that emphasized a meat diet supplemented with processed hard seeds, acorns, fish, and mollusks. The elaboration and use of ideotechnic artifact types and the emphasis on wealth observed at many Late period South Bay sites was not well developed on the coast, and a Middle/Late Transition period has not been observed. After AD 1200, however, an increasing demand for *Haliotis* and *Olivella* shells, materials used as markers of wealth and status throughout the interior of Central California, put the coastal people in a unique position as providers. Concurrently, the hunting of terrestrial game decreased significantly (Hylkema 1991).

On a general level, archaeological sites in the South Bay and most of Central California show a steady progression toward an intensified collector adaptive mode that emphasized reliance on stored vegetal food resources, in particular the acorn. The development of an acorn economy is often cited as the principal factor underlying demographic and cultural developments of the region (Baumhoff 1963:155–236; Basgall 1987:21–52; Mayer 1976:30; and others). By the terminal phase of the Early period, mortuary sites around San Francisco Bay show increased frequencies of mortars and pestles. Deceased members of various communities began to be interred as groups within their residential deposits, and social distinctions appeared in the form of unique grave-associated artifacts distributed among a few individuals. This pattern continued throughout the Middle period. Towards the terminal phase of the Middle period, however, social systems among divergent cultural regions intensified and many localities were transformed into an interrelated economic network with an extensive geographic range (see Fredrickson 1974b:57–73). Still other cultural traditions of the Bay Area (that is, Meganos) became more isolated, progressively retreating as the Berkeley pattern sites transformed into traits characteristic of the Augustine pattern.

Within the South Bay, archaeological sites dating to the Middle/Late Transition (ca. AD 700 to 1200) have produced artifact types in mortuary contexts that identify this as a period of socioeconomic transformation. By the Late period (ca. AD 1200 to the 1770s), an elaborate social hierarchy had emerged. Certain ideotechnic artifacts found with burials (particularly *Haliotis* banjo pendants, tobacco pipes, and incised bird bone whistles) coincide with an elaboration and refinement of wealth, status, and institutional organization. Although it is convenient to associate this development with the productivity of localized environments, the resource base was already well established before the florescence of the Ohlone culture that began during the Middle/Late Transition.

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CHAPTER 14

Late Holocene in the San Francisco Bay Area

Temporal Trends in the Use and Abandonment of Shell Mounds in the East Bay

KENT G. LIGHTFOOT AND EDWARD M. LUBY

Native peoples produced a diverse range of archaeological remains along the bay shore and interior valleys of the greater San Francisco Bay Area during the Late Holocene. The Bay Area supported a sizeable population of Costanoan (Ohlone), Coast Miwok, Bay Miwok, Plains Miwok, Patwin, and Wappo speaking peoples who were dispersed within a number of small communities at the time of early contact with Spanish explorers and missionaries (see Milliken 1995:13–30). Archaeological research undertaken over the last 90 years has focused primarily on the great shell mounds along the bay shore that consisted of extensive complexes of artificial mounds constructed of many cubic meters of sediments, marine shell, ash, and rocks. As summarized elsewhere (Moratto 1984:218–238; Nelson 1909), these mounded sites measured from 9 to 183 m in basal diameter and rose 1 to 9 m above the ground surface.

The creation of the earliest known mounds began about 5000 to 4000 years ago, but the apogee of mound construction took place during the Late Holocene when hundreds of these impressive features once dotted the late prehistoric cultural landscape. Distributed along the shoreline where streams emptied into the bay, they tend to be found in discrete mound clusters composed of four to six separate sites (for example, Banks and Orlins 1985:113–114; Heizer and Baumhoff 1956:37; Nelson 1909:328–329). Most mounds were produced over many hundreds of years by accretion; consequently, the long-term growth of these sites has entombed diverse artifactual and faunal assemblages, architectural features, and in some cases, hundreds or even thousands of human burials representing many generations of Native peoples.

Since the days of the earliest archaeological practitioners in the Bay Area, scholars have wondered about the motives and meanings of the peoples who built, used, and abandoned these impressive mounds. Why did local maritime hunter-gatherers create them? What were they used for? When and why were they abandoned? In a recent overview of shell mound research, Lightfoot (1997) noted that considerable variation existed in the size, internal composition, function, and occupational history of bay shore sites that have been subsumed under the overarching category of "shell mound." Recognizing that the specific histories and functions of mounded sites varied somewhat across both space and time, he also recognized a common trend. Most of the large and deeply stratified bay shore sites, such as Emeryville (ALA-309), West Berkeley (ALA-307), and Ellis Landing (CCO-295), appear to have been used repeatedly over hundreds or even thousands of years as ceremonial places, long-term repositories for the dead, and residential spaces. Although Leventhal (1993) and Meighan (1987) argued persuasively that some archaeological places in the San Francisco Bay and Sacramento Delta areas may have functioned as specialized cemeteries, Lightfoot (1997) concluded that most of these massive raised sites were mounded villages, where a diverse range of sacred and domestic activities took place.

The early formation of the great mounds in the terminal Middle Holocene occurred when the rate of sea level rise declined, and extensive mud flats and tidal marshes first became well established across the bay. Lightfoot (1997) argued that the intentional construction of mounded space along the emerging bay shore would have kept coastal residences above water during wet winter months and would have provided ideal locations for exploiting nearby open bay water and shoreline resources. Furthermore, over many generations of use and deposition, the mounds would have become highly visible cultural features on the flat bay shore landscape. These salient cultural features may have become

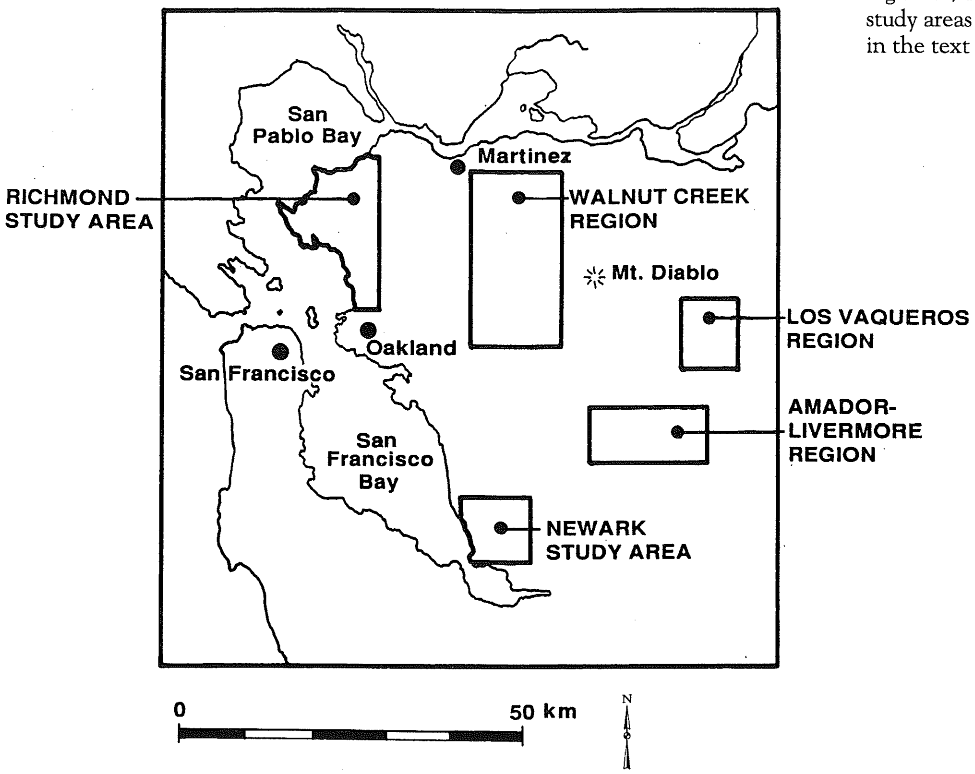


Figure 14.1 Map of Richmond and Newark study areas showing primary sites discussed in the text

symbolic historical markers for specific bay shore communities whose roots penetrated back many generations. They were visual manifestations of the direct link between the living and the dead; people dwelled on top of mounds whose internal cores encapsulated the sacred remains of their ancestors going back many generations.

The purpose of this chapter is to build on this interpretive framework by considering diachronic trends in the construction, use, and abandonment of San Francisco Bay shell mounds in the Late Holocene. Specifically, we consider current interpretations of shell mound communities, feasting ceremonies, and resource intensification by examining subsistence and settlement changes primarily in the East Bay (Alameda and Contra Costa Counties) (see Hylkema, chapter 13, this volume regarding the southern San Francisco Bay Area and Pacific Coast). We begin with a brief description of the dynamic environmental context (sea level rise, alluvial deposition, past precipitation patterns) of the Late Holocene in the San Francisco Bay Area. We then discuss how cultural historical taxonomies have influenced recent interpretations of shell mounds by emphasizing progressive evolution over time in the development of shell mound communities, rise of sociopolitical complexity, intensification of ceremonial practices, and growth of local Native populations. This interpretive framework is evaluated by examining space/time trends in the use and abandonment of East Bay sites through the Early (3000 to 500 BC), Middle (500 BC to AD 900) and Late periods (AD 900 to 1700). Our analysis suggests that local communities underwent significant reorganization during the Middle/Late period transition (AD 700 to 1100) when most of the large shell mounds no longer served as the primary residences for local communities. In the final section, we explore several ambiguities in current interpretive models of mounded villages in light of their abandonment and limited reuse in the Late period and suggest several directions for future research.

ENVIRONMENTAL CONTEXT

The San Francisco Bay Area is endowed with the largest estuarine system in California, a linked network of waterways extending from the Sacramento and San Joaquin Delta that drains 40% of the state's landmass through Suisun Bay, the Carquinez Strait, San Pablo Bay, and San Francisco Bay (figure 14.1). The four primary ecological communities that flourish in the vast wetland environs—freshwater marshes, salt marshes, mud flats, and open waters—grade into one another from the freshwater delta, through the shallow waters of the Suisun Bay, Carquinez Strait, San Pablo Bay, and southern San Francisco Bay, to the deeper channels of San Francisco Bay and the Golden Gate. Schoenherr (1992:516, 672–693), in describing the basic flora and fauna for each community, noted that these wetland environs are extremely productive, not so much because of overall species diversity but the enormous number of individuals for each species represented in each community. The marshlands and mud flats are the key to the tremendous productivity of the Bay Area, as they support clams, mussels, oysters, crabs, and the young of many fish in the greatest contiguous expanse of tidal wetland habitats on the Pacific Coast of North America (Conradson 1996:6). These small creatures, in turn, provide sustenance for the upper food chain that has been greatly impacted in recent years by water diversions, overfishing, and pesticide disposal (see Nichols et. al. 1986). In Late Holocene times, however, as documented in archaeological assemblages, the bay was thriving with many species of fish (e.g. green and white sturgeon, chinook and coho salmon, bat rays, thresher and leopard sharks, assorted surf perches, and jack smelt), an enormous population of both resident and migratory waterbirds and shorebirds (for example, ducks, geese, cormorants, loons, and grebes), and marine mammals (for example, sea otters, harbor seals, and sea lions) (see Brooks 1975; Follett 1975; Gobalet 1981, 1985; Gobalet and Strand 1979; Howard 1929; Simons 1979, 1981, 1985, 1992).

The adjacent terrestrial landscape consists of the relatively flat bay shore and surrounding hills and valleys of the Coast Ranges and East Bay hills. Prior to widespread agricultural and residential development in the late 19th and early 20th centuries, this landscape was characterized by extensive grassland, oak woodland, and chaparral habitats crosscut by riparian corridors containing willows, cottonwoods, ferns, rushes, and cattails. These interior habitats once supported populations of large game animals, including black-tailed deer, tule elk, and pronghorn antelope; other smaller fauna, such as California quail, black-tail jackrabbits, and brush rabbits; as well as anadromous fish and freshwater mussels in the freshwater wetlands (Bard, Busby, and Kobori 1983:3.1–3.3; Holman and Clark 1982:8–13; Schoenherr 1992:270–277).

The greater San Francisco Bay was created only in the last 11,000 to 10,000 years as a consequence of post-Pleistocene sea level rise. Prior to being inundated, the area was a river valley through which water flowed to the Pacific Ocean. The waters of the Sacramento and San Joaquin Rivers circulated through the river valley's north arm to the ocean, and the waters of Coyote Creek and other tributaries of the Coast Ranges drained into the ocean through its south arm. The valley was first submerged along the Golden Gate and deeper river channels in the Early Holocene due to the rise in sea level. Paleoenvironmental reconstructions of the estuarine system formation by Atwater, Hedel, and Helley (1977; Atwater et al. 1979), based on detailed analyses of sediments and associated organisms from deep boreholes, suggest that the sea level rose an average of 2 cm/year between 9500 and 8000 BP. With the inundation of the Golden Gate and deep river channels, the estuary spread rapidly across the relatively flat slope of the Bay Area, appearing to have advanced as much as 30 m a year in some places (Atwater, Hedel, and Helley 1977:11). The rapid rise of seawater precluded the development of any extensive tidal marshlands at this time (Bickel 1978:11–12).

Due to the shallow contour of much of the Bay Area, the estuarine system continued to expand relatively rapidly between 8000 and 6000 BP, even as the rate of sea level rise was slowing. By about 6000 BP, sea level rise declined to only 0.1 to 0.2 cm/year, and the bay system expanded at a much slower rate (Atwater, Hedel, and Helley 1977:11). The broad, nearly flat surfaces of southern San Francisco Bay, northern San Pablo Bay, and Suisun Bay were gradually inundated, and sediment accumulations and plant maintenance along the margins of the estuarine system finally exceeded sea level rise. The latter process created thousands of hectares of intertidal mud flats and thriving salt and brackish tidal marshes. The colonization and growth of tidal marshes and mud flats varied greatly in time and space across the Bay Area, however. A comparison of sediment cores suggests marshland developments in the delta began about 6000 BP, about 3000 BP near the north end of Coyote Hills and about 2000 BP in the southern reaches of San Francisco Bay (Atwater et al. 1979:349; Bickel 1981:19). An explosion in the number of oyster beds began in the southern reaches of San Francisco Bay about 2500 BP (Bickel 1978:12).

The Late Holocene was marked by oscillations in temperature and precipitation that produced periods of cooler, wetter climate associated with extensive alluvial deposition separated by temporal intervals of warmer, drier climate with minimal deposition. The effects of these alternating environmental conditions are most noticeable in the interior valleys, where archaeological remains along the flood plains of streams tend to be buried. Archaeological research in the interior valleys of the East Bay, including the Walnut Creek region (Banks, Orlins, and McCarthy 1984; Fredrickson 1966, 1968, 1980), the Amador-Livermore region (Wiberg 1996, 1997), and the Los Vaqueros region (Meyer and Rosenthal 1997), highlights the strong propensity for sites to be buried under 1 to 3 or more meters of alluvium. Banks, Orlins, and McCarthy (1984) believed that significant episodes of alluvial deposition can be correlated with three periods of cooler and wetter conditions: (1) the early Recess Peak Glacial Advance (ca. 850 to 750 BC), (2) the later Recess Peak Glacial Advance (ca. AD 50 to 450), and (3) the Matthes Glacial Advance (ca. AD 1300). These wetter, cooler periods of high sediment load were punctuated by times of warmer, drier conditions. The most salient period was the Medieval Climatic Anomaly that produced droughts across much of California from about AD 650 to 850 and about AD 1150 to 1250 or later (see Jones et al. 1999; Raab and Larson 1997:324–325; Stine 1994). Ingram (1998:108) described a marked lithologic unconformity about 1.5 to 1.8 m deep throughout the south San Francisco Bay that dated to about AD 450 to 750. This unconformity may be the consequence of a prolonged period in which sediments flowing into the bay from the Sacramento and San Joaquin Rivers, as well as from smaller streams draining the nearby Coast Ranges, decreased markedly during drought conditions.

The reduction in the overall health and productivity of the greater San Francisco Bay since AD 1850 is well documented. It was the consequence of reduced freshwater inflows resulting from the damming and diversion of rivers, hydraulic mining debris, agricultural activities, diking and land reclamation, and disposal of pesticides and domestic and industrial wastes (see Atwater et al. 1979; Conradson 1996:8–12; Nichols et. al. 1986). One of the most salient problems was the reduction of tidal marsh habitats. Prior to AD 1850, 1400 km^2 of freshwater marsh were mapped in the delta and another 800 km^2 of saltwater marsh along the bay shore. After almost 150 years of reclamation projects and residential and commercial development, only about 125 km^2 of undiked tidal marsh remain today (Atwater et al. 1979:347; Nichols et al. 1986:568). The impact of the last 150 years on the archaeological record has been particularly dramatic, as agricultural and residential development destroyed or severely damaged many shell mound sites (Nelson 1909:327; Moratto 1984:226), and hydraulic mining from AD 1853 to 1884 may have buried other bay shore sites under 0.25 to 1.0 m of sediment in the Suisun, San Pablo, and central San Francisco Bays (Nichols et. al. 1986:568).

RECENT INTERPRETATIONS OF LATE HOLOCENE SHELL MOUNDS

Our purpose here is not to summarize the history of archaeological research in the greater San Francisco Bay Area (see Lightfoot 1997:129–131; Moratto 1984:226–237) but to examine the implications of cultural historical taxonomies on recent interpretations of shell mounds. The earliest work of L. L. Loud, Nels Nelson, W. E. Schenck, Max Uhle, and others in the first three decades of the 20th century described the site structure, internal constituents, and spatial distribution of more than 425 mounded sites across the Bay Area. Post-World War II studies by Robert Beardsley, James Bennyhoff, David Fredrickson, and Bert Gerow continued this tradition of recording and describing sites in Central California, but these researchers began to direct much of their energies to issues of chronology and cultural affiliation, primarily through the study of burials, grave lots, and shell bead seriations. The focus on space/time frameworks and cultural historical analysis remains important today, along with subsistence practices, settlement patterns, regional exchange, and technology.

The cultural historical framework of Bay Area archaeology greatly influences current interpretive models of Late Holocene shell mounds. Beginning with the tripartite sequence of Early, Middle, and Late horizons, originally developed for the Central Valley and delta regions by Lillard, Heizer, and Fenega (1939) and extended (with some refinements) to the Bay Area by Beardsley (1948, 1954), there has always been an element of developmental progression in the cultural historical taxonomies employed in Central California. Designated as the Central California Taxonomic System, this early taxonomy classified various archaeological traits (burial mode and orientation, bead types, projectile point types, and ground stone artifacts) in a temporal scheme from early to late that assumed an organic progression or development over time (see Moratto 1984:178–185 for an excellent discussion).

Important modifications were made to the Central California Taxonomic System in the 1960s and 1970s by Bennyhoff and Fredrickson (1994) and Fredrickson (1994a, 1994b) with the introduction of the concepts of period, district, and pattern. These concepts, developed during the height of cultural evolutionary thinking in American archaeology, also emphasized developmental progression from early to late in the increasing complexity of cultural traits. Fredrickson (1973, 1994a:39–40) originally defined four overarching periods for California, which were later expanded to six (PaleoIndian; Lower, Middle and Upper Archaic; Lower and Upper Emergent) (Fredrickson 1974a, 1994b). These periods provided a much-needed temporal framework for over 10,000 years of prehistory. The four or six period scheme also presented a cultural evolutionary framework that accentuated growth over time in economic activities, craft specialization, regional exchange, sociopolitical complexity, and ritual ceremonies. Within these periods, a district defined specific culture units in geographical space; the pattern was employed to classify archaeological cultures with similar economic and technological adaptations.

Two dominant and widespread patterns have been defined in the Bay Area: Berkeley and Augustine. The former, which includes components previously defined in the Middle horizon, was characterized by an emphasis on grinding technology, a well-developed bone tool industry, flexed burials with a rarely elaborated mortuary complex, and certain types of *Haliotis* and *Olivella* shell beads and ornaments. Acorns were the dominant staple, although there was an emphasis on shellfish collecting along the bay shore, and a larger population appears to have been supported given the increase in number and depths of sites (Fredrickson 1994a:44–45). The Augustine pattern, which incorporates cultures previously included with the Late horizon, developed out of the earlier Berkeley pattern with the introduction of the bow, arrow, and harpoon; an emphasis on hunting, fishing, and acorn collecting; greater social differentiation in regards to wealth; use of cremation for "wealthier" burials; distinctive forms of

Haliotis and *Olivella* shell beads; advent of clam disk beads as a form of currency; and intensification of regional trade (Bennyhoff 1994a; Fredrickson 1994a:45). The Augustine pattern was also distinguished by a proliferation of settlements, larger populations, and new levels of social and political complexity (for example, Moratto 1984:211–213; Wiberg 1997:12).

Most Bay Area archaeologists tend to employ a hybrid classification that combines various components of the above taxonomic systems. While the horizon concept is no longer widely employed, the tripartite classification of the Central California Taxonomic System is alive and well with the widespread use of Early, Middle, and Late periods to define temporal and cultural units in the terminal Middle Holocene and Late Holocene. In many reports, the Berkeley and Augustine patterns are used interchangeably with the Middle and Late periods (for comprehensive discussions, see Banks and Orlins 1985:28–51; Wiberg 1996:123–128, 1997:9–17). The six periods defined by Fredrickson are commonly employed as well, especially in cases where the chronology of archaeological remains spans the Early, Middle, and Late horizons (for example, Meyer and Rosenthal 1997:II.12–II.14). In this chapter, we employ the temporal units of Milliken and Bennyhoff (1993:386), who divided the classic tripartite chronology into the following periods: Early (3000 to 500 BC), Lower Middle (500 BC to AD 300), Upper Middle (AD 300 to 900), Late Phase 1 (AD 900 to 1500), and Late Phase 2 (AD 1500 to 1700). They further defined the interface between the Upper Middle and Late Phase 1 as the Middle/Late Transition (AD 700 to 1100).

Current interpretations of shell mounds are very much influenced by the progressive evolutionary trends as outlined in the cultural historical taxonomies of Central California. It is generally assumed that increased growth and complexity took place in local bay shore communities throughout the Early, Middle, and Late periods. The underlying premise of evolutionary progression is evident in Lightfoot's (1997) model of the rise of shell mound communities in the greater San Francisco Bay Area during the Late Holocene. He summarized previous work on mound clusters that suggested that the oldest and largest site in each mound complex was located nearest the bay and was ringed by other medium size and small mounds. In arguing that mounded sites were both villages and cemeteries, he proposed that the earliest established bay shore settlements may have served as sociopolitical and ceremonial centers for later multisite communities. As the local population grew during the Late Holocene and nearby mounded villages were established, the older mounds would have become increasingly important centers for ceremonies, regional exchange activities, and sociopolitical decision making, especially in the Late period. He would even speculate that the highly elaborated cremation burials defined as part of the Late period Augustine pattern might be the elites who oversaw important ceremonial and political activities at the major centers.

Recent studies of resource stress and intensification in the Bay Area also emphasize an evolutionary progression in the growth of local communities over time. Jack Broughton's (1994b, 1997, 1999) and Dwight Simon's (1992) synthetic studies of faunal assemblages from bay shore sites indicate marked changes took place in the ratio of ungulate to sea otter remains and sturgeon to small fish species during the Late Holocene. Broughton (1994b:387–396) evaluated several alternative explanations for the shift from large to small prey packages over time, including environmental change, site seasonality, and technology, concluding that the shift was most likely due to increasing human population and the overexploitation of local resources. In considering the temporal trends in resource exploitation, one may expect that during the end of the Late Holocene there should be good evidence of fully developed shell mound communities, as well as increasing evidence of territorial competition brought about by resource stress.

Luby and Gruber's (1999) model of mortuary feasting and social aggrandizement at large shell mound villages can also be situated within this cultural evolutionary framework. They argued that communal gatherings during mortuary rituals provided an excellent opportunity for elite families to exhibit prestige and to establish binding contractual debts through the giving of food and other goods during public feasts. In the process of preparing, consuming, and depositing the remains of shellfish, meat dishes, and other foods, shell mounds became material symbols of past feasts that honored the ancestors and reinforced social ties of the living with the dead. More importantly, the feasts presented a ritual context for aspiring elites to enhance their status and prestige through public exhibits of generosity during funerals and other ceremonial activities. While Luby and Gruber do not directly posit a temporal trend in the development of communal feasts and prestige enhancement, two important criteria of the Augustine pattern—greater ceremonialism and social differentiation—suggest that these mortuary related activities should be well developed in the Late period.

EVALUATING MODELS OF LATE HOLOCENE SHELL MOUNDS

Since the cultural historical taxonomies that continue to direct and influence archaeological research in the Bay Area were constructed during the 1940s and 1970s, the opportunity now exists to evaluate the progressive developmental framework with new settlement data and syntheses derived from recent CRM studies. In this section, we critically evaluate the evidence for the rise of shell mound communities in the Early, Middle, and Late periods that may

Table 14.1. Radiocarbon assessments and calibrated dates for the Richmond study area.

SITE	LAB/SAMPLE NO.	MATERIAL	^{14}C YEARS BP	CALIB. AGE RANGE	REFERENCE
CCO-268	UCR-838	Deer bone	2555±120	Not reported	Banks and Orlins 1979:8.3
CCO-269	UCR-779	Shell	3030±120	1550-900 BC	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-817	Charcoal	2605±100	1000-400 BC	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-816	Charcoal	2250±110	800 BC-AD 0	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-813	Charcoal	2220±110	800-650 BC 550, BC-AD 50	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-777	Charcoal	2195±100	550 BC-AD 50	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	Beta-73436	Human bone	2110±60	370-280 BC 260, BC-AD 10	Holson et al. 2000: Table 13.1
CCO-269	Beta-73432	Human bone	1890±60	40 BC-AD 250	Holson et al. 2000: Table 13.1
CCO-269	UCR-776	Charcoal	1360±150	AD 350-1000	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-775	Charcoal	1145±130	AD 650-1200	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-269	UCR-778	Charcoal	1135±100	AD 660-1050	Banks and Orlins 1979:8.3; Holson et al. 2000: Table 13.1
CCO-270	UCR-781	Charcoal	2260±100	Not reported	Banks and Orlins 1979:8.3
CCO-270	UCR-782	Shell	2230 150	Not reported	Banks and Orlins 1979:8.3
CCO-270	UCR-780	Shell	2165±100	Not reported	Banks and Orlins 1979:8.3
CCO-270	UCR-814	Fish bone	1200±150	Not reported	Banks and Orlins 1979:8.3
CCO-270	UCR-783	Organic soil	1105±100	Not reported	Banks and Orlins 1979:8.3
CCO-271	UCR-815	Charcoal	2615±110	Not reported	Banks and Orlins 1979:8.3
CCO-271	UCR-812	Fish bone	2110±100	Not reported	Banks and Orlins 1979:8.3
CCO-271	UCR-811	Charcoal	1980±150	Not reported	Banks and Orlins 1979:8.3
CCO-271	UCR-837	Deer bone	1890±110	Not reported	Banks and Orlins 1979:8.3
CCO-271	Coles	Charcoal	1665±85	Not reported	Banks and Orlins 1979:8.3
CCO-295	UCR-1167b	Shell	3680±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-295	UCR-1167a	Charcoal	2990±120	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1166b	Shell	1205±90	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1151	Ash	675±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1166a	Charcoal	580±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1150b	Shell	560±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1154b	Shell	545±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1152	Charcoal	425±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1148	Charcoal	315±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1149	Charcoal	300±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1154a	Charcoal	270±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1147	Ash	250±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1150a	Charcoal	215±80	Not reported	Banks and Orlins 1981: Table 9.1
CCO-297	UCR-1153	Charcoal	<150	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1155a	Charcoal	3820±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1155b	Shell	3530±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1164	Shell	3360±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1163	Shell	3120±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1165	Shell	2905±100	Not reported	Banks and Orlins 1981: Table 9.1
CCO-298	UCR-1156	Charcoal	2785±200	Not reported	Banks and Orlins 1981: Table 9.1
CCO-299	Beta-9622	Charcoal?	1060±60	Not reported	Banks and Orlins 1981: Table 9.1
CCO-600	Beta-73434	Human bone	2130±70	380-10 BC	Holson et al. 2000: Table 13.1
CCO-600	Beta-73433	Human bone	2070±60	360-300 BC 240, BC-AD 70	Holson et al. 2000: Table 13.1
CCO-600	Beta-73435	Human bone	1130±60	AD 770-1020	Holson et al. 2000: Table 13.1
CCO-601	Beta-73431	Elk bone	1750±60	AD 130-410	Holson et al. 2000: Table 13.1
ALA-307	not listed	Charcoal	3860±450	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-125	Charcoal	3700±350	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-127	Charcoal	3700±300	Not reported	Wallace and Lathrap 1975:58

continued

Table 14.1. Radiocarbon assessments and calibrated dates for the Richmond study area, *continued*.

SITE	LAB/SAMPLE NO.	MATERIAL	^{14}C YEARS BP	CALIB. AGE RANGE	REFERENCE
ALA-307	M-124	Charcoal	3500±300	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-122	Charcoal	3210±300	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-126	Charcoal	3140±450	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-123	Charcoal	2880±300	Not reported	Wallace and Lathrap 1975:58
ALA-307	M-121	Charcoal	2700±300	Not reported	Wallace and Lathrap 1975:58
ALA-307	CAMS-6831	Charcoal	4320±70	3030-2890 BC	Ingram 1998:108
ALA-307	CAMS-6747	Charcoal	3630±70	2110-1830 BC	Ingram 1998:108
ALA-307	CAMS-6615	Charcoal	3510±70	1920-1690 BC	Ingram 1998:108
ALA-307	CAMS-6614	Charcoal	3420±70	1860-1560 BC	Ingram 1998:108
ALA-307	CAMS-6745	Charcoal	3370±60	1730-1530 BC	Ingram 1998:108
ALA-307	CAMS-6612	Charcoal	3290±120	1720-1410 BC	Ingram 1998:108
ALA-307	CAMS-6613	Charcoal	3210±90	1600-1320 BC	Ingram 1998:108
ALA-307	CAMS-6611	Charcoal	3120±100	1490-1190 BC	Ingram 1998:108
ALA-307	CAMS-6610	Charcoal	2950±80	1290-1010 BC	Ingram 1998:108
ALA-307	CAMS-6744	Charcoal	2810±70	1050-830 BC	Ingram 1998:108
ALA-307	CAMS-6609	Charcoal	2670±50	840-800 BC	Ingram 1998:108
ALA-307	CAMS-10394	Charcoal	2240±60	390-170 BC	Ingram 1998:108
ALA-307	CAMS-10393	Charcoal	1950±80	40 BC-AD 130	Ingram 1998:108
ALA-307	CAMS-10392	Charcoal	1670±60	AD 260-430	Ingram 1998:108
ALA-307	CAMS-31461	Charcoal	1280±60	AD 780-670	Ingram 1998:108
ALA-309	1-7967	Charcoal	2620±70	900-540 BC	Broughton 1997:850
ALA-309	I-7073	Charcoal	2530±105	890-390 BC	Broughton 1997:850
ALA-309	1-7964	Charcoal	2400±70	770-270 BC	Broughton 1997:850
ALA-309	1-9893	Charcoal	2370±70	760-240 BC	Broughton 1997:850
ALA-309	LJ-199	Charcoal	2310±220	900 BC-AD 135	Broughton 1997:850
ALA-309	Beta-76862	Bone collagen	2070±60	200 BC-AD 70	Broughton 1997:850
ALA-309	Beta-76865	Bone collagen	1980±50	60 BC-AD 130	Broughton 1997:850
ALA-309	Beta-76867	Bone collagen	1970±50	50 BC-AD 135	Broughton 1997:850
ALA-309	Beta-76864	Bone collagen	1400±50	AD 590-695	Broughton 1997:850
ALA-309	1-9896	Charcoal	1110±70	AD 780-1030	Broughton 1997:850
ALA-309	1-7963	Charcoal	1030±60	AD 890-1160	Broughton 1997:850
ALA-309	Beta-76863	Bone collagen	950±50	AD 1000-1215	Broughton 1997:850
ALA-309	Beta-76866	Bone collagen	720±60	AD 1220-1395	Broughton 1997:850

have been characterized by ceremonial and political centers, population growth and increasing territorial restriction, social stratification, and mortuary feasting. Our evaluation is based on archaeological data from the East Bay region, including both Contra Costa and Alameda Counties. We selected this region for our investigation because it is the most intensively studied area of the greater San Francisco Bay. Not only did early University of California, Berkeley archaeologists, such as Nels Nelson and Max Uhle, undertake pioneering excavations of the classic shell mound-type sites of Ellis Landing (CCO-295), West Berkeley (ALA-307), and Emeryville (ALA-309), the CRM-funded research conducted by Peter Banks, Robert Orlins, John Holson, and others has now produced a number of sophisticated investigations of the spatial structure and constituents of mounded sites.

The evidence from two East Bay areas is examined here: the Richmond study area, centered in western Contra Costa County, and the Newark study area, located approximately 50 km south of Richmond in southern Alameda County. The Richmond study area stretches across a roughly 150 km^2 area of bay shore and adjacent landscape from Emeryville and Berkeley to Point Pinole. The Newark study area is located near the Coyote Hills along the margins of the bay shore in an area approximately 100 km^2 in size.

Richmond Study Area

Banks and Orlins (1979:8.10–8.12, 1981:3.64–3.65, 1985:113–114) defined no less than eight discrete mound clusters based on the spatial proximity of nearest neighbors in the Richmond study area. More than 60 bay shore sites have been recorded here, of which at least 34 contained no less than 2 m of cultural deposit (Banks and Orlins 1985:31). Twenty-six sites have been archaeologically excavated or intensively surface collected, yielding sufficient samples of diagnostic artifacts to assign them to five temporal units. In addition, 82 radiocarbon dates have been reported for 12 of the sites.

Below we consider the space/time distribution of 26 bay shore sites in the Richmond study area that have been dated

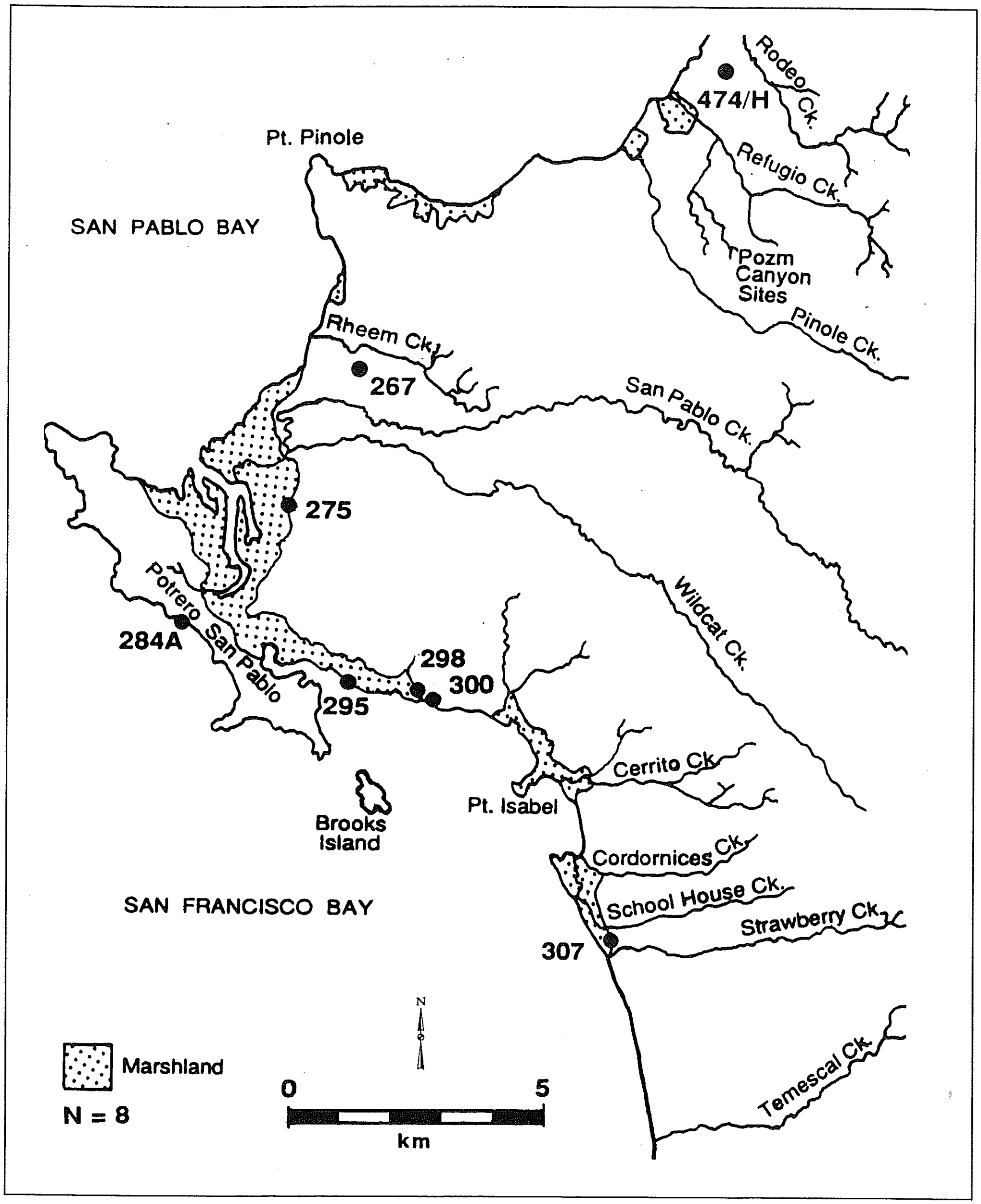


Figure 14.2 Early period (3000-500 BC) sites of the Richmond study area

by diagnostic artifacts, obsidian hydration, and/or radiocarbon analysis to the five periods outlined earlier. The site chronology is based primarily on Holson et al. (2000), who updated Banks and Orlins's (1979, 1981, 1985) detailed study of sites in western Contra Costa County, as well as on recent chronological information presented for CCO-156 and CCO-474/H by Waechter (1992:7–13).

Early Period (3000 to 500 BC). Eight bay shore sites were established during this period (figure 14.2), including Ellis Landing (CCO-295) and West Berkeley (ALA-307). For the latter site, there are now 23 radiocarbon dates, the earliest one spanning 4390 to 4250 RYBP (3030 to 2890 cal BC) (Ingram 1998:107; table 14.1). The majority of the Early period sites were situated along the southern bay shore of the study area that faces San Francisco Bay. Only one site (CCO-474/H) with Early period materials has been found north of Point Pinole.

Lower Middle Period (500 BC to AD 300). Twenty sites date to this period (figure 14.3), including the well-known Ellis Landing (CCO-295), West Berkeley (ALA-307), and Emeryville (ALA-309) shell mounds. Three mound clusters were taking shape during this period: seven sites in the lower San Pablo Creek complex (CCO-267, CCO-268, CCO-269, CCO-270, CCO-271, CCO-600, CCO-601), two sites in the Potrero San Pablo cluster (CCO-284, CCO-284a), and two sites in the Stege Mound complex (CCO-298, CCO-300). In comparison with the Early period, there was a marked increase in the number of sites along the southern and central bay

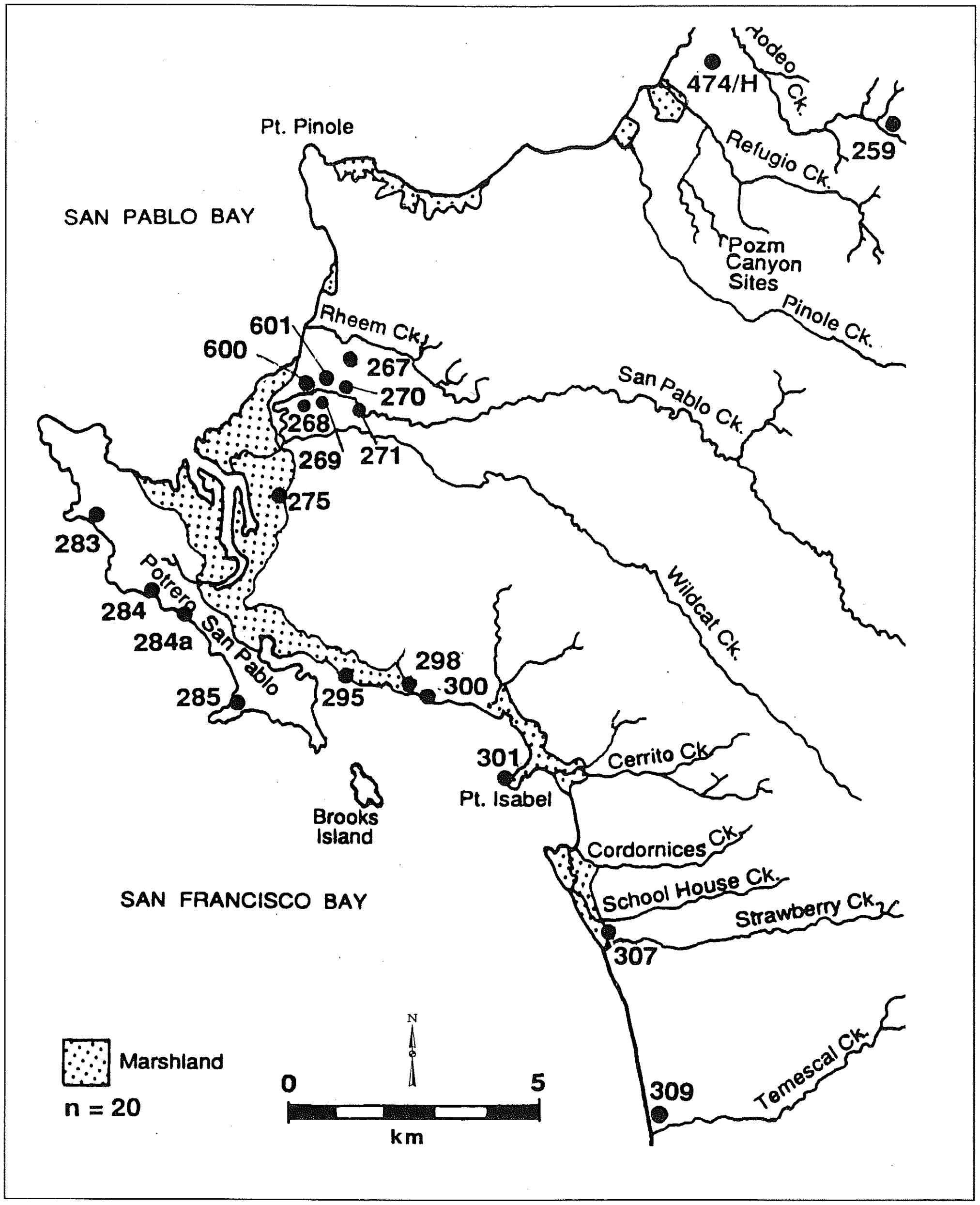


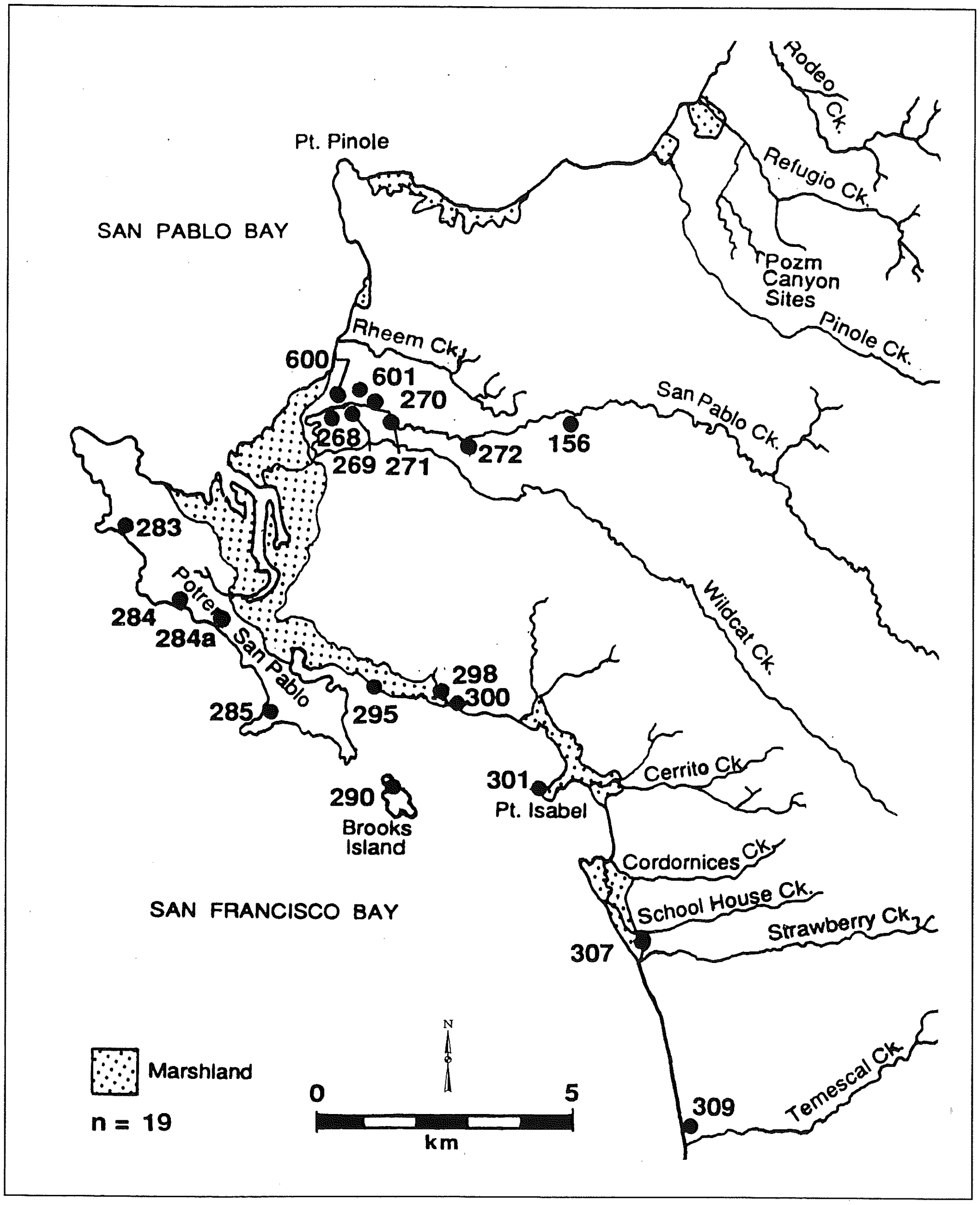
Figure 14.3 Lower Middle period (500 BC-AD 300) sites of the Richmond study area

shore habitats of the study area. Only two sites (CCO-474/H, CCO-259 [Fernandez Mound]) dating to this period were found north of Point Pinole.

Upper Middle Period (AD 300 to 900). Nineteen sites are assigned to this period (figure 14.4), and their spatial distribution is very similar to that of the Lower Middle period. Along the southern and central bay shore, the major shell mounds continued to show evidence of use, including CCO-295, ALA-307, and ALA-309, as well as the Lower San Pablo Creek complex, the Potrero San Pablo cluster, and the Stege Mound complex. Two sites (CCO-156, CCO-272) were established along San Pablo Creek about four to five km from the bay shore. Sites dating to the Upper Middle period were not detected north of Point Pinole. Fernandez Mound apparently was abandoned at this time (Banks and Orlins 1979:3.7–3.9).

Late Period, Phase 1 (AD 900 to 1500). Only ten dated sites exhibited evidence of use during Phase 1 (figure 14.5). A significant decrease in the number of sites took place along the southern and central bay shore, and those that remained tend to be clustered around the Richmond Harbor (CCO-290, CCO-295, CCO-298, CCO-299). The mound clusters defined for the Middle period all but disappeared. Only one site (CCO-271) in the lower San Pablo Creek Mound complex was occupied, two sites (CCO-298, CCO-299) continued to be used in the Stege Mound complex, and the Potrero San Pablo cluster was completely abandoned. Of the major shell mounds that have been excavated in the study area, only Ellis Landing (CCO-295) showed evidence of use throughout Phase 1. Emeryville (ALA-309) appears to have been occupied during the first half of Phase 1, while

Figure 14.4 Upper Middle period (AD 300-900) sites of the Richmond study area



West Berkeley (ALA-307) was probably abandoned towards the end of the Upper Middle period (table 14.1). While many of the previously occupied bay shore locations were deserted before or during the early years of Phase 1, sites situated several kilometers into the interior along freshwater creeks continued to be used (CCO-156, CCO-272). Fernandez Mound, situated at least 4.5 km from the San Pablo Bay shore, was probably reoccupied as well.

Late Period, Phase 2 (AD 1500 to 1700). Only nine sites are assigned to this period (figure 14.6). Most of the bay shore locations in the study area were abandoned before or during Phase 2. Interestingly, sites situated on the bay that contain Phase 2 components were centered almost exclusively around the Stege Mound complex in Richmond Harbor. The Stege Mound complex was now composed of one site that had been occupied in Phase 1 (CCO-299), two sites (CCO-298, CCO-300) that were reused after being previously abandoned in Phase 1, and a newly established site, CCO-297, which was inhabited only during Phase 2. Other bay shore sites include the nearby Ellis Landing site (CCO-295) that continued to be used during Phase 2, and CCO-301 on Point Isabel. The remaining three sites (CCO-272, CCO-259, CCO-349) were situated in interior habitats along freshwater streams some distance from the bay shore.

Newark Study Area

In the Newark study area, we believe there may be as many as four mound clusters, based on a review of site file records housed at the Phoebe Hearst Museum of Anthropology at

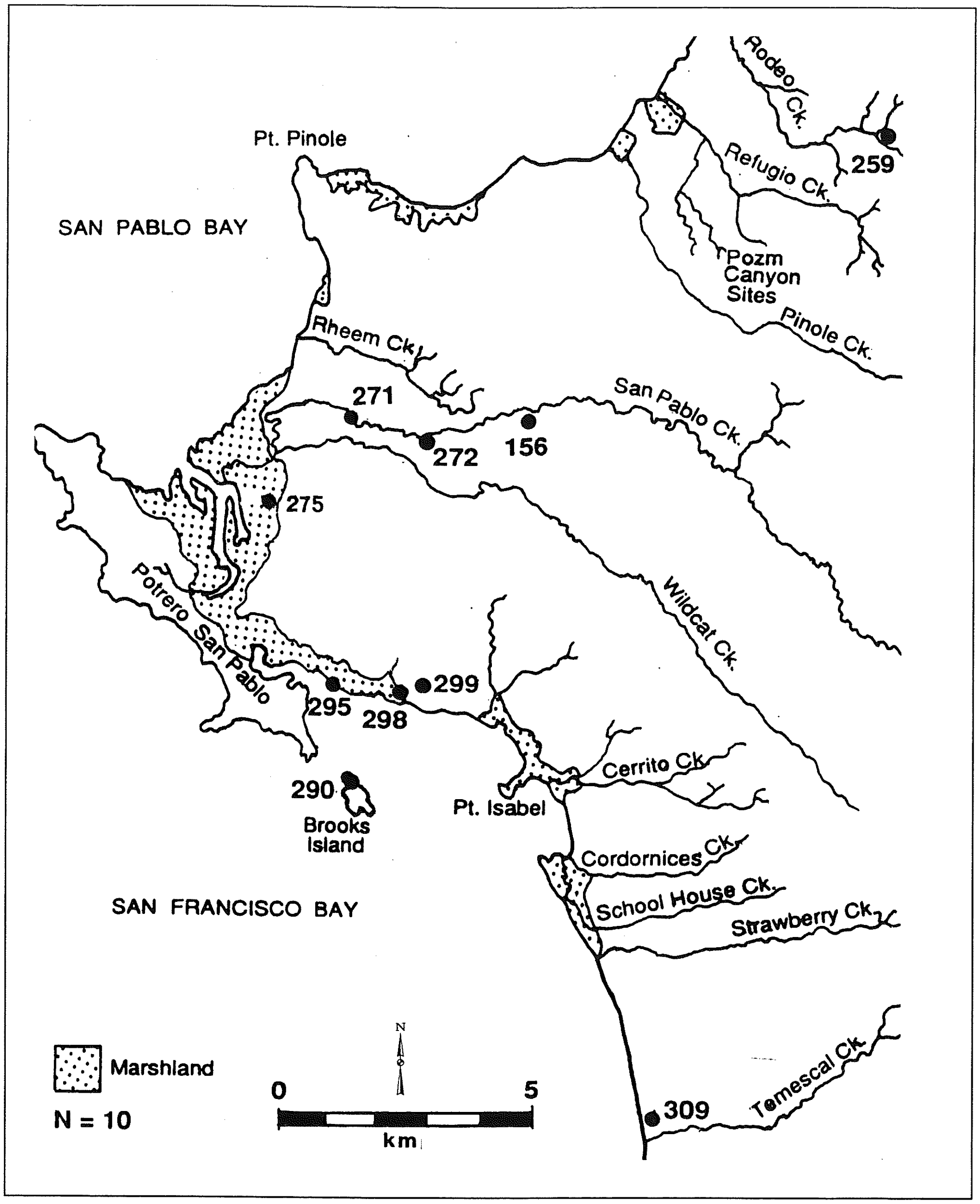


Figure 14.5 Late period—Phase 1 (AD 900-1500) sites of the Richmond study area

University of California, Berkeley and the Northwest Archaeological Information Center at Sonoma State University. These include the well-known Coyote Hills cluster (ALA-328, ALA-329, ALA-12, ALA-13), a Mowry Landing cluster (ALA-59, ALA-336, ALA-337), a Haley Road cluster (ALA-330, ALA-331, ALA-332), and an Olympia Mound cluster (ALA-446, ALA-424, ALA-465, ALA-466). A fifth site, ALA-392, may also be associated with the Olympia Mound group. In the first three clusters, at least one of the associated mounds has a basal diameter of 100 m or more and deposits 2 or more m deep. Indeed, these three shell mound groups may be represented by the "Indian Mound" symbols on an early geological map of the area (Whitney 1873). Because of disturbance, the fourth cluster is more tentative, although at least one of the associated sites, ALA-446, appears to be the remains of a "large midden mound" (Bard and Busby 1987). The Newark study area shell mounds were referred to in a series of well-known newspaper articles by Yates (1875), and a pattern of larger shell mounds in close association with smaller sites can be discerned in his writings.

Of the fifteen sites included in the Newark study area, sufficient temporal information is available only for the sites in the Coyote Hills cluster (figure 14.7). As a result of the limited temporal information in comparison with the Richmond study area, we discuss diachronic changes in only a preliminary manner. The Patterson Mound (ALA-328) appears to have been the first of the group to be occupied, at the very end of the Early period (ca. 500 BC). All four sites in the Coyote Hills cluster were used during the Middle

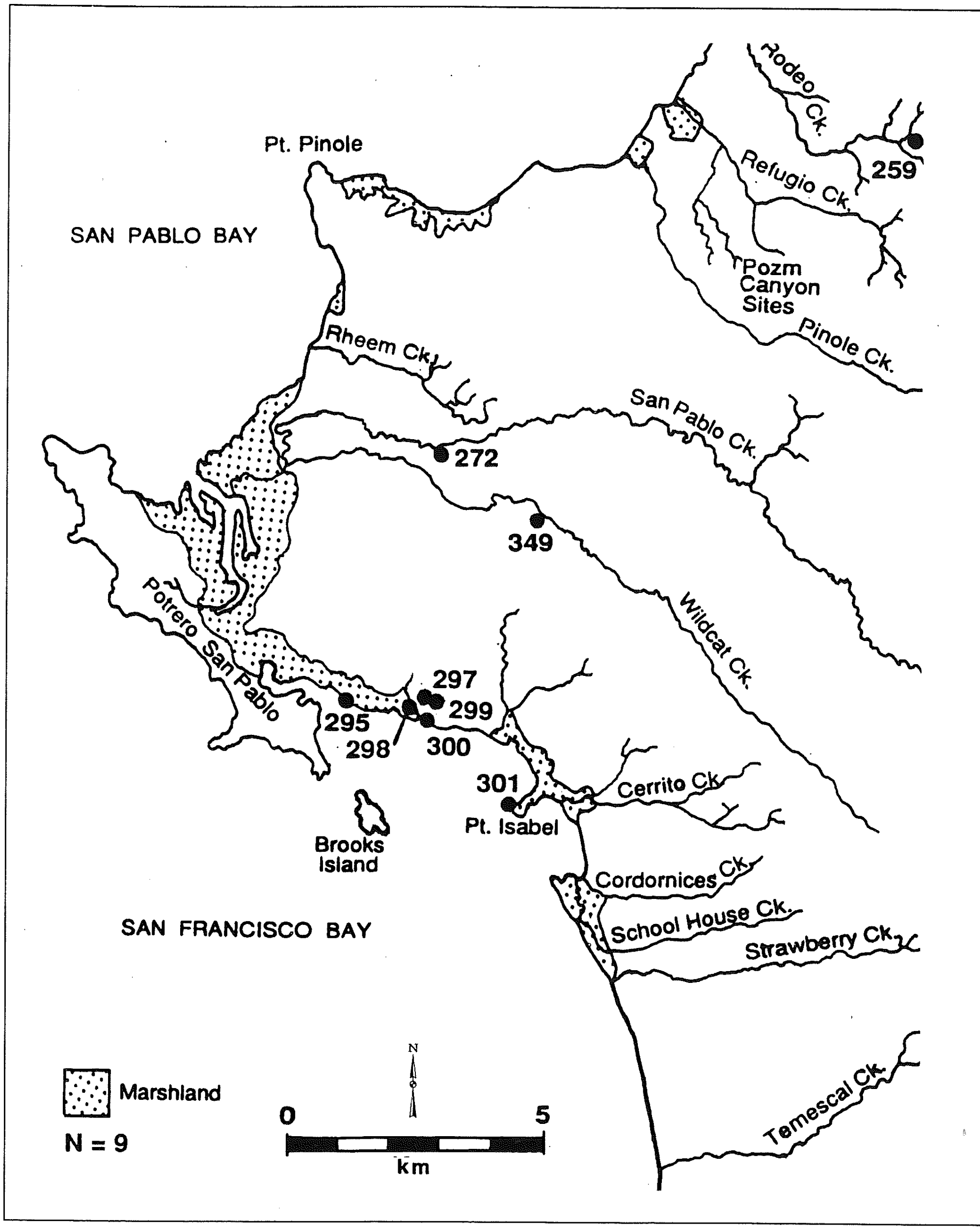


Figure 14.6 Late period—Phase 2 (AD 1500–1700) sites of the Richmond study area.

period (500 BC to AD 900) (Bickel 1981; Rackerby 1967; Leventhal 1993). By the beginning of the Late period (AD 900), three of the four sites were no longer occupied, and ALA-328, probably the largest of the group, was abandoned for the duration of Phase 1 (AD 900 to 1500). The Ryan Mound (ALA-329) was inhabited during the very end of Phase 1 (AD 1300 to 1500) (Coberly 1973), although a more recent analysis by Leventhal (1993) suggests that the site was used throughout Phase 1 of the Late period (AD 900 to 1500). ALA-328 was reoccupied during Phase 2 (AD 1500 to 1800), and a Phase 2 occupation is also present at ALA-329 (Leventhal 1993).

The temporal evidence for sites in the three other mound clusters is limited. In the Haley Road cluster, there is evidence that the Haley Road mound (ALA-330) was occupied during both the Middle (500 BC to AD 900) and Late periods (AD 900 to 1500), and that ALA-331 was inhabited sometime during the Late period (Parkman 1979). In particular, occupation at ALA-330 is believed to be contemporary with the very Late period Phase 1 occupation formerly ascribed to the Ryan Mound (AD 1300 to 1500) (Phebus 1973). No temporal information is available for the Mowry Road cluster; these sites were apparently destroyed in 1959, and it does not appear that archaeological material was systematically collected. In the Olympia Mound cluster, ALA-446 may have been used throughout the Middle and Late periods (Bard and Busby 1987), while ALA-424, a small midden probably inhabited on a seasonal basis, was initially occupied between AD 700 to 900 and probably through the beginning of the Late period (AD 900 to 1100).

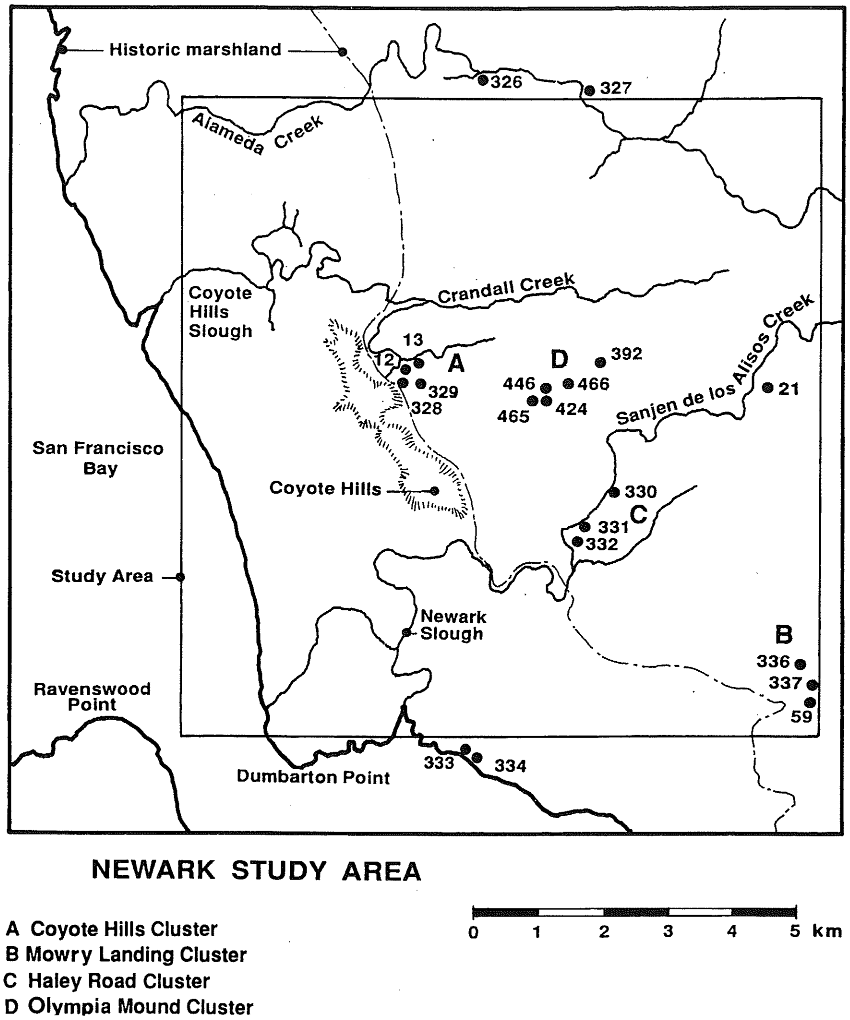


Figure 14.7 Map showing four mound clusters of the Newark study area

Colonial Period

As elsewhere in California, the Colonial period was a time of dramatic change in the San Francisco Bay Area. This period began in AD 1769 when sustained contact between local Native peoples and Europeans commenced. This period is not well defined archaeologically, and little is known of the location and distribution of Native sites either in the specific study areas examined here or in the San Francisco Bay Area in general. Most information concerning this period is derived from ethnohistoric analyses that provide an invaluable view of Native life based on investigations of mission records, diarist accounts, and other Spanish documents (A. Brown 1974, 1994; S. Cook 1957; Milliken 1991, 1995). As analyses of the ethnographic record become more available (for example, Ortiz 1994), narratives and other forms of ethnographic information may also supply an important perspective regarding the cultural landscape during this period.

Employing Franciscan mission records and other pertinent documents, Milliken (1995) reconstructed the sociopolitical landscape of the greater San Francisco Bay Area for 45 independent tribes (or tribelets) at the time of early contact with Europeans, and traced their incorporation into mission settlements through AD 1810. The "tiny" tribes consisted of about 200 to 400 people who resided in tightly defined territories some 13 to 19 km across, although population densities and tribal areas varied somewhat. Each tribe was an autonomous polity under the leadership of one or more headmen and religious specialists. Social and political differentiation existed along the axes of age, kinship, and gender, with special distinctions made for some male and female members of higher status families. The degree of political complexity probably varied from tribe to tribe; but there is little indication that any of the Bay Area tribes can be characterized as well-developed chiefdoms with leadership vested in political offices, codified political hierarchies, and ranked social classes (for example, Lightfoot 1993:183–184). Some tribes may have established central "principal" villages where the majority of their people resided, while the populations of other tribes were more commonly dispersed into multiple small hamlets. In any case, none of these settlements appear to have been occupied year-round. Village populations tended to follow a pattern of dispersal and convergence at different locations throughout the year, depending upon the season, local environmental conditions, and ever changing regional sociopolitical landscape (Holson et al. 2000:20–24; Milliken 1995:19–20).

Based on Milliken's (1981; 1995:229, 243) detailed analysis, the Richmond study area was occupied by the Huchiun and Huchiun-Aguasto tribes in the Colonial period (see also Holson et al. 2000:16–24). Members of both tribes were fluent speakers of the Costanoan language. The tribal territory of the Huchiun included much of the study area, while the Huchiun-Aguasto people may have foraged along the southeast shore of San Pablo Bay in the northern section of the study area. The principal villages mentioned in the mission records for the Huchiun were Genau, Josquizara, and Guequessosmac, but they have not been precisely located. Two Costanoan speaking tribes resided within the Newark study area: the Tuibun to the south and the Yrgin to the north (Milliken 1995:229, 258, 261). Only 20 members of the Tuibun tribe were identified in the baptismal records at Mission San Jose, and their principal villages are not known. The Yrgins (and related Jalquins) were incorporated into Mission San Francisco and Mission San Jose, and little is known about their villages. The Fremont Plains, an area that partially includes the Newark study zone, appears to have been densely populated, however. The explorer Fages in 1772 noted the presence of five villages, each with six conical houses, situated along the creeks flowing out of the East Bay hills (Milliken 1991:35).

Although ethnohistoric analyses have their own particular biases, it is worth noting that early European accounts do not suggest that Indian villages were located high atop mounded places. Shell was observed near Indian villages according to some explorers' journals (for example, Anza 1776 [A. Brown 1974:16–17], and Crespi 1772 [A. Brown 1994:13]), but there is little evidence that bay shore settlements in the Colonial period were associated with large shell mounds. Some of the villages were described as small groups of conical huts situated close to the area where marshes met groves of trees. It is possible that some of these villages may have been associated with small mounds, but the earliest European observations remain silent on this matter. Other villages were entirely situated away from the bay shore (A. Brown 1974; Milliken 1991).

Descriptions of abandoned villages are numerous in explorer accounts. Milliken (1995:21) identified them as seasonal villages whose populations had moved elsewhere during their annual rounds. But site abandonment may have taken place as Natives attempted to avoid confrontations with European explorers. It is even possible that site abandonment may have been the consequence of lethal epidemics unleashed during or even before the first face-to-face contacts with Europeans, although this scenario has yet to be critically evaluated.

Discussion

The implications of these space/time trends for interpretive models of East Bay shell mounds are twofold. First, the Middle period, between 500 BC to AD 900, appears to have been the golden age of shell mound communities in both study areas. Shell mound polities flourished across the bay shore region, with large mounded villages and village clusters probably serving as centers for undertaking diverse economic activities, observing ritual practices, augmenting the status and reputations of some tribal members, sponsoring mortuary feasting, and burying the dead. Detailed analyses of mammal, bird, fish, and mollusk remains from Middle period sites in the Richmond study area strongly suggest that these mounded villages were used most of the year (Brooks 1975:107; Holson et al. 2000:351–449, 579; Simons 1979:15.15; Veldhuizen 1981:15.22). At Middle period mounds, diverse foods were processed and consumed, including large terrestrial herbivores such as tule elk and black-tailed deer, along with smaller terrestrial game, harbor seals, and sea otters (Broughton 1994b, 1997, 1999; Simons 1992). The avifauna is dominated by geese, ducks, and shorebirds, while large numbers of sturgeon, chinook salmon, and bat rays were captured. At least two sites in the lower San Pablo Creek mound cluster are identified as possible sturgeon processing sites, where green and white sturgeons weighing over 20 kg were initially butchered (Holson et al. 2000:447–449, 577). Bay mussel is a common constituent in most Middle period sites, along with barnacles, crabs, whelks, oysters, burrowing clams, and bent-nose clams, depending largely on whether mud flat, rock, or gravel surfaces were being harvested (see Holson et al. 2000:394–397). Architectural evidence of house structures has been unearthed at a few Middle period sites, such as Emeryville, West Berkeley, and ALA-13 (Rackerby 1967:8; Schenck 1926:183, 195; Wallace and Lathrap 1975:44), and cooking areas, ovens, and pits were recorded in excavations of the lower San Pablo Creek mound complex (Banks and Orlins 1979).

Hundreds of burials of men and women, most in flexed positions, and some children were interred in the mounds (Banks and Orlins 1979, 1981, 1985; Bickel 1981; Holson et al. 2000; Nelson 1910; Uhle 1907). While many individuals were associated with none or a few mortuary goods, a few elaborate graves have been documented that contained substantial numbers of *Olivella* and *Haliotis* beads and ornaments (see Holson et al. 2000:535–551). Furthermore, at a few sites there is "tantalizing evidence" of the special way in which children were treated at death which may indicate a social system based on inherited status (Holson

2000: 551). Ceremonial offerings of birds of prey were also found in some mounds in both study areas (Phebus 1973; Wallace and Lathrap 1975).

Second, there is evidence of the abandonment of many bay shore locations during the Middle/Late Transition and Late periods. Banks and Orlins (1985:34) and Elsasser (1978:43) made similar observations about the abandonment of bay shore locations in the East bay at the end of the Middle period. Terry Jones' (1992:12–13) study of the broader settlement trends of the greater San Francisco Bay Area highlighted the profusion of bay shore components in the Middle period and a marked transformation in the Late period. "On the southern shore of the Bay, as on the open coast of Monterey Bay, the number of coastal sites occupied decreases, use of inland sites increases, and the overall number of residential sites decreases" (T. Jones 1992:13). Broughton (1999:31–33, Figure 5.2) also noted the impressive number of Middle period sites in his analysis of population dynamics in the greater Bay Area. He also located numerous Phase 1 sites in some places, a finding that emphasizes the importance of examining settlement trends in local regions to understand population dynamics on the broader, regional scale.

The process of abandonment is evident in the Newark study area, where three of the four sites in the Coyote Hills cluster were apparently abandoned at the end of the Middle period. The most striking evidence for the abandonment of mounded villages is observable in the temporal pattern of ^{14}C dates in the Richmond study area. Table 14.1 presents 82 ^{14}C dates (in radiocarbon years before present, or RYBP) for the 12 sites plotted in figures 14.8a and 14.8b. Calibrated dates, when reported in site reports and published articles, are also listed in table 14.1. As illustrated in figures 14.8a and 14.8b, only two sites in the Richmond study area are associated with ^{14}C dates younger than 1000 RYBP. These include the three youngest of 13 dates for ALA-309 (Emeryville shell mound) that range from 1030 ± 60, 950 ± 50, and 720 ± 60 RYBP, with calibrated dates of AD 890 to 1162, AD 1000 to 1215, and AD 1220 to 1395, respectively. Eleven of the 12 ^{14}C dates from CCO-297 range between 675 ± 80 and <150 RYBP (no calibrated dates are reported). Thus, the current chronological data for East bay shell mounds indicate the majority were abandoned as residential places before or during the Middle/Late Transition, between AD 700 and 1100.

In considering these terminal dates, it is important to emphasize that the upper deposits of the mounds may have been destroyed or removed before archaeological investigations took place (for example, Broughton 1999:32; Lightfoot 1997:135–136). Nelson (1909:327) observed in 1908 that "not a single mound of any size is left in absolutely pristine condition" and that most sites were being rapidly destroyed by agricultural practices, urban expansion, and commercial mining operations for garden soil and fertilizer. It is possible that many East Bay shell middens were occupied in the Late period, but that evidence of this late occupation was subsequently destroyed.

In evaluating this problem, we cannot rule out the possibility that more of the East bay mounds may have been occupied through the Middle/Late Transition or even Phase 1. We are not suggesting that, however, all bay shore mounds in all areas were abandoned or that mounds were abandoned at exactly the same time. The timing of abandonment was not uniform, as some bay shore sites continued to be occupied while others in both study areas were deserted. For example, both Ellis Landing and the Ryan Mound were supposedly occupied during Phase 1 of the Late period, and the small seasonally occupied site, ALA-446, was inhabited beginning in the Middle/Late Transition. Furthermore, there is some evidence that some bay locations were reused, but that the nature of the occupation does not appear to have been as intense or continuous as during the Middle period. We recognize that the abandonment process may be related to transformations in the use and function of bay shore locations. Some sites that served as mounded villages in the Middle period were apparently deserted and then later reused as special-purpose places in the Late period where individuals continued to be buried and where occasional gatherings and ceremonies took place.

There is no evidence that mounds or mound clusters were occupied as residential places at the time of early encounters between Spanish explorers and local Native tribes. As outlined above, our reading of journal accounts of early expeditions to the east shore of San Francisco Bay from AD 1769 to 1776 detected no mention of Native activities associated with large mounded villages or cemeteries. If the large mounded sites were still being occupied at this time, then we find it very odd that the multiple eyewitness accounts of the cultural landscape neglected to describe them. We recognize, however, that smaller mounded sites might still have escaped the notice of early explorers.

Abandonment and Reuse of Shell Mounds

Why were large shell mounds abandoned as residential places, with some then reused as special-purpose sites in the Late period? Several possible explanations are proffered that consider environmental degradation, subsistence change, population movements, and reorganization of local communities.

Environmental Degradation. Ingram (1998:108) suggested that the depopulation of mounded villages, such as West Berkeley, may be related to drought conditions associated with the Medieval Climatic Anomaly that affected sediment flows and the salinity levels of bay waters. Banks and Orlins

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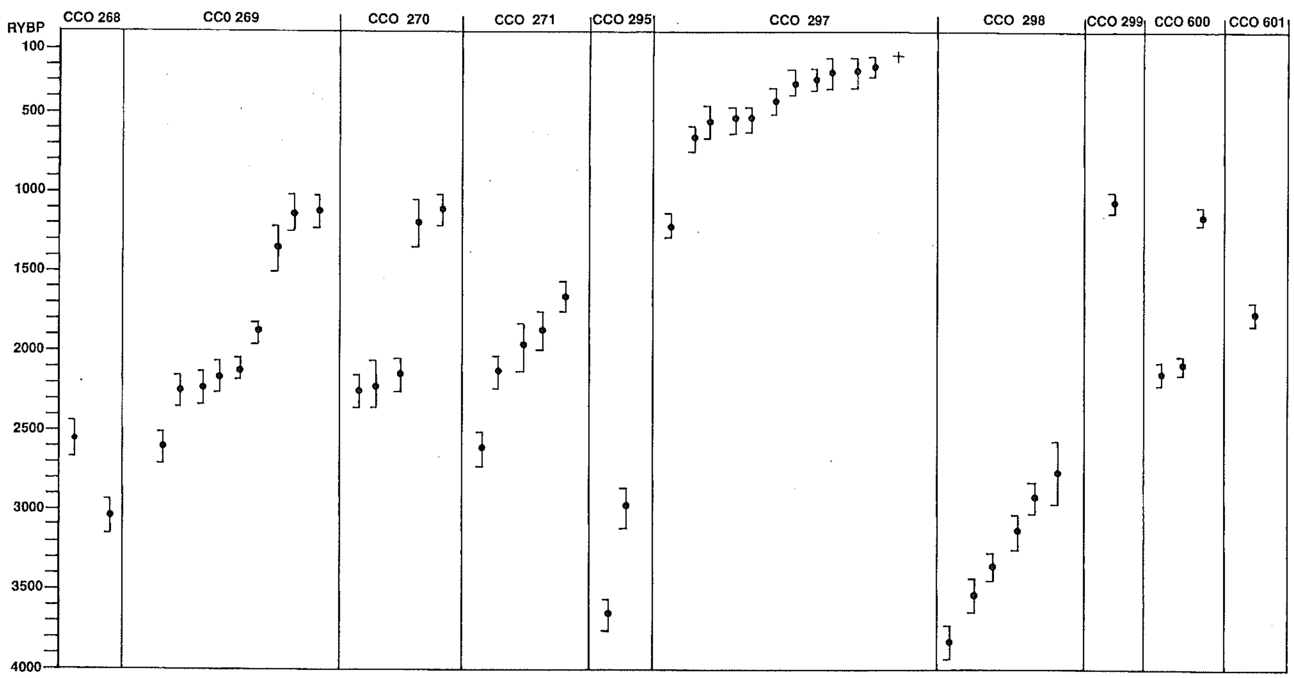

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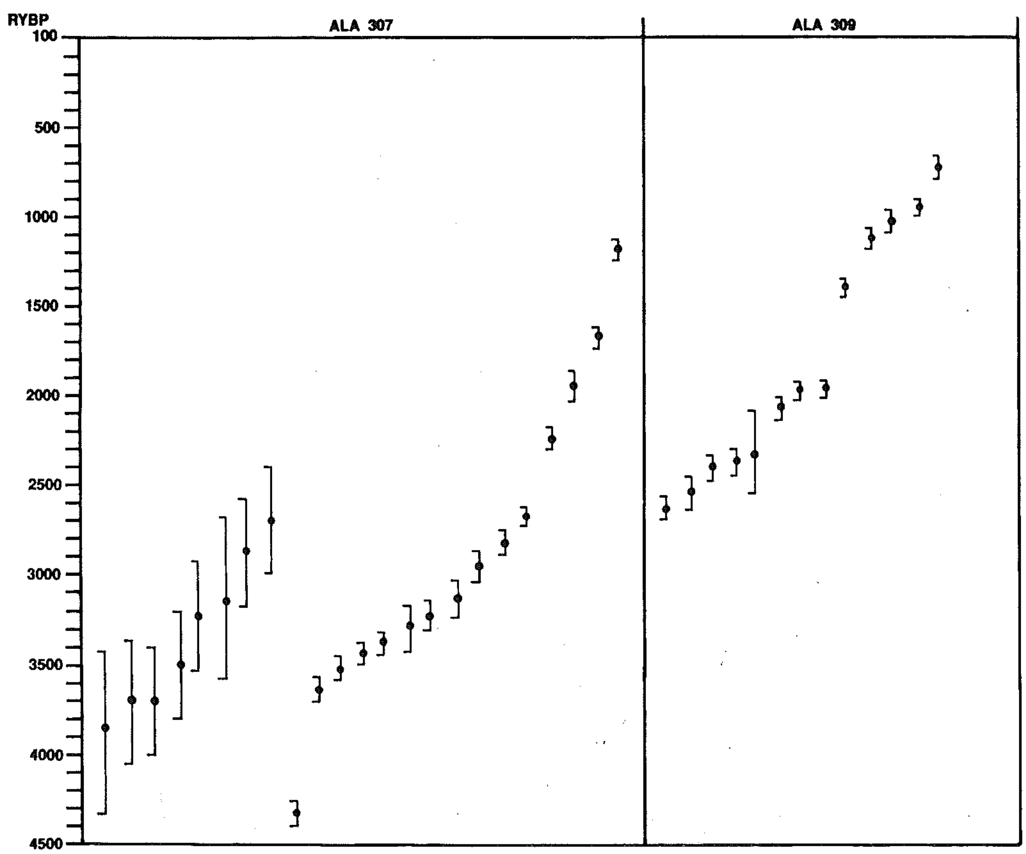


Figure 14.8 Radiocarbon dates (n=82) from 12 sites in the Richmond study area

(1985:115–117) argued that the abandonment of Late period Phase 1 sites was also related to warmer, drier conditions and to subsequent rapid sea level rise that affected the availability of bay shore resources.

Subsistence Change. Gould (1964:152), in considering Late period Phase 2 abandonment of shell middens, suggested it may be associated with the shift from shellfish collecting along the bay shore to acorn exploitation in interior valleys. He argued, similar to Heizer and Baumhoff (1956:38), that acorn economies afforded the significant advantage of producing a stable crop that could be stored. Gould proposed that, as people began to turn their attention to the oak woodlands of the interior, less and less time was spent at bay shore locations. This potential explanation has not yet been critically evaluated.

Population Movements. The explanation for population movements may involve intrusion of foreign peoples into the Bay Area or transitions from the bay shore to other areas, such as nearby interior valleys. Population intrusion has long been employed in California to explain changes in subsistence and settlement. It is possible that populations with no prior knowledge or use of shell mounds moved into the Bay Area from elsewhere. For example, Bennyhoff (1994b) argued for a Meganos intrusion from the Stockton district into the delta and interior valleys of Contra Costa County during the transition between the Early and Middle periods, and into the Middle period (see also Wiberg 1996, 1997). Bennyhoff (1994b:83) noted that the later Middle/Late Transition period was a time of disruption across Central California, and the advent of the Augustine pattern heralded the intrusion of Patwin speaking people into the North Bay. In considering the shell mounds of the East Bay, however, Bennyhoff (1994a:66) argued that the bay shore population of west Contra Costa and Alameda Counties represented a single population over time: the physical attributes of the skeletal remains did not change and numerous cultural traits persisted through time.

In another scenario, local populations may have shifted the location of their primary residences along the bay shore to interior valley places, possibly due to drought, intensified acorn exploitation, resource stress, or strife. In evaluating this option, it is interesting to note that a similar kind of abandonment or reorganization of space was taking place in the interior valleys of Contra Costa County, although the timing of this transformation appears to differ somewhat from the East Bay. In synthesizing settlement data from the Walnut Creek region, Banks, Orlins, and McCarthy (1984:3.17–3.19) noted that, during periods of increased alluvial deposition, sites were temporarily abandoned but then reoccupied when favorable conditions returned. But they observed that a significant change took place during the transition from the Berkeley to the Augustine pattern: "With a few exceptions, notably at CA-CCO-241 and -308, no habitation sites continued from Berkeley pattern times into Augustine pattern times. Most Berkeley pattern sites appear to have been abandoned, and Augustine pattern sites were established at new locations" (Banks, Orlins, and McCarthy 1984:3.19). Sites appear to have been abandoned between AD 500 and 700, while the reoccupation of new places began between AD 700 and 900 (see Banks, Orlins, and McCarthy 1984:3.21). Meyer and Rosenthal (1997:v.8), in their archaeological synthesis of the Los Vaqueros region, also observed a significant shift in subsistence and settlement during the Upper Archaic/Emergent Transition period (AD 450 to 1250). Few archaeological remains date to this period, suggesting a change to more short-term and periodic land use. Unlike the preceding and following periods, no clear residential bases were identified in the study area.

Reorganization of Bay Area Communities. The abandonment and reuse of some large shell mound sites may signal a transformation in the organization of bay shore communities that was related to changes in settlement round, social organization, and symbolic structure. For example, the apparent abandonment of many shell mounds as primary residential places in the Late period may be associated with settlement strategies involving a more dispersed seasonal round. Year-round occupation of mounded villages may have given way to a more fluid seasonal movement, as described in the ethnohistorical literature (for example, Milliken 1991, 1995).

There is some question as to whether the abandonment of mounded villages in the Late period was necessarily associated with depopulation of the region. Analyses of faunal remains from Late period sites by Broughton (1994b, 1997, 1999) and Simons (1992) indicate a significant decrease in the quantity of artiodactyl and sturgeon remains, while sea otter and smaller fishes increased substantially. While this change may be directly related to drought conditions, Broughton (1994b:387–390) made a strong case that this transformation in the exploitation of large to small prey was not related to environmental variables per se but rather to hunting pressure and overharvesting caused by increased human population densities in the Late Holocene. Broughton's scenario implies that sizeable human populations may have continued to use the East Bay after many shell mounds were abandoned as residential places. In this light, it is interesting that, while early Spanish accounts did not observe any shell mound communities per se, they did note the Bay Area was well populated with Native peoples. But this raises the intriguing issue of where Late period sites are located and whether they may be underrepresented in regional syntheses at the expense of the more visible shell mounds.

There are examples of Late period residential sites that are not mounded villages. For example, the McCoy site

(ALA-28) is a nonmound site located approximately 30 km east of the Newark study area in the interior Livermore Valley. Described by its excavators as a "village site" with a shallow, dark midden possessing at least 11 undisturbed "house depressions," some with floors, this single-component Late period site is associated with bone tools, ground stone items, and burials (McGeein and McGeein 1956). During the Late period, populations may have become more evenly distributed across the landscape, occupying both bay shore and interior habitats, a trend suggested by the settlement patterns during Late period Phases 1 and 2 in the Richmond study area (see figures 14.5 and 14.6). Rather than concentrating communities in shell mound clusters along the bay, Late period populations may have increasingly produced nonmounded residences, similar to ALA-28, in a variety of coastal, riparian, and oak-woodland places.

The paucity of Late period residential sites may be related to the problem of detecting nonmounded sites with relatively low archaeological visibility. This detection bias will be even greater if Late period residences are buried under alluvium, either along the bay shore or interior drainages that feed into the bay. As described earlier, there have been episodes of alluvial deposition along the bay margins (for example, hydraulic mining debris) and the floodplains of streams and creeks in interior valleys. Three sites just outside the Newark study area may provide us with other examples of what these nonmounded habitation sites look like: ALA-342, described as a Late period campsite with pit ovens, cobbles, and burials (C. King 1968, 1978); ALA-48, a large "black habitation midden" with hearths, burials, and ground stone items, located at the mouth of a creek draining Niles Canyon (Pentergast 1951); and ALA-53, a nonmidden site located 20 km north of the Coyote Hills, with human remains, mortars, and shell items buried under more than a meter of deposits (Lanning and Bennyhoff 1955). We suggest the strong probability that nonmounded sites situated along the bay shore or interior drainages have been buried, and that we are observing only a partial picture of the regional settlement system.

It is significant that, at about the same time the mounded villages were being abandoned and then reused, innovations in mortuary practices, including cremations and inflationary offerings of shell beads, appeared among communities along the bay shore and interior valleys (Fredrickson 1974b; Milliken and Bennyhoff 1993). In addition, significant shifts in regional exchange networks took place. Obsidian trade or procurement from North Coast Ranges and the Eastern Sierra Nevada sources (primarily Bodie and Casa Diablo) in the Early and Middle periods changed to primarily Napa Valley obsidian in the Late period (Bard, Busby, and Kobori 1983:13.7; Meyer and Rosenthal 1997:v.10–v.11; Wiberg 1997:19). Clam disk beads probably originating from the Marin and Sonoma coastline were also recovered in large numbers from sites with Late period components (Wiberg 1996:379).

The reorganization of East Bay communities appears to have involved a transformation in the ideological meaning of mounded villages and the corporate identity of local mound groups that was symbolized by the remains of ancestors going back many generations. Indeed, the likely association between feasting, prestige enhancement, and large shell mounds, as discussed by Luby and Gruber (1999), may have reached its climax in the Middle period. The reoccupation or reuse, however, of some of the large mounds also suggests that a core function of the mounds as places for burying the dead was retained. Although the local community still continued important activities at the mounds, such as ceremonial celebrations of the ancestors and periodic communal feasting during burials, they were probably occupied on a more limited basis, as nonmounded villages may have become more common in the Late period. If higher population densities and increased territorial circumscription took place during the Late period, as some ethnohistorical analyses suggest, then feasting and other redistributive behaviors may have been more important than ever in easing competitive pressures, as discussed in more detail by Luby and Gruber (1999).

Finally, unlike the lower Sacramento Valley and the Santa Barbara Channel areas, few bioarchaeological analyses of populations in the East Bay have focused on diachronic changes in health levels, stress indicators, or levels of interpersonal violence, which elsewhere in California have provided insight into resource stress (for example, Dickel, Shulz, and McHenry 1984; Lambert 1994; Lambert and Walker 1991; Walker 1986). Instead, most studies have identified pathological features in specific individuals or have characterized general health levels based on assessments of entire populations recovered from sites. Studies of archaeologically recovered populations from ALA-328 and ALA-329, for example, identified relatively high levels of both dental and degenerative diseases, as well as evidence of interpersonal violence, but did not examine temporal trends within each of these sites (Brabender 1965; Jurmain 1990a, 1990b, 1991). The investigation of health and disease from a temporal perspective, which is increasingly common in CRM studies (for example, Holson et al. 2000; Wiberg 1996), promises to make significant contributions to studies of change in population density and territorial circumscription in the greater San Francisco Bay Area.

CONCLUSION

We believe East Bay Native communities underwent significant transformations during the transition between the Middle and Late periods. Key structural components of these changes probably included alterations in ceremonialism, subsistence technology, mortuary ritual, and regional trade patterns. In particular, the view offered of East Bay Native communities in ethnohistoric and ethnographic analyses, in which village populations dispersed and reconvened in various camps throughout the year, may have been set in motion by the likely abandonment of shell mounds during the Middle/Late Transition period (AD 700 to 1100). Whatever the specific factors involved in these settlement changes, whether environmental, demographic, technological, biological, or ideological, there appears to have been a shift in the use and function of the larger shell mounds at the close of the Middle period. During the Late period, larger shell mounds either remained unoccupied or were reused in different ways. We believe this situation reflects wider organizational changes throughout East Bay Native communities at this time.

This study highlights the potential problems of employing taxonomic systems that assume progressive evolutionary changes from simple to complex over time. While previous cultural historical frameworks provide many insights regarding material culture change, we need not presume that the transformation from the Berkeley to Augustine pattern, for example, would entail greater sociopolitical complexity. We feel the transition between the Middle and Late periods is best viewed as a series of organizational changes that took place in cultural systems that were markedly complex and distinctive in their own way. Future investigations may find it informative to consider the many varied dimensions of hunter-gatherer complexity across these periods, regardless of whether or not such complexity resulted in more or less hierarchically organized complex societies.

Acknowledgments. We are grateful for the assistance of John Holson of Pacific Legacy who made available reports from recent mitigation work in the greater San Francisco Bay Area and kindly provided information regarding sites CCO-269, CCO-270, CCO-600, and CCO-601. We appreciate the constructive comments of Roberta Jewett, Terry Jones, Jon Erlandson, and anonymous reviewers of an earlier version of this chapter. Our thanks to Judith Ogden for drafting the figures.

CHAPTER 15

Late Holocene Cultural Diversity on the Sonoma Coast

KATHERINE M. DOWDALL

In this chapter, I explore the Late Holocene coexistence of three distinctive lifeways on the Sonoma Coast of Northern California (figure 15.1) by comparing contemporaneous, yet contrasting, assemblages recovered from lithic deposits, camp sites, and residential sites. Earlier in time, people engaging in two of these three distinctive lifeways occupied adjacent territories, a not uncommon situation. As time went on, people with two distinctive lifeways occupied portions of the same territory. Groups with different lifeways inhabiting the same geographic space have been studied extensively by cultural anthropologists. Such groups include the Mbuti, Efe, Aka, and Baka hunter-gatherers and Bantu agriculturalists of the African rainforest (see Hewlett 1996; Turnbull 1962). In the North Coast Ranges, archaeologists have been studying the coexistence of different prehistoric lifeways for over 25 years (Dowdall 1995; Fredrickson 1974a; Hayes and Hildebrandt 1985; Psota 1994; Stewart 1993; Wickstrom 1986; White 1984; White and Fredrickson 1992; White et al. 2000).

Ethnographers have recorded considerable variation in sociopolitical complexity among California tribelets (see Heizer 1978; Kroeber 1925, 1962). Those considered less complex (that is, village communities) tended to show such traits as band social organization, ad hoc exchange, absence of social ranking or central administration, and no craft specialization. Tribelets that were considered more culturally complex, showed such traits as sedentism, regularized exchange, social ranking, relatively strong but noncoercive central administration, and craft specialization. Still others appeared to shift between these two extremes, spending part of the year as extended family bands and the rest of the year in multifamily and semipermanent villages (Fredrickson 1996; see also Gearing 1958; Oliver 1962).

In 1973, Fredrickson proposed the archaeological "pattern" as a polythetic taxonomic unit that helps recognize spatial variability in the material record, including traits related to variations in sociopolitical complexity. The pattern is thought to reflect a way of life shared by a number of different peoples usually residing in adjacent territories within a larger geographic space (Fredrickson 1994a:40). It is marked by typologically cohesive assemblages of artifacts used directly in coping with the environment (Fredrickson 1994c:78). Cultures that share a pattern can be assumed to interact more with one another, both directly and indirectly, than with cultures exhibiting different patterns (Fredrickson 1994a:40). As conceived by Frederickson (1994a:41), an archaeological pattern shares similar technological skills and devices; similar economic modes of production, distribution, and consumption, especially in trade networks and practices surrounding wealth; and similar mortuary and ceremonial practices.

My research suggests that three patterns coexisted on the Sonoma Coast during the Late Holocene. The Mendocino pattern represents mobile groups present along the northern Sonoma Coast between about 2000 BC and continuing for some time after AD 1000. The Augustine pattern, dated between about AD 1000 to 1800, represents extended residential use of the northern coast. The Berkeley pattern, dated between about 1500 BC and AD 1000, represents a more sedentary lifeway on the southern Sonoma Coast. Sites resulting from human occupation related to these three archaeological patterns are distinguished by their distinctive technological assemblages, including different proportions of obsidian debitage and tools from different interior sources.

ENVIRONMENTAL SETTING

Contemporary Conditions

Today, the exposed northern Sonoma Coast is shrouded in fog most of the year and characterized by flat wind-swept

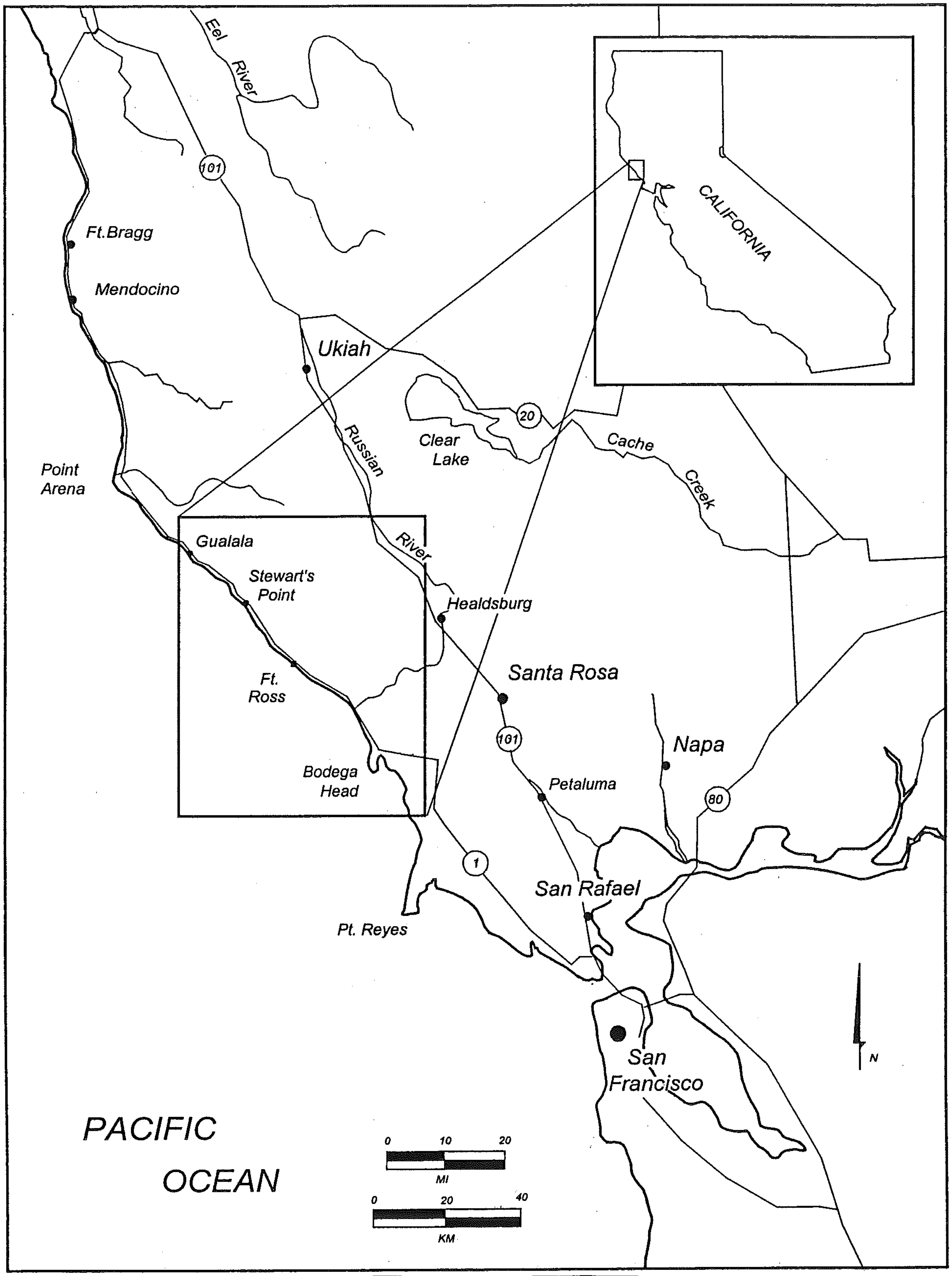


Figure 15.1 Location of the Sonoma Coast

terraces jutting out over the Pacific Ocean. The terraces are dotted with sandstone outcrops that provide the only shelter from prevailing winds. Along the terraces is a host of coastal strand and prairie plant communities. The coastal strand is dominated by lowlying species such as sagebrush (*Artemisia pycnocephala*) and lupine (*Lupinus arboreus*) (Munz and Keck 1973:12). Native coastal prairie species consist of bunch grasses and various flowering herbs (Munz and Keck 1973:17).

A rocky intertidal zone lies below the cliff edge where the terraces meet the Pacific Ocean. The terraces rise to the east in a series of geologically uplifted and eroded steps that, as they gain height, become ridges. The ridges continue for 32 kilometers, serving as part of a trail system. Creeks fed by springs and rivers begining in this ridge system, cut across the terraces, and drain into the Pacific Ocean. The terraces support many species of birds, as well as rabbits and black-tailed deer (J. Arnold 1970:117-141). The creeks contain freshwater and anadromous fish, and the rocky intertidal zone supplies a variety of shellfish.

On the southern Sonoma Coast, Bodega Bay provides an extremely rich biotic environment. Both saline and freshwater marshes, as well as more than 500 acres of tidal flats, are protected by high sand dunes. A rocky intertidal zone occurs along the Bodega Peninsula, and estuaries are located on the west side of the Russian River and at the mouths of Salmon Creek and Estero Americano. The 15 km of rolling hills make access to inland areas relatively unchallenging. The harbor waters and freshwater marsh sustain fish and birds, as do the tidal mud flats during high tide. During low tide, large clams may be procured from the mud flats. The rocky shore supplies a variety of shellfish, and black-tailed deer are abundant throughout the area. In ethnographic times, elk were common on both the northern and southern Sonoma Coast (Gifford 1967:16; Kelly 1991:135).

Paleoclimate

Pollen samples from 13 locations in the North Coast Ranges show signs of a Middle Holocene optimum (ca. 6500 to 1570 BC) when drought-tolerant species expanded, temperatures were higher, and precipitation was lower than today (West 1993:230). After circa 1570 to 350 BC, declining oak pollen values and increasing Douglas fir values at most localities suggest more maritime conditions, with wet winters and moderate temperatures throughout the year (West 1993:230). These data suggest that, for much of the Late Holocene, temperatures were comparable to those of today throughout the North Coast Ranges. A pollen core dated to about AD 650 from Preston Lake in northern Sonoma County suggests only minor changes in local and upland vegetation (West 1985:11). Within the redwood belt adjacent to the Sonoma Coast, West (1988) found that between AD 330 and initiation of logging in the 1800s, a dense redwood forest with little understory or ground cover existed.

ETHNOHISTORIC BACKGROUND

In ethnographic times, the Kashaya Pomo occupied the exposed northern Sonoma Coast and interior ridges, and the Bodega Miwok occupied the sheltered southern coast and adjacent rolling hills (figure 15.2). Although both groups exhibited collector subsistence strategies and a central-based village settlement pattern (Kelly 1978; Stewart 1943), marked differences existed between them. The Kashaya had permanent villages situated at varying distances from the ocean (as much as 35 km inland) and seasonal camp sites along the coast, on creek banks, and in the redwoods (Bean and Theodoratus 1978:289; Gifford 1967:7). Kashaya coastal camp sites were primarily occupied between April and June when shellfish and ocean fish were harvested (Kniffen 1939).

During winter, the interior villages above the Gualala River were occupied and the coast was nearly deserted. Late fall activities led to a movement to the interior, but the exposed coast was not a desirable place to live anyway. Heavy midwinter rains swelled the local rivers, and salmon fishing began using spears or basketry traps. Traps, used primarily on smaller creeks where dams could be constructed, were inserted in breaks in these structures. By April, the salmon season was ending, and with it the drift toward the coast began. By late spring, the coast villages were occupied. Mussel, clam, abalone, and ocean fish were caught and deer were shot. Villagers baked shellfish by covering them with leaves, coals, and hot rocks. They caught marine fish with deer bone hooks attached to kelp lines and baited with abalone or other materials. Interior Pomo from Ukiah and Cloverdale came to gather seaweed at this time. There was no fee or exchange charged for use of the resource, nor did the visitors need to formally ask permission.

As spring advanced there was greater activity. Days were spent gathering and drying seaweed or collecting salt. Women gathered roots, preferring moist spots lying on the inner margin of the coastal terrace. They gathered wild celery, wild onion, and wild potato. Clover was eaten in great quantities at this time of year. By mid-June activities gradually decreased along the coast (Kniffen 1939:385-388). Acorns, collected in the fall and used throughout the year in meal or bread, were a staple. In addition, buckeye nuts, a variety of berries, and seeds from at least 15 grasses were gathered (Bean and Theodoratus 1978:290). Gifford (1967:17) reported that the Kashaya did not use sea lions, seals, or whales.

Patterns of seasonality and settlement were different for the Bodega Miwok whose coastal territory included low-lying areas with extensive bays, lagoons, sloughs, and marshes. Villages, concentrated on the shores of Bodega Harbor, were occupied year-round, while others were situated along the

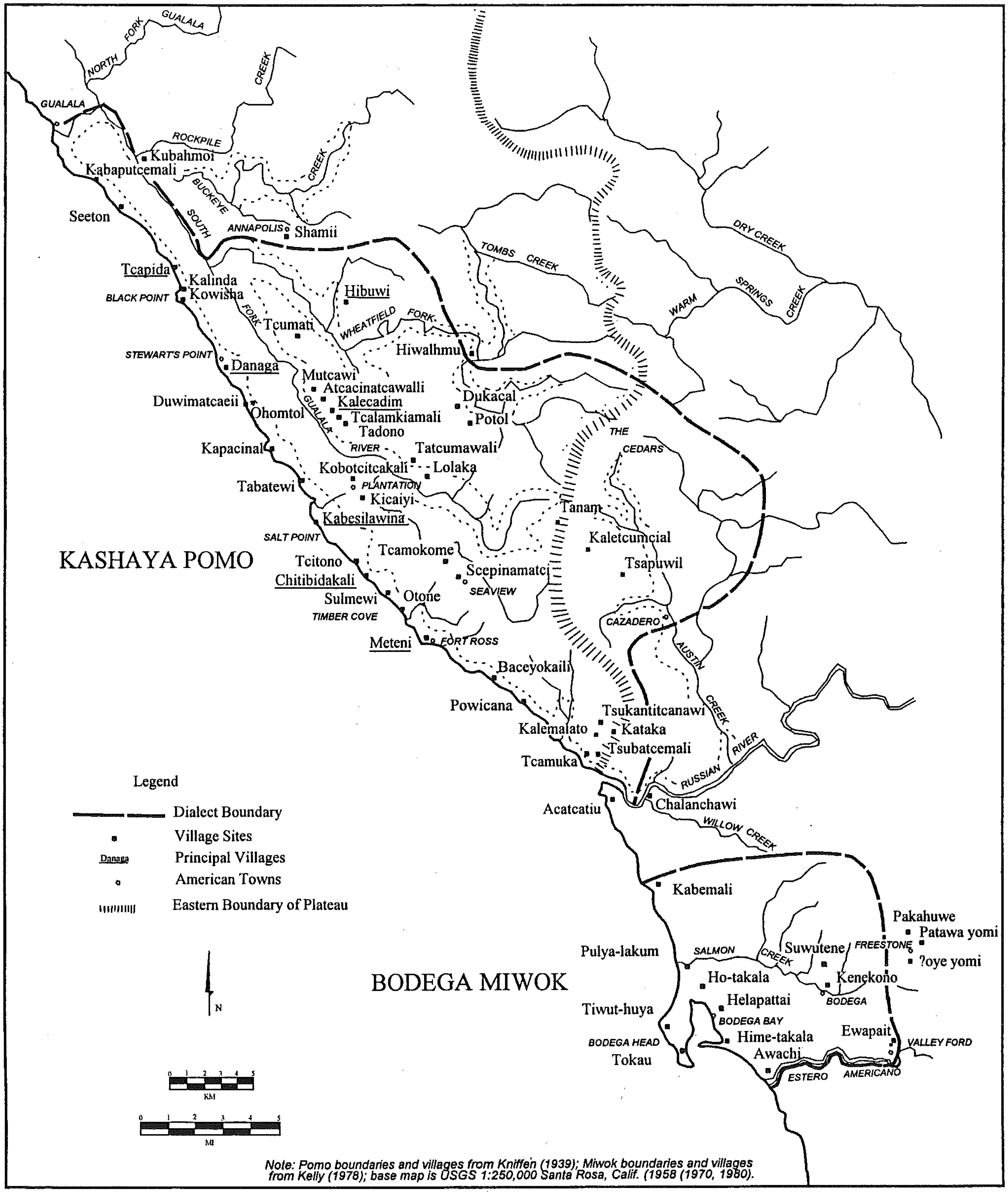


Figure 15.2 Ethnographic territories of the Kashaya Pomo and Bodega Miwok

open coast and in the interior. Although villages were adjacent to the shore, lagoons, and sloughs, in the summer attention shifted to the hills for hunting and for gathering vegetable products (Kelly 1978:416).

Some animal foods, such as deer and crab, were available throughout the year. Winter and early spring were times of shortage, when stored dried acorns, seeds, and kelp were the mainstay. Steelhead and salmon were taken during the winter runs. In late winter there were geese; in spring small fish stranded at low water in pools on the rocks were collected, and another species of kelp was eaten (Kelly 1978:415-416). Generally, there was heavy reliance on fish. Surf fish were caught with circular dip nets, and bay fish in seines stretched between tule balsa boats. A line with gorge was used for bullhead; weirs, dip nets, or stabbing spears for steelhead and salmon; and nets or poison for eels.

With regard to shellfish, only mussels and several kinds of clams were important as food. The relative abundance of shellfish was made clear by Miwok consultant, Tom Smith, who stated that: "...deer were not plentiful, rabbit more plentiful than deer, and more clams than rabbits were eaten" (Tom Smith [Kelly 1978:416]). Like the Kashaya to the north, the Bodega Miwok reportedly did not eat sea mammals. Acorn-bearing oaks, clam beds, fishing spots, and hunting locations could all be privately owned by an individual or a family, and tribal members paid to use such lands. These places were never sold but were inherited by other family members (Kelly 1991:193-195).

HISTORY OF ARCHAEOLOGICAL RESEARCH

No fewer than 30 archaeological sites have been investigated on the Sonoma Coast over the last 60 years or so (table 15.1; figure 15.3). Most of these have been investigated in the last several decades within the context of cultural resource management projects.

Beardsley published the first work on the southern Sonoma Coast in 1954 when he identified a variant of the Berkeley pattern at Bodega Bay, marked by elaborate bone tools and other artifacts that indicated ties to San Francisco Bay. Subsequent research confirmed these initial findings (Alvarez 1990; Fredrickson 1962). At about the same time, Meighan completed subsurface investigations at two protohistoric Kashaya sites: coastal SON-250/H, and SON-256 located about 5 km inland. Completed in 1951, these investigations were reported late in 1967 (Meighan 1967). Both sites contained obsidian and chert artifacts, animal bone, and stone tools. The artifact types varied between the two sites, however, and the interior site contained clamshell disk beads and glass bifaces. Meighan argued that the variation was indicative of distinct seasonal living patterns.

In 1962, Fredrickson carried out investigations at SON-292, SON-293, and SON-324 on Bodega Head, where he identified two distinct temporal occupations, one dating to the Middle period and the other to the Late period. Both were thought to represent seasonal use of marine resources. Frederickson concluded that Bodega Head was used intensively during the Middle and early Late periods until about AD 1500, when the Coast Miwok began using the area either less intensively or for shorter periods of time.

Also interested in linguistic prehistory, Layton (1990) conducted excavations in southern Mendocino County to test models of Pomo prehistory. He suggested that the sudden appearance of Konocti obsidian on the coast at a time correlated with hydration values of about 2.5 microns represented the westward expansion of Pomoan speakers from the interior to the Mendocino Coast (Layton 1990:60).

Lightfoot, Wake, and Schiff (1991) reported the results of ethnohistoric and archaeological survey work in the Fort Ross vicinity. Like other workers who had conducted survey-based research on the northern Sonoma Coast (Bramlette and Dowdall 1989; Pritchard 1970), Lightfoot, Wake, and Schiff (1991:111-112) found that the earliest sites in their study area were broad, dispersed lithic deposits and that intensive occupation did not begin until about AD 1000. Lightfoot also tested the applicability of Perlman's (1980) coastal productivity model to the northern Sonoma Coast through analysis of findings from previous work in the area along with data supplied by his excavations at Fort Ross. Perlman predicted that low productivity resource areas, such as the rocky Sonoma Coast, would restrict sociopolitical complexity and support only small, highly mobile hunter-gatherer populations. Lightfoot (1992) found that the Sonoma Coast did not support Perlman's model and suggested that Late period settlement patterns functioned around a central "village" located along the first ridge, with short-term camps on the coast and inland. Lightfoot (1992:50) further pointed out that, as Stewart (1943) first suggested, high population densities and sociopolitical differentiation may be associated with this type of settlement pattern.

Schwaderer (1992) reported on excavations at SON-348/H near Duncan's Landing, where the ^{14}C chronology indicates human occupation between about 7580 and 1120 cal BC (table 15.2). Five temporal components were identified based on stratigraphy, ^{14}C dates, and midden constituents. The obsidian artifacts recovered came primarily from the Napa and Annadel sources, with hydration measurements ranging from 1.3 to 7.1 microns for Napa obsidian and 1.3 to 5.2 microns for Annadel obsidian (Schwaderer 1992:59-60). The projectile points recovered were primarily nondiagnostic lanceolate forms (Schwaderer 1992:62). A wide variety of resources was processed at SON-348/H, suggesting year-round site use. This usage implies that, from the earliest documented human presence, obsidian was arriving at the site

Table 15.1 Excavated sites on the Sonoma coast

SITE	SITE TYPE	OBSIDIAN HYDRATION SOURCE	OBSIDIAN HYDRATION RANGE/MEAN/SD	SITUATION/ELEVATION	ARTIFACTS	REFERENCE
SON-190	Lithic deposit	Annadel Napa Konocti Borax Lake	1.2–3.5 / 2.4 / 0.7 2.3–4.4 / 3.4 / 0.7 2.0–6.0 / 3.5 / 0.9 2.9–8.4 / 3.2 / 0.2	Coastal terrace, 30 m	Projectile point, biface, flake tool, used flake, core, battered cobble	Purser et al. 1990
SON-250 / H	Camp	Annadel Napa Konocti Borax Lake	1.6-3.3 / 2.5 / 0.5 2.3-2.3 / 2.3 / 0.0 2.3-2.5 / 2.4 / 0.1 –	Coastal terrace, 75 m	Projectile points, dietary shell, dietary bone	Meighan 1967 Beard 1997
SON-256	Camp			Coastal terrace adjacent to creek, 50 m	Projectile points, unifaces, cores, battered cobbles, bone tools, *Haliotis* pendant blank, dietary shell, dietary bone	Meighan 1967
SON-292	Residential	Annadel Napa Konocti Borax Lake	1.0–1.8 / 1.4 / 1.0 0.1–4.0 / 2.7 / 1.0 – –	Small point, 25 m	Projectile points, unifaces, flake tools, cores, ground stone, pitted stones, battered cobbles, human bone, beads, bone tools, dietary shell, dietary bone	Fredrickson 1962
SON-293	Residential	Annadel Napa Konocti Borax Lake	1.1–2.6 / 1.9 / 0.5 1.0-5.3 / 3.2 / 1.3 – –	Small point, 25 m	Projectile points, flake tools, unifaces, battered cobbles, beads, dietary shell, dietary bone	Fredrickson 1962
SON-298	Residential	Annadel Napa Konocti Borax Lake	– 1.0–3.6 / 2.1 / 1.0 – –	Harbor, 25 m	1 projectile point, unifaces, human remains, 1 bead, dietary shell, dietary bone	Robinson 1985
SON-299	Residential			Harbor, 5 m	Projectile points, bifaces, ground stone, notched stones, human graves, red ochre, quartz crystals, charm stones, beads, *Haliotis* ornaments, bone tools, dietary shell, dietary bone	Porter and Watson 1933
SON-300	Residential	Annadel Napa Konocti Borax Lake	1.3–1.9 / 1.6 / 0.2 2.0–3.6 / 2.4 / 0.3 – –	Harbor, 10 m	Projectile points, human bone, dietary shell, dietary bone	Fredrickson 1976
SON-320	Residential			Harbor, 5 m	Projectile points, 1 drill, 1 core, beads, *Haliotis* pendants, worked steatite, dietary shell, dietary bone	King 1966
SON-321	Residential	Annadel Napa Konocti Borax Lake	1.2–2.3 / 1.75 / 0.4 1.8–3.6 / 2.7 / 0.6 – –	Harbor, 10 m	Projectile points, flake tools, battered cobbles, dietary shell, dietary bone	Alvarez 1991
SON-324	Residential	Annadel Napa Konocti Borax Lake	1.0–3.4 / 2.2 / 0.7 – – –	Cove, 25 m	Projectile points, ground stone, battered cobbles, notched stones, features, human remains, 1 clam shell fish hook, beads, dietary shell, dietary bone	Fredrickson 1962

continued

Table 15.1, *continued*

SITE	SITE TYPE	OBSIDIAN HYDRATION SOURCE	OBSIDIAN HYDRATION RANGE/MEAN/SD	SITUATION/ELEVATION	ARTIFACTS	REFERENCE
SON-347	Residential	Annadel Napa Konocti Borax Lake	0.9-1.1/1.0/ 0.0 1.0-2.7/1.0/ 0.0 – –	Coastal bench, 10 m	Projectile points, bifaces, features, beads, bone tools, dietary shell, dietary bone	Adams et al. 1997
SON-348/H	Residential	Annadel Napa Konocti Borax Lake	1.3-5.2/3.3/ 1.2 1.3-7.1/3.8/1.5 – 7.4-7.4/ 7.4/ 0.0	Rock shelter on coastal terrace, 20 m	Projectile points, ground stone, flake tools, features, beads, *Haliotis* pendant blank, bone tools, dietary shell, dietary bone, floral residues	Schwaderer 1992
SON-369	Residential			Knoll between two ravines with creeks, 300 m	Projectile points, ground stone, pitted stones, red ochre, worked steatite, *Haliotis* pendant blank, beads, bone tools, dietary shell, dietary bone	Meighan 1967
SON-458 lithic locus	Lithic deposit	Annadel Napa Konocti Borax Lake	1.1-3.7/2.4/0.8 1.3-5.3/3.3/1.2 2.0-4.8 /3.6/0.9 1.4-1.4/1.4/ 0.0	Coastal terrace, 10 m	Projectile points, biface, uniface, flake tool, battered cobble, blood residues	Dowdall 1995
SON-458 shell locus	Camp	Annadel Napa Konocti Borax Lake	1.1-2.0/1.6/0.3 1.0-2.5/1.8/0.5 2.0-2.3/ 2.2/0.2 –	Rock shelter on coastal terrace, 10 m	Projectile points, biface, core, battered cobbles, pecked cobble, groundstones, dietary shell, dietary bone, floral residues	Dowdall 1995
SON-458 non-shell locus	Camp	Annadel Napa Konocti Borax Lake	1.2-2.1/1.7/0.3 1.0-2.6/1.8/0.5 1.9-2.3/2. 1/ 0.2 2.9-2.9/2.9/ 0.0	Coastal terrace, 10 m	Projectile points, bifaces, uniface, used flakes, core, battered cobbles, pecked cobble, groundstones, girdled stones, dietary bone, floral residues	Dowdall 1995
SON-473	Camp			Coastal terrace, 10 m	Bifaces, unifaces, ground stone, pecked cobbles, battered cobbles, dietary shell, dietary bone	Dowdall 1988
SON-670/H	Residential	Annadel Napa Konocti Borax Lake	0.9-1.8/ 1.4/0.3 1.2-4.4/2.1/ 0.7 – –	Sheltered gully adjacent to creek, 30 m	Projectile points, beads, bifaces, battered cobbles, pecked cobble, ground stones, girdled stone, and fire-affected rock	Stillinger 1975; Leary et al. 1991; Lightfoot et al. 1991
SON-865	Lithic deposit	Annadel Napa Konocti Borax Lake	1.1-3.0/2.1/ 0.6 1.3-5.9/3.6/ 1.4 1.0-4.4/2. 7/ 1.0 1.4-5.3/3.3/ 1.1	Coastal terrace, 15 m	Projectile point, biface, flaked tool, used flakes, core, battered cobbles pecked cobble, ground stones, and floral residues	Dowdall 1995

continued

Table 15.1, *continued*

SITE	SITE TYPE	OBSIDIAN HYDRATION SOURCE	RANGE/ MEAN/SD	SITUATIONELEVATION	ARTIFACTS	REFERENCE
SON-867	Lithic deposit	Annadel Napa Konocti Borox Lake	1.2–4.7 / 2.1 / 0.5 0.9–7.5 / 2.7 / 1.0 1.0–4.0 / 2.6 / 0.9 0.8–0.8 / 0.8 / 0.0	Coastal terrace, 15 m	Projectile points, bifaces, flaked tool, core, battered cobbles, groundstones and floral residues, blood residues	Dowdall 1995
SON-1453	Lithic deposit	Annadel Napa Konocti Borox Lake	2.2–3.3 / 2.8 / 0.4 2.2–6.6 / 4.4 / 1.3 – –	Coastal terrace, 10 m	Bifaces, ground stone, battered cobbles	Allison et al. 1989
SON-1454 / H	Lithic deposit Historic period component	Annadel Napa Konocti Borox Lake	1.0–4.8 / 2.0 / 0.6 1.0–5.9 / 3.5 / 1.5 – –	Coastal terrace, 10 m	Bifaces, ground stone, battered cobbles	Allison et al. 1989
SON-1455	Camp	Annadel Napa Konocti Borox Lake	0.8–2.5 / 1.3 / 0.3 1.0–3.9 / 1.7 / 0.4 1.0–2.3 / 1.7 / 0.4 1.2–3.2 / 2.3 / 0.7	Coastal terrace, 25 m	Projectile points, bead, bifaces, used flakes, cores, battered cobbles, pecked cobble, groundstone, girdled stones, shell, fire-affected rock, dietary bone	Farris 1986
SON-1661	Lithic deposit	Annadel Napa Konocti Borox Lake	1.2–4.0 / 2.6 / 0.9 1.3–5.7 / 3.5 / 1.3 1.6–5.3 / 2.8 / 1.1 2.6–7.9 / 3.7 / 0.7	Coastal terrace, 75 m	Projectile points, bifaces, unifaces, ground stone, pitted stones, pecked cobbles	Dowdall n.d.
SON-1896	Camp site	Annadel Napa Konocti Borox Lake	0.9–1.0 / 1.0 / 0.1 0.9–1.6 / 1.3 / 0.3 – –	Hill top, 170 m	Projectile point, beads, used flakes, groundstones, shell, dietary bone, floral residues	Parkman 1990
SON-1897 / H (NAVS)	Lithic deposit Protohistoric residential component	Annadel Napa Konocti Borox Lake	0.9–5.2 / 2.7 / 1.1 1.0–6.6 / 3.3 / 1.4 – –	Coastal terrace, 30 m	Projectile points, bifaces, flake tools, ground stone	Lightfoot et al. 1997
SON-1898 / H (FRBS)	Lithic deposit Russian period component	Annadel Napa Konocti Borox Lake	1.1-4.6 / 2.2 / 0.7 1.2–4.8 / 3.0 / 1.1 – 2.0–3.1 / 2.5 / 0.4	Beach below coastal terrace, 0 m	Projectile points, bifaces, flake tools, ground stone	Lightfoot et al. 1997
SON-1918	Lithic deposit	Annadel Napa Konocti Borox Lake	1.3–3.6 / 2.6 / 0.7 1.0– 6.2 / 3.2 / 1.3 3.0–3.5 / 3.2 / 0.2 –	Coastal terrace, 15 m	Projectile point, bifaces, uniface, battered cobbles, groundstone	Dowdall et al. 1991
Tomato patch	Residential Russian period component	Annadel Napa Konocti Borox Lake	– 0.7–2.6 / 2.1 / 0.8 – 1.0–2.4 / 1.7 / 0.5	Ridge top, ca. 100 m	Projectile points, bifaces, flake tools, ground stone, pitted stones, features, beads, dietary shell, dietary bone	Martinez 1998

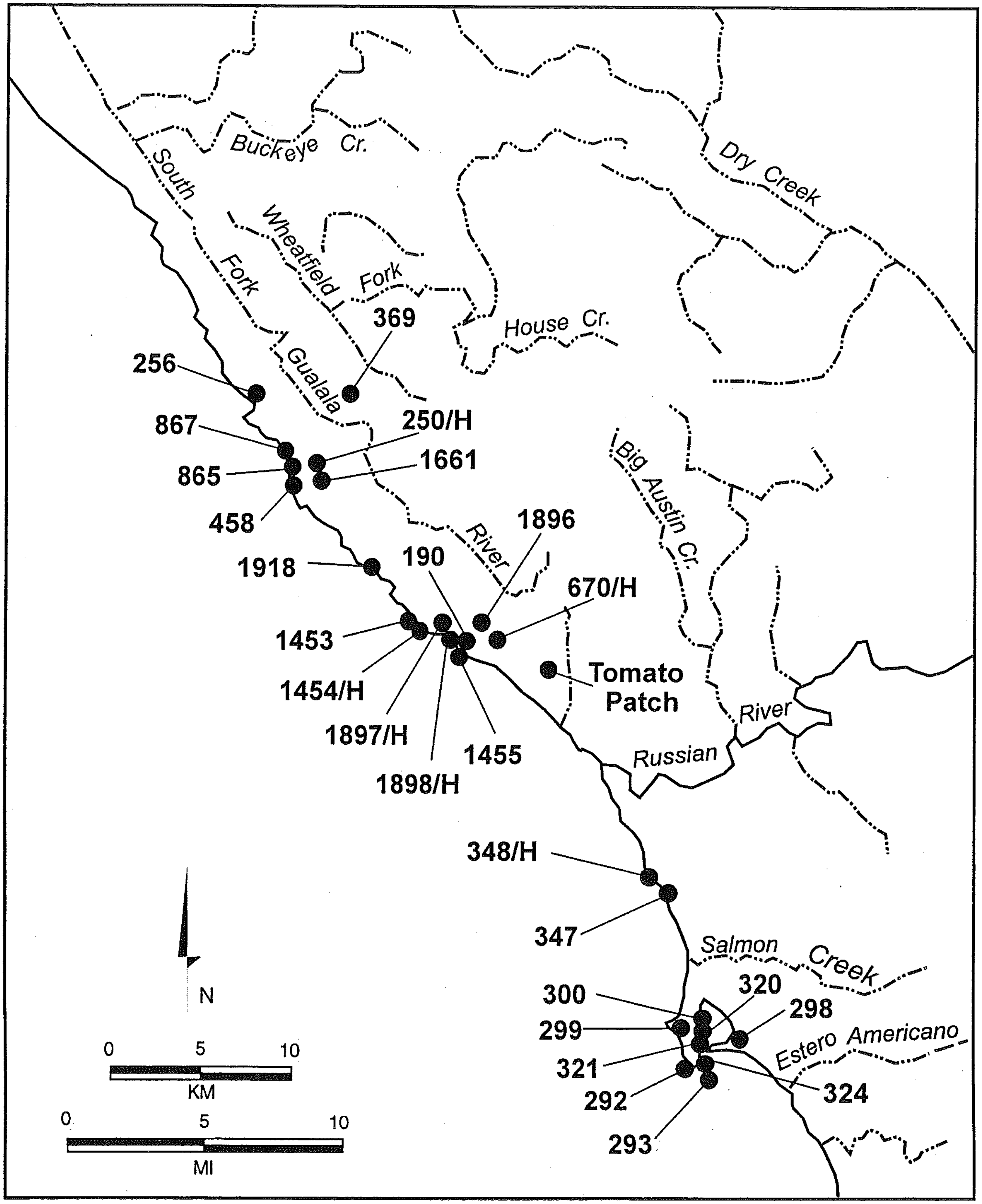


Figure 15.3 Excavated sites of the Sonoma Coast

Table 15.2 Radiocarbon dates from the Sonoma Coast

SITE	MATERIAL	LAB. NO.	MEAS. ^{14}C AGE	CONV. ^{14}C AGE	CALIB. AGE (1 σ RANGE)
SON-348/H	*Saxidomus shell*	Beta-34837	3210±100	3620±100	BC 1260 (1120) 960
SON-348/H	Charcoal	Beta-35226	3400±120	3400±120	BC 1880 (1680) 1520
SON-348/H	*Mytilus shell*	Beta-37472	4640±90	5050±90	BC 3070 (2910) 2860
SON-348/H	Charcoal	Beta-35228	6260±120	6260±120	BC 5290 (5230) 5060
SON-348/H	*Mytilus shell*	Beta-37473	7850±110	8260±110	BC 6460 (6370) 6220
SON-348/H	Charcoal	Beta-35229	8620±420	8620±420	BC 8040 (7580) 7100
SON-348/H	*Mytilus shell*	Beta-34844	8210±110	8620±110	BC 7000 (6760) 6590
SON-1455	Charcoal	UCR-1935	150±0	150±0	AD 1680 (1690, 1730, 1810, 1930, 1954) 1954
SON-1455	Charcoal	UCR-1931	450±80	450±80	AD1410 (1440) 1610
SON-1455	*Haliotis rufescens*	UCR-1932	460±100	870±100	AD 1640 (1840) 1870
SON-1455	Charcoal	UCR-1933	510±70	510±70	AD 1330 (1430) 1440
SON-1455	Charcoal	UCR-1934	1120±100	1120±100	AD 780 (900, 920, 980) 1020
Tomato Patch	Charcoal	CAMS-37696	120±50	120±50	AD 1680 (1700, 1720, 1820, 1850, 1860, 1870, 1880, 1920, 1954) 1955
Tomato Patch	Charcoal	CAMS-37697	190±60	190±60	AD 1660 (1670, 1780, 1800, 1940, 1954) 1954
Tomato Patch	Charcoal	CAMS-37694	1860±50	1860±50	AD 80 (130, 210) 240
Tomato Patch	Charcoal	CAMS-37695	2090±60	2090±60	BC 200 (90, 80, 60) AD 0

Note: All calibrations via Stuiver and Reimer 1993; marine samples corrected with upwelling value of 365±35 years.

via direct procurement or exchange (Schwaderer 1992:69).

Focusing on obsidian, Dowdall (1995) synthesized Sonoma Coast prehistory, concluding that the first sustained use of the northern Sonoma Coast was by people with a Mendocino pattern tool kit and social organization. Later in time, people with an Augustine pattern tool kit and social organization used the coast.

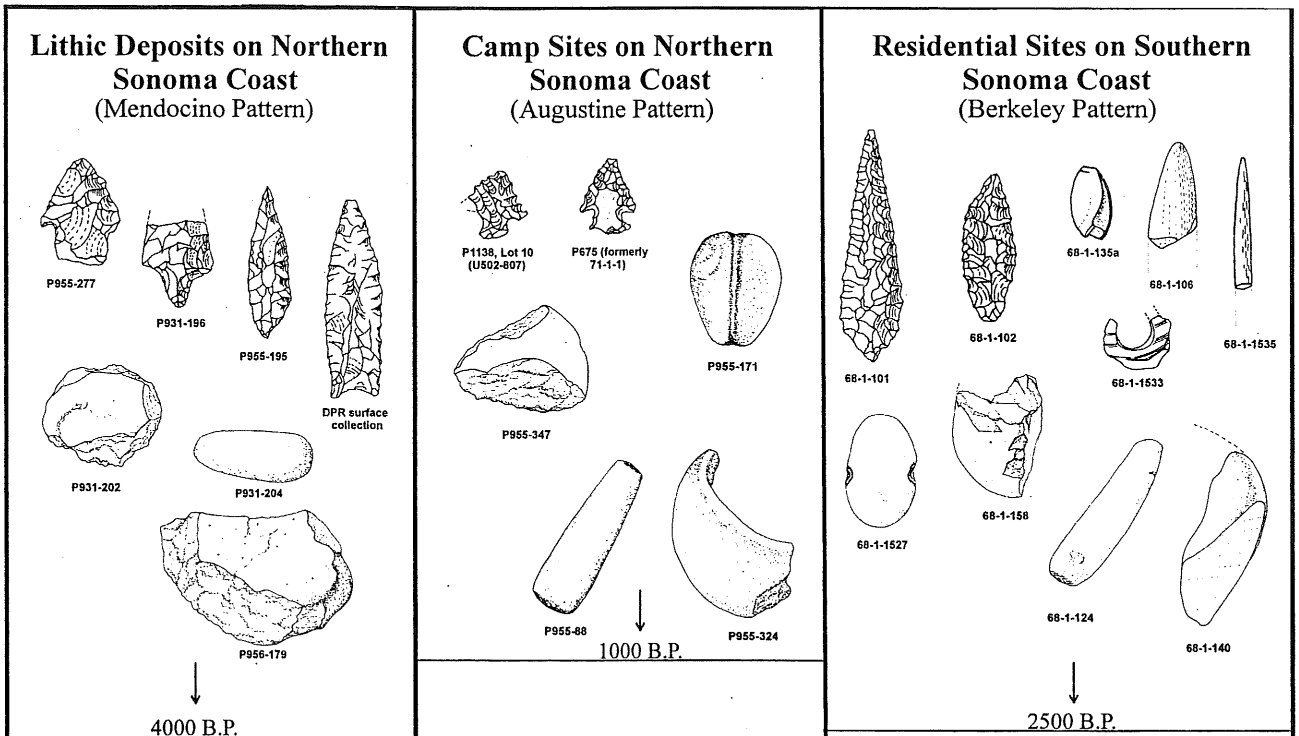
Martinez (1998) reported findings from a ridge-top village site (Tomato Patch) first recorded by Omar Stewart (1943), documenting features characteristic of ethnographic villages, such as an assembly structure and house depressions. Many of the artifacts recovered, including 158 contact period beads and chipped glass tools, were historic in nature. Through cross-dating, obsidian hydration, and ^{14}C dating, Martinez (1998) found that the site contained materials from three temporally discrete occupation periods: prehistoric, Russian, and post-Russian. Radiocarbon dates suggested occupation from about AD 1 to 1800 (table 15.2), with obsidian hydration values (n=34) ranging from 0.9 to 4.4 microns (Martinez 1998:114, 225). Martinez (1998:114-115) concluded that the temporal data indicated long-term use of the site. She also provided evidence for continuity in such traditional domestic practices as acquisition of mollusks and deer, stone tool manufacture, and village spatial organization (Martinez 1998:124-134).

CULTURAL CHRONOLOGY

The Late Holocene is commonly divided into three major temporal divisions in north coastal California: Middle Archaic (2000 to 500 BC), Upper Archaic (500 BC to AD 1000), and Emergent (AD 1000 to 1800) periods (Fredrickson 1973, 1974a). The Emergent is commonly subdivided into Lower (AD 1000 to 1500) and Upper (AD 1500 to 1800). As mentioned previously, artifactual and chronometric data from the Sonoma Coast also suggest that three archaeological patterns were present: Mendocino, Berkeley, and Augustine. The Mendocino pattern, dating circa 2000 BC to some time after AD 1000 on the northern Sonoma Coast, is represented by heavily curated assemblages containing many different dart point styles and contrasting tool stone sources (for example, all four North Coast Ranges obsidian sources; Franciscan and Monterey chert). Typical artifact types include wide-stemmed, contracting-stemmed, and concave-base projectile points, hand stones, and milling slabs (figure 15.4).

About 1000 years ago, changes occurred on the northern Sonoma Coast marked by the appearance of the Augustine pattern. Represented at such sites as SON-250/H, SON-256, SON-458, SON-473, SON-1455, and SON-1896, this pattern is denoted by small corner-notched projectile points, well-made stone pestles, bowl mortars, and grooved stone net weights (figure 15.4).

While the Mendocino pattern may eventually prove to be represented in southern Sonoma County at unexplored lithic scatters, the Late Holocene is currently marked by the appearance of the Berkeley pattern about 500 BC. Large residential middens at such sites as SON-292, SON-293, SON-298, SON-299, SON-300, SON-320, SON-321, SON-324, and SON-347 have produced typical Berkeley pattern artifacts, including shouldered lanceolate projectile points, clamshell fishhooks, notched stone net weights, bone awls, bone spatulas, and stone bowl mortars and pestles (figure 15.4). These assemblages are typologically similar to sites located farther south, as exhibited by the Berkeley pattern on the Marin



Cat.#	Site	Artifact	Provenience
P955-277	Son-458	chert wide-stem point	Lupine 7A, 90-100 cm
P931-196	Son-867	chert contracting-stem point	surface
P955-195	Son-458	chert non-shouldered lanceolate point	surface
DPR (no #)	Son-458	chert concave base point	surface
P931-202	Son-867	schist battered cobble	surface
P931-204	Son-867	sandstone bifacial handstone	surface
P956-179	Son-865	sandstone slab fragment	Vu1, 60-70 cm

Cat.#	Site	Artifact	Provenience
P1138	Son-250/H	obsidian corner-notched point	Unit 5, Level 2
P675	Son-670/H	obsidian corner-notched point	Unit M20, 0-40 cm
P955-171	Son-458	sandstone incised stone	S17/E10, 0-10 cm
P955-347	Son-458	schist battered cobble	RS3, 50-60 cm
955-88	Son-458	schist pestle	S16/E0 10-20 cm
P955-324	Son-458	sandstone mortar fragment	RS3 30-40 cm

Cat.#	Site	Artifact	Provenience
68-1-101	Son-292	obsidian shouldered lanceolate point	R44, 24-30 cm
68-1-102	Son-292	obsidian shouldered lanceolate point	J54, 18-24 cm
68-1-135a	Son-292	olivella shell, spire-lopped bead	J54, 18-24 cm
68-1-106	Son-324	bone spatulate tool fragment	M3, 36-42"
68-1-1535	Son-324	bone awl tip	M1, 48-54"
68-1-1533	Son-324	clam shell fish hook fragment	M1, 30-36"
68-1-1527	Son-324	notched stone (possible net sinker)	A1, 30-36"
68-1-158	Son-292	battered cobble tool	surface
68-1-124	Son-292	schist pestle	Q15, 42-48 cm
68-1-140	Son-292	sandstone mortar fragment	surface (site vicinity)

Figure 15.4 Archaeological patterns of the Sonoma Coast

County Coast (see Hylkema, chapter 13, this volume). Similarities to cultures of the San Francisco Bay area are striking.

INTERACTION SPHERES AND OBSIDIAN STUDIES

Obsidian in the North Coast Ranges occurs at four geologically distinct source locations: Napa Glass Mountain in Napa County, Annadel in Santa Rosa, and Mount Konocti and Borax Lake in Lake County (figure 15.5). The geographically patterned distribution of culturally used obsidian from a specific source is taken to represent an interaction sphere within which different cultures interacted more with one another than with outsiders, thus sharing more material similarities than with cultures outside the interaction sphere (Fredrickson 1994a:40).

In ethnographic times, individual tribelets controlled obsidian sources. Although autonomous in day-to-day activities, individual tribelets were linked to other tribelets by political, ritual, and economic obligations that varied in function and through time (Hughes and Bettinger 1984; see Kroeber 1925). These tribelet alliances, rather than individual tribelets, are thought to be reflected in the archaeological distribution of obsidian artifacts (Hughes and Bettinger 1984:157). It is inferred that the relative dominance of a given source represents the relative strength of social ties, either directly or indirectly, with neighboring tribelets. Similar source ratios among many sites in a given geographic area are thought to be reflective of an interaction sphere. An abrupt geographic shift in source ratios is thought to represent a boundary between interaction spheres (Hughes and Bettinger 1984:165-166). Changes in source ratios through time represent shifts in exchange relationships and perhaps a shift in population in a given locality (see Fredrickson 1989). Combined with other lines of evidence, source ratios are also thought to shed light on social organization and mode of exchange.

Obsidian source and hydration data from 25 sites on the Sonoma Coast show strong patterning in source distribution frequencies that correlates with ethnographic interaction spheres. Between the Gualala and Russian Rivers (ethnographic Kashaya Pomo territory), obsidian hydration profiles for Emergent period (AD 1000 to 1800) sites show representation of all four North Coast Ranges sources: Napa, Annadel, Konocti, and Borax Lake (table

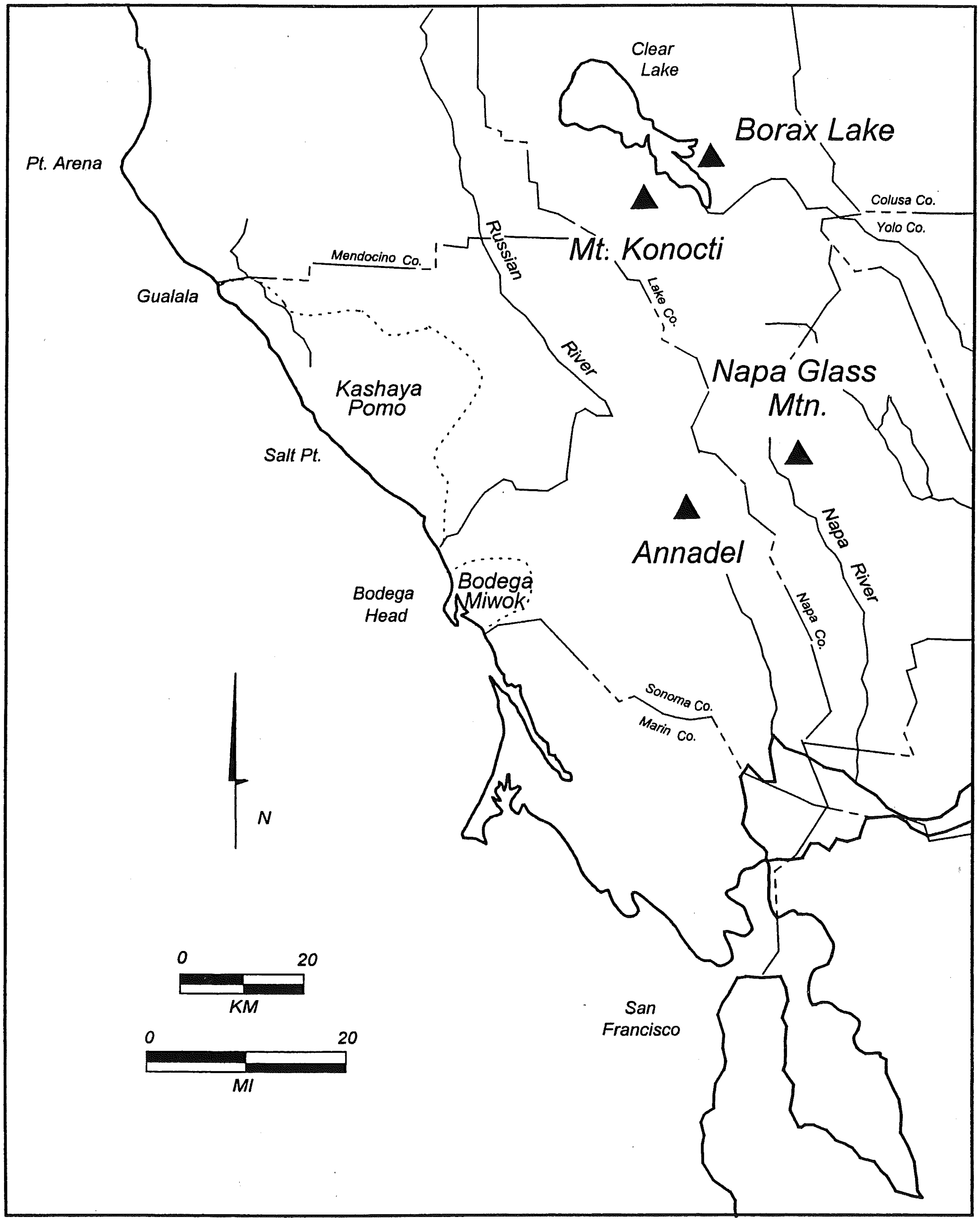


Figure 15.5 Locations of North Coast Range obsidian sources

Table 15.3 Summary of emergent period* obsidian source data from the Sonoma Coast

	ANNADEL		NAPA		KONOCTI		BORAX LAKE		TOTAL	
	N	%	N	%	N	%	N	%	N	%
Gualala River to Russian River	151	45.0	146	43.5	29	8.6	9	2.6	335	99.8
Russian River to Salmon Creek	7	35.0	13	65.0	0	0.0	0	0.0		100.0
Salmon Creek to Estero Americano	23	37.0	39	61.9	0	0.0	0	0.0	62	100.0
TOTAL	181	43.4	198	47.4	29	6.9	9	2.1	417	98.8

* Emergent period hydration: Annadel <1.8 microns; Napa <2.3 microns; Konocti <2.3 microns; Borax Lake <2.9 microns.
Sources: Adams et al. 1977; Allison 1989; Alvarez 1991; Beard 1997.; Dowdall 1995, n.d.; Dowdall et al. 1991; Lightfoot et al. 1991, 1997; Martinez 1998; Parkman 1990; Robinson 1985; Schwaderer 1992; Stillinger 1975.
Note: Obsidian recovered by Fredrickson 1962 was analyzed for this chapter

Table 15.4 Blood residue findings from Sonoma Coast artifacts

SITE	SPECIMEN	PROVENIENCE	ARTIFACT	MATERIAL	ANTISERUM
SON-458	P955-349	S17/E10 30-40 cm	Biface fragment	Brown Franciscan chert	Bear, chicken, rabbit, trout
SON-458	P955-286	S17/E10 0-10 cm	Nonshouldered lanceolate fragment	Brown Franciscan chert	Chicken, rabbit, trout
SON-458	P955-277	Lupine 2 120-130 cm	Wide-stemmed projectile point	Brown Franciscan chert	Bear, chicken, rabbit, trout
SON-458	P955-70	S24/W1 30-40 cm	Nonshouldered lanceolate projectile point	Brown Franciscan chert	Bear, chicken, rabbit, trout
SON-458	P955-285	S17/E10 10-20 cm	Nonshouldered lanceolate projectile point	Gray banded Monterey chert	Chicken
SON-458	P955-354	Surface	Concave base projectile point	Black Monterey chert	Chicken
SON-867	P931-144	VU2 60-70 cm	Stemmed projectile point	Obsidian 2.4 microns Annadel	Chicken
SON-867	P931-196	Surface	Contracting-stemmed projectile point	Brown banded Franciscan chert	Chicken
SON-867	P931-194	STU 2 0-10 cm	Flake tool	Obsidian diffuse hydration	Chicken, trout
SON-867	P931-193	VU2 120-130 cm	Nonshouldered lanceolate projectile point	Red Franciscan chert	Chicken, trout
SON-867	P931-98	VU3 10-20 cm	Large biface fragment	Brown Franciscan chert	Chicken, trout
SON-867	P931-205	VU2 70-80 cm	Split pebble biface	Obsidian 3.2 microns Napa Valley	Chicken
SON-867	P931-109	VU3 60-70 cm	Nonshouldered lanceolate projectile point fragment	Brown Franciscan chert	Chicken, trout

15.3), with Lake County sources in lower frequencies. Cultural and social ties linking these people with groups living near the Lake County sources were apparently not as strong as those with people who facilitated their acquisition of Annadel and Napa Valley obsidian. In assemblages south of the Russian River, moreover, artifacts made from Lake County obsidians are absent, apparently reflecting the ethnographic boundary zone (Russian River to Salmon Creek) between the Kashaya Pomo and Bodega Miwok. Also south of the Russian River, the dominance of Napa obsidian over Annadel suggests that there may have been stronger ties with groups having access to obsidian from Napa Valley, even though it was 35 km farther away than the Annadel source. The source ratio differences between geographic zones suggest that people south of the Russian River were part of a different interaction sphere than people to the north.

SETTLEMENT AND SUBSISTENCE

The heavily curated assemblages typical of the Mendocino pattern are thought to reflect a forager subsistence strategy in which the coast was used for seasonal hunting with atlatls and for seed processing. Blood residue analysis conducted on tools from Mendocino pattern assemblages suggests that birds, rabbits, fish, and bear were all hunted with darts (table 15.4). The absence of mortars and pestles suggests that the Mendocino pattern lifeway did not include a well-developed acorn economy.

The Augustine pattern represents the introduction of temporary residences on the northern Sonoma Coast, possibly by the ethnographic Kashaya Pomo whose permanent settlements were in the interior. Augustine subsistence differed in a number of ways from that of the Mendocino pattern. Although both seem to represent seasonal use of the coast, the Augustine pattern shows a reliance on rocky shore marine resources, acorns, deer, and sea mammals, as well as the technological distinction of hunting with a bow. Ethnographic analogy suggests that coastal occupation may have been in the spring and summer when shellfish and ocean fish were harvested (Gifford 1967:7; Kniffen 1939:387-388). Seasonal use of the coastal terrace for specific resources may have allowed those with a more sedentary Augustine pattern way of life to coexist with minimal conflict with those that had a more mobile Mendocino pattern one.

The Berkeley pattern, in contrast, suggests a more sedentary subsistence strategy than either Mendocino or Augustine. The presence of mortars and pestles in Berkeley pattern assemblages suggests a well-developed acorn economy. A year-round reliance on the highly productive bay shore and other wetland habitats, and on acorns set this subsistence strategy apart from either of the northern adaptations.

The Berkeley pattern expression on the southern Sonoma Coast suggests the movement of a culture already developed elsewhere, rather than an in situ development. Expanding on ideas first developed by Fredrickson (1973, 1974a), Stewart (1993:166) suggested that people with a Berkeley pattern lifeway, having filled up the margins of the bay, expanded north and east to occupy similar marshy lands that could have been exploited from semisedentary bases. A possible, if less likely, alternative would be a rapid acculturation to the Berkeley pattern by an in situ population. The Berkeley pattern brought residential stability to the southern Sonoma Coast. Archaeological evidence suggests that this sedentism involved focused exploitation of concentrated resources supported by participation in an exchange network that supplemented the resource base from outside.

Site Types

Three site types—lithic deposits, camp sites, and residential sites—have been identified along the Sonoma Coast. They are defined by artifact types and the presence or absence of dietary debris and features. Data from 28 excavations show structural, temporal, and spatial distinctions.

Lithic Deposits. Lithic deposits and camp sites occur on the northern Sonoma coastal terrace and continue at least a few kilometers inland beyond the first ridge at approximately 3000 foot elevation (Bramlette 1990; Lightfoot, Wake, and Schiff 1991; Lightfoot 1992). Lithic deposits, which tend to occur in unsheltered locations, are seldom associated with a fresh water source (Bramlette and Dowdall 1989). Ten deposits have been investigated (Allison 1989; Dowdall et al. 1991; Lightfoot, Wake, and Schiff 1991, 1997; Purser, Beard, and Praetzellis 1990) and eight have been reported on. Several lithic deposits have also been recorded on the southern Sonoma Coast, but none has been excavated.

Nearly all the lithic deposits contain some combination of points, simple flake tools, and grinding implements. These sites are large but diffuse deposits characterized by dart points, low frequencies of debitage, and low frequencies of food processing implements such as hand stones and milling slabs. They lack bowl mortars and pestles, features of any kind, and dietary refuse (table 15.5). They generally have temporally long obsidian hydration profiles, with roughly equal numbers of Napa and Annadel artifacts but only small amounts of Lake County obsidians. Arrow points have also been recovered from lithic deposits, but in the absence of other Augustine pattern materials, these are considered to reflect activities associated with camp sites. Camp sites, which contain dietary refuse such as marine shell, often occur as loci within or adjacent to lithic deposits.

Obsidian hydration and sourcing indicate that the lithic deposits began to form about 4000 years ago during the Middle Archaic period (Dowdall 1995:86) and continued to be used into the Late Holocene (table 15.6). Analysis of the assemblages suggests that hunting and the processing of hard seeds were the main economic activities (table 15.5; figure 15.4).

Lithic deposits show a high degree of variability in point styles and materials, which has been interpreted as a sign of high curation rates (that is, artifacts being kept for a long time) (Fredrickson and White 1994:5-6). Artifacts made from different varieties of chert are common, as are those from various obsidian sources. At some sites, however, some lithic raw materials are represented by a single specimen. In terms of stylistic variability it is not uncommon for single deposits to produce examples of concave-based, contracting-stemmed, and unshouldered lanceolate points, with some types represented by a single specimen. Obsidian reduction consists only of resharpening debris. For the entire obsidian hydration profile, equal numbers of Annadel and Napa specimens, accompanied by low frequencies of Konocti and Borax Lake materials, suggest relatively uniform obsidian use through time.

In the absence of dietary remains, blood residue analysis was conducted on tools from the lithic sites. All tools from SON-250/H, SON-292, SON-458, SON-867, and SON-1661 were tested against bear, chicken, deer, rabbit, and trout antisera. Unfortunately, there was no antiserum for pinnipeds. Twenty-eight positive reactions were obtained on 13 of the 50 tools submitted, including nine dart points, three bifaces, and a flake tool (J. Fagan 1998). Several tools tested positive for more than one antiserum (table 15.4). Positive reactions included 13 (or 46%) for chicken antiserum, which reacts with all Galliformes such as pheasants, partridges,

Table 15.5 Constituent diversity comparison of six Sonoma Coast lithic deposits by geographic zone and order of least to greatest consituent diversity

ARTIFACTS FROM ALL SONOMA COAST SITES	GUALALA RIVER TO TIMBER COVE				TIMBER COVE TO RUSSIAN RIVER		
	1661	867	458	865	1918	190	TOTAL
Olivella saucer bead							
Tivela cylindrical bead							
Haliotis pendant							
Haliotis pendant blank							
Worked steatite							
Red ochre							
Glass point							
Wooden pendant							
Charmstone							
Clam shell fish hook							
Notched stone							
Serrated point							
Midden							
Gunther barbed point							
Clam disk bead							
Girdled stone							
Clam shell bead							
Olivella spire-lopped bead							
Contact period bead							
Human bone							
Feature							
Bone tool							
Pestle							
Undetermined point style							
Dietary bone							
Dietary shell							
Crescent			1				1
Stemmed point		1					1
Contracting stem point		1					1
Shouldered lanceolate		1					1
Obsidian core/core tool						1	1
Wide stem point			1				1
Concave base point			1				1
Side notch point	1						1
Mortar	1						1
Pitted stone	2						2
Nondiagnostic point		1				2	3
Chert core/core tool		1		1		2	4
Milling slab				4			4
Pecked cobble	2			3			5
Corner notch point	3				1	1	5
Uniface or fragment	1		1		2	1	5
Flake tool/used flake		1	1	4		2	8
Nonshouldered lanceolate	2	2	4				8
Handstone	4	2		1	1	1	9
Battered cobble	6	6	1	1	2	1	17
Biface or fragment	7	3	1	1	7	6	25
Chert debitage	191	229	95	92	47	137	791
Obsidian debitage	227	449	56	435	264	261	1692
TOTAL	447	697	162	542	324	415	2585

SON-1897/H and -1898/H excluded from this analysis because of mixed prehistoric and protohistoric components (for example, multiple pestles clustered in Native Alaskan bone bed but also found throughout site).

Table 15.6 Summary of Sonoma Coast obsidian hydration values from all sites by type(excluding SON-670/H, SON-348/H, and Tomato Patch.

PERIOD	APPROX. YEARS BP	OBSIDIAN SOURCES				LITHIC DEPOSITS					CAMP SITES					RESIDENTIAL SITES				
		A	N	K	BL	A	N	K	BL	TOTAL	A	N	K	BL	TOTAL	A	N	K	BL	TOTAL
		0.3	0.4	0.4	0.5												1			1
		0.4	0.5	0.5	0.6												3			3
		0.5	0.6	0.6	0.8				1	1							4			4
		0.6	0.8	0.8	1.0											1	2			3
		0.7	0.9	0.9	1.1							3			3	1				1
		0.8	1.0	1.0	1.2		8	2		5		12	2	1	15	4	8			7
		0.9	1.2	1.2	1.4	1	9		2	9	6	4			10	9	2			6
		1.0	1.3	1.3	1.6	3	10	1		13	3	13			16	3	1			3
		1.1	1.4	1.4	1.7	5	6	2		12	1	2			3	3	3			5
		1.2	1.6	1.6	1.9	14	3	1		17	1	3			4	4	11			13
Upper		1.3	1.7	1.7	2.0	8	9			17	3	3			6	1	5			6
Emergent		1.4	1.8	1.8	2.3	10	5			14		8			8	2	8			10
	500	1.5	1.9	1.9	2.4	18	4			19	1	6			7	1	6			7
		1.6	2.0	2.0	2.6	10	3	2		11	3	10	6		19					
Lower		1.7	2.2	2.2	2.7	19	7		3	24	2	3			5		7			7
Emergent	1000	1.8	2.3	2.3	2.9	35	7	4	1	42		9	5	1	15	1	2			3
		1.9	2.5	2.5	3.1	12	4	5	2	18		2	1		3	2	6			8
		2.0	2.6	2.6	3.2	10	2	3	1	13	1	1		1	3		1			1
		2.1	2.7	2.7	3.4	12	4	1	1	15		1			1		9			8
		2.2	2.9	2.9	3.5	9	4			9	1				1	1	6			7
		2.3	3.0	3.0	3.7	15	7	1		18							3			3
		2.4	3.1	3.1	3.9	12	9			16				1	1		4			4
		2.5	3.2	3.2	4.0	17	10	2		24	1				1		1			1
Upper		2.6	3.4	3.4	4.1	12	6	3		18										
Archaic	2500	2.7	3.5	3.5	4.3	9	6	3		16							1			1
		2.8	3.6	3.6	4.5	6	20	2		26							2			2
		2.9	3.8	3.8	4.6	4	12		2	17							1			1
		3.0	3.9	3.9	4.8	4	9		1	11		1			1					
		3.1	4.0	4.0	4.9	3	7	2		10										
		3.2	4.2	4.2	5.1	2	2			4										
		3.3	4.3	4.3	5.3	2	5		1	6	1				1					
		3.4	4.4	4.4	5.5	2	6	2	1	10										
		3.5	4.6	4.6	5.6	3	3			6										
		3.6	4.7	4.7	5.8	1	4		1	6										
		3.7	4.8	4.8	6.0	3	5	1	1	8							1			1
Middle		3.8	4.9	4.9	6.1	1	4	1		5										
Archaic	4000	3.9	5.0	5.0	6.2		8	1		8										
		4.0	5.2	5.2	6.4	1	5			6										
		4.1	5.3	5.3	6.6	1	7	1		6										
		4.2	5.5	5.5	6.8	2	2			3										
		4.3	5.6	5.6	7.0	1	3			2										
		4.4	5.7	5.7	7.1	2	2			2										
		4.5	5.9	5.9	7.2		2			2										
		4.6	6.0	6.0	7.4			1	1	2										
		4.7	6.1	6.1	7.6	1				1										
		4.8	6.2	6.2	7.7	1	1			2										
		4.9	6.4	6.4	7.9	1			1	1										
		5.0	6.5	6.5	8.1				1	1										
		5.1	6.6	6.6	8.2	1	3			3										
		5.2	6.8	6.8	8.4	2			1	1										
		5.3	6.9	6.9	8.5															
		5.4	7.0	7.0	8.7															
		5.5	7.1	7.1	8.9															
		5.6	7.3	7.3	9.0															
Lower		5.7	7.4	7.4	9.2															
Archaic	8000	5.8	7.5	7.5	9.3		1			1										
		5.9	7.7	7.7	9.5															
		6.0	7.8	7.8	9.7		1			1										
		TOTAL				275	235	41	22	482	24	81	14	4	123	28	88			116

quail, and grouse; Anseriformes such as geese, ducks, and swans; and Columbiformes such as doves and pigeons. There were eight (or 29%) positive reactions for trout antiserum, which reacts with all members of the genus *Oncorhynchus*, including anadromous salmon, steelhead, and resident rainbow trout. Four (or 14%) reactions were for rabbit, including all members of the Liporidae (that is, rabbit and jackrabbit). There were three (or 11%) reactions for bear antiserum, suggesting hunting or processing of black bear or brown bear. These results suggest that dart points were used in the generalized pursuit of hunting terrestrial and marine prey. The fish residues are the first evidence of marine or aquatic prey recovered from lithic deposits. The generalized hunting strategy suggested by these findings is consistent with the lifeway generally inferred for the Mendocino pattern—one of highly mobile, relatively wide-ranging family bands.

Camp Sites. Camp sites tend to occur in sheltered locations, such as the leeward side of sandstone outcroppings, and they frequently have a fresh water source nearby (Bramlette and Dowdall 1989). Many of these sites have been identified on the northern Sonoma Coast terraces, with seven having been excavated (Beard 1997; Dowdall 1988, 1995; Farris 1986; Meighan 1967; Parkman 1990) and six reported on. The camp sites are small undifferentiated deposits containing dietary refuse (for example, bone and/or shell), with low numbers of flaked stone tools, arrow points, mortars, pestles, and girdled stones (table 15.7). They are characterized by short obsidian hydration profiles dominated by Napa Valley obsidian. Obsidian hydration and sourcing indicate that the camp sites began to form in the Lower Emergent period (Dowdall 1995:87) a little over 1000 years ago (2.6 microns; table 15.6). The Napa dominated hydration profiles from camp sites are contemporaneous with an influx of Konocti obsidian (at 2.5 microns) on the Mendocino Coast (Layton 1990), suggesting that regularized exchange was initiated in both areas at this time. The assemblages from camp sites suggest procurement and processing activities. Site inhabitants relied on rocky coast marine resources and acorns, although hunting and hard seed processing are also represented (figure 15.4).

Rocky shore species dominate the shellfish remains at camp sites. A small amount of California mussel (*Mytilus californianus)* and limpet (*Collisella* spp.) shell was recovered from SON-1896/H (Parkman 1990) and SON-1455 (Farris 1986). California mussel dominated the middens at SON-458 (Dowdall 1995) and SON-473 (Dowdall 1988).

Fish remains were limited to unidentifiable bones recovered from SON-1896/H (Parkman 1990), SON-1455 (Farris 1986), and SON-473 (Dowdall 1988). Very low numbers of minnow (*Cyprinidae*), greenling (*Hexagrammos* sp.), steelhead trout (*Salmo gairdnerii*), and China rockfish (*Sebates nebulosus*) remains were recovered from SON-458. The identified species represent endemic cold water forms available year-round in intertidal and near inshore habitats which suggests inshore or shoreline fishing (Quinn 1995:326).

Grinding tools indicative of acorn and hard seed processing (a mortar fragment, slab fragments, pestles, and handstones) were recovered from SON-458, SON-473, and SON-256. Among the archaeobotanical remains from SON-458, bay nut (*Umbellularia californica*) was the dominant taxon, with small amounts of huckleberry (*Vaccinium* sp.), wild cucumber (*Marah* sp.), acorn (*Quercus* sp.), and tule (*Scirpus* sp.) (Dowdall 1995:197-199; Wohlgemuth 1995:292-323). All identified species contain edible parts and are available in the summer or fall (Wohlgemuth 1995:309).

With regard to hunting, arrow points and fragments and faunal remains were recovered from all six camp sites. A mule deer (*Odocoileus hemionus*) metapodial was found at SON-1896/H (Parkman 1990), and a few possible artiodactyl bone fragments were recovered from SON-458 (Dowdall 1995). Fragmentary remains from mule deer and the caudal end of a sacrum of an adult sea lion (*Zalophus californianus*) were recovered from SON-1455 (Farris 1986). Meighan's (1967:47) mound analysis revealed that shellfish and sea mammals formed the subsistence of the group. The four sites taken together show evidence of deer and sea mammal hunting as related to the camp sites' usage.

Meighan also discussed large dart points recovered from SON-256, which he suggested may have been used for sea mammal hunting.. Inspection of site photographs (Meighan 1952) suggests nonshouldered lanceolate style dart points may be part of a Mendocino pattern component and not part of Augustine pattern camp site occupation.

Camp sites on the northern Sonoma Coast are compatible with expectations of seasonal Augustine pattern use. Exploitation of a variety of rocky coast shellfish, nearshore fish, acorns, grass seeds, deer, and sea mammals are compatible with the seasonal round of the ethnographic Kashaya Pomo. The overrepresentation of Napa Valley material suggests more regularized economic ties than those reflected by the lithic deposits. Taken together, the assemblages, obsidian hydration data, and dietary remains suggest that these sites represent the seasonal hamlets of a tribelet in its extended family structural pose primarily during the spring and summer (see Gearing 1958; Oliver 1962).

Presidential Sites. Thirteen Sonoma Coast residential sites have been reported (Adams, Stoddard, and Fredrickson 1977; Alvarez 1991; Fredrickson 1962; T. King 1966; Porter and Watson 1933; Robinson 1985). These sites are large, often stratified shell middens that produce human graves and other features, shell beads, bone tools, tools for food processing and cooking, dietary refuse, and obsidian tools and debitage (Fredrickson 1962). They tend to show obsidian hydration profiles dominated by Napa Valley obsidian beginning about

Table 15.7 Sonoma Coast constituent diversity comparison of six camp sites by geographic zone and order of least to greatest constituent diversity

ARTIFACTS FROM ALL	GUALALA RIVER TO TIMBER COVE			TIMBER COVE TO RUSSIAN RIVER			
SONOMA COAST SITES	256	458 shell	458 non-shell	473	1455	1896	TOTAL
Crescent							
Stemmed point							
Contracting stem point							
Gunther barbed point							
Clam shell fish hook							
Olivella saucer bead							
Tivela cylindrical bead							
Haliotis pendant							
Wooden pendant							
Obsidian core/core tool							
Notched stone							
Wide stem point							
Concave base point							
Side-notch point							
Clam shell bead							
Olivella spire-lopped bead							
Clam disk bead							
Worked steatite							
Glass point							
Red ochre							
Human bone							
Bone tool	1						1
Mortar		1					1
Charmstone						1	1
Serrated point						1	1
Haliotis pendant blank	2						2
Girdled stone			2				2
Corner notch point					2		2
Nondiagnostic point			2				2
Milling slab		1		2			3
Nonshouldered lanceolate	3						3
Pitted stone	5						5
Shouldered lanceolate		3	2				5
Handstone		1	1		1	2	5
Undetermined point style	6						6
Pestle	2		1	4			7
Pecked cobble		1	1	3	2		7
Contact period bead					1	8	9
Flake tools/used flake		1	2		7	2	12
Chert core/core tools	6	1	1		6		14
Biface or fragment		2	9	4	2		17
Uniface or fragment	12		1	3		1	17
Battered cobble	5	3	2	1	151		162
Chert debitage	x	38	746	79	540	x	1403
Obsidian debitage	x	107	1160	174	63	x	1504
Feature					x		
Dietary bone	x	x	x	x	x	x	
Dietary shell	x	x		x	x	x	
Midden	x	x	x	x	x	x	
TOTAL	42	159	1930	270	775	15	3191

x = present

2500 years ago in the Upper Archaic period (table 15.6). Assemblages from residential sites suggest heavy reliance on marine resources, but acorn and small seed processing as well as hunting, are also represented.

Rocky shore species, or a combination of rocky shore and bay species, dominate the shellfish remains recovered from southern Sonoma Coast residential sites. California mussel was the dominant species recovered from SON-299 (Greengo 1951), SON-324 (Fredrickson 1962), and SON-347 (Adams, Stoddard, and Fredrickson 1977). Large quantities of mussels and smaller quantities of various clams (for example, Washington clam [*Saxidomus nuttalli*] and littleneck clam [*Protothaca staminea*]) were the dominant species recovered from SON–293. SON-300 produced fragments of mussel (dominant) and clam (Fredrickson 1976:4), and SON-321 yielded almost equal amounts of mussel and clam (Washington clam and gaper [*Tresus nuttalli*]) (Alvarez 1991:15). Only the shellfish remains from SON-298 were dominated by clams, primarily *Tresus*, *Protothaca*, *Saxidomus*, and *Clinocardium* (Robinson 1985).

A clamshell fish hook representing line fishing was recovered from SON-324 (Fredrickson 1962:56). Other evidence of possible fishing includes notched stones or net weights, many of which were recovered from SON-299 (Porter and Watson 1933), with some from SON-324 and SON-293 (Fredrickson 1962). Beardsley (1954:38-39) suggested that side-notched net weights dwindled or disappeared after the McClure phase (that is, Berkeley pattern) and may represent the loss of net fishing late in time. Unidentified fish vertebrae were recovered from SON-293, SON-298, and SON-324.

Grinding implements indicative of acorn processing were recovered from four sites. Porter and Watson 1933 (cited by Beardsley 1954:59-60) recovered many bowl mortars from SON-299, and several pestles and fragments were recovered from SON-292, SON-293, and SON-324 (Fredrickson 1962). Two sites contained grinding implements indicative of hard seed processing: a slab and handstones recovered from SON-347 (Adams, Stoddard, and Fredrickson 1977) and two handstones recovered from SON-324 (Fredrickson 1962).

Hunting implements were most commonly made of obsidian, with a small number of morphological themes, grading one into the other. Shouldered lanceolate dart points, nondiagnostic lanceolate points, and medium and large bifaces were recovered from nearly all the sites. Arrow points from several sites suggest Augustine pattern use despite their low numbers. Faunal assemblages consisted primarily of unidentifiable mammal bone. Only SON-321 and SON-298 had identifiable assemblages. The faunal assemblage at SON-321 was dominated by black-tailed deer, with some tule elk (*Cervus nannodes*) and unidentifiable bird bone (Alvarez 1991). Very low frequencies of sea otter, sea lion, and brush rabbit elements, as well as one Artiodactyl element, comprised the faunal assemblage at SON-298.

Residential sites on the southern Sonoma Coast also commonly exhibit the extensive bone tool assemblage of the Berkeley pattern. Bone awls, needles, chisels, and daggers, as well as bird bone tubes, whistles, and ornaments, were recovered from SON–299 (Porter and Watson 1933). Two bone awls, a bone spatula, and a bone tube were recovered from SON–324 (Fredrickson 1962) (figure 15.4) and bone awls were recovered from SON-320 (T. King 1966) and SON–347 (Adams, Stoddard, and Fredrickson 1977). Bone tools and polished bone fragments were recovered from SON-292 and SON-300 (Fredrickson 1962; 1976).

Burials and human remains were recovered from several residential sites on the southern Sonoma Coast. Berkeley pattern interments are characterized by a flexed position, usually with the head oriented to the west. Numerous bone implements were often buried with the dead, and red ochre was common (Beardsley 1954:28, 46, 59). Of the 137 burials recovered from SON–299, 50% contained associated artifacts, and red ochre was included with many (Porter and Watson 1933). Human remains were also recovered from SON-292, SON-324, and SON-298 (Fredrickson 1962; Robinson 1985). A coffin burial recovered from SON-293 (Fredrickson 1962) indicates historic period use.

Except for glass trade beads from the historic period, shell beads were of local manufacture. Beads diagnostic of the Berkeley pattern included *Olivella* saucers from SON-299 and *Olivella* spire-lopped from SON-347, SON-292, and SON-298. Ornaments associated with the Berkeley pattern included a *Haliotis* ornament and perforated mica ornaments recovered from SON-299. A *Tivela* cylindrical bead from SON-293 and clam disk beads from SON-292, SON-293, and SON-320 suggest Augustine pattern use. A *Haliotis* pendant blank was also recovered from SON-320. Glass trade beads from SON-293 and SON-320 indicate Historic period use.

These findings from the southern Sonoma Coast are compatible with general observations made for the Berkeley pattern. Augustine pattern artifacts were recovered from nearly all the coastal residential deposits, but no discrete components have been identified. The chipped stone assemblages are dominated by shouldered lanceolates and bifaces, suggesting a small number of morphological themes compared to the relatively large number of discrete types in the lithic deposits north of the Russian River. The tools, together with a diverse assemblage of shell bead types, shell ornaments, a shell fishhook, an array of bone tools, internal site differentiation, and human graves, distinguish Berkeley pattern coastal shell middens from Augustine pattern sites north of the Russian River. Assemblages at the latter suggest a heavy reliance on a variety of rocky coast, bayshore, and wetland resources. Acorn and seed processing and hunting

Table 15.8 Constituent diversity comparison of 13 residential sites by geographic zone and order of least to greatest constituent diversity

ARTIFACTS FROM ALL SONOMA COAST SITES	GUALALA RIVER TO TIMBER COVE	TIMBER COVE TO RUSSIAN RIVER		RUSSIAN RIVER TO SALMON CK		SALMON CREEK TO ESTERO AMERICANO								
	369	Tom. P.	670/H	348/H	347	300	299	320	321	292	293	324	298	TOTAL
Crescent														
Stemmed point														
Contracting stem point														
Obsidian core/core tool														
Gunther barbed point			1											1
Clam shell fish hook												1		1
Wooden pendant											1			1
Red ochre	1						x							1
Pecked cobble			1											1
Wide stem point				1										1
Concave base point												1		1
Side-notch point										1				1
Chert core/core tool										1				1
Mortar							x			1				1
Clam shell bead			2											2
Worked steatite	1							1						2
Olivella saucer bead				1				2						3
Glass point	1	2												3
Girdled stone			2								1			3
Serrated point			3											3
Milling slab		2		1	1									4
Haliotis pendant blank	3							1						4
Haliotis pendant				1				3						4
Feature		4		x			x			x	x	x		4
Notched stone							x					5		5
Pitted stone	4	1								1				6
Shouldered lanceolate				2			x	3		2		1		8
Pestle	1	1	1							3	1	1		8
Uniface or fragment										2	6		1	9
Olivella spire-lopped bead		2		6	1			1		2		1	1	12
Handstones		2	6	2	1							2		13
Corner notch point			8		3			2	1					14
Biface or fragment		5	5		1		x				2	1		14
Nonshouldered lanceolate			19	1						1	1		1	23
Clam-disk bead	27		1					120		1	3			152
Battered cobble	1	x	6						3	11	14	3		37
Bone tool	10	13		8	1		x			1	1	4		38
Nondiagnostic point			2	2	1	4				15	9	11	5	49
Undetermined point style	11	40												51
Flake tool/used flake		x		63					1	10	24	5		103
Human graves							137							137
Contact period bead	16	158	15					1500			29			1718
Chert debitage	x	x	x	73	x	x	x	x	31	x	x	x	193	297
Obsidian debitage	x	x	x	23	x	x	x	x	86	x	751	x	44	904
Bone ornament							x							x
Bird bone whistle							x							x
Quartz crystal							x							x
Charmstone							x							x
Haliotis ornament							x							x
Human bone							x			x		x	x	x
Dietary bone	x	x		x	x	x	x	x	x	x	x	x	x	x
Dietary shell	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Midden	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TOTAL	76	232	69	181	9	4	137	1633	122	51	844	36	244	3638

x = presence of; Tom P. = Tomato Patch

of a variety of large and small game are also represented (figure 15.4).

SOCIAL COMPLEXITY

In the North Coast Ranges, the Mendocino pattern is generally assumed to represent the forager subsistence strategy of highly mobile, relatively wide-ranging family bands. Fredrickson (1996:25) suggested that these family bands were weakly bounded socially, with group membership marked by a high degree of fluidity. Territorial boundaries were also likely to have been permeable. The high degree of variability in point styles and raw materials reflected in Mendocino pattern lithic deposits has been interpreted as a sign of high curation rates, which are thought to reflect informal exchanges between family bands (Fredrickson and White 1994). Obsidian profiles show relatively equal proportions of Annadel and Napa specimens, accompanied by low frequencies of Konocti and Borax Lake material, which may represent the permeable social boundaries of extended family band social organization. A presence in excess of 3000 years on the Sonoma Coast suggests that the Mendocino pattern lifeway was relatively stable through time, changing little even in the midst of a contemporaneous tribelet organization (see Fredrickson and White 1994).

The nature of Augustine assemblages, in contrast, suggests tribelet social organization in a seasonal extended family pose. The tool assemblages, obsidian hydration data, and dietary remains from Augustine coastal sites suggest the seasonal hamlets of tribelet subgroups, probably occupied primarily during the spring and summer (see Gearing 1958; Oliver 1962). Based on ethnographic modeling, by early fall and through the winter these family groups would have been located in multifamily residential villages on the first ridge system or farther inland (Kniffen 1939:386).

The Berkeley pattern is envisioned as a highly sedentary expression of tribelet social organization with formalized exchange alliances. The presence of locally manufactured shell beads suggests the social marking associated with permanent multifamily villages. In multifamily villages, social information, such as status, affiliation, and ownership, can be expressed through such stylistic elements as beads and ornaments. These elements facilitate repetitive communication with those who interacted on a regular but infrequent basis, such as intra- or intertribelet non-kin groups (see Wobst 1977; Weissner 1983). Like the camp sites in the north, overrepresentation of Napa Valley material suggests participation in a regularized exchange system.

CONCLUSIONS

Obsidian hydration studies suggest that hunter-gatherers employing the Mendocino pattern lifeway (Fredrickson and White 1994:1; White and Fredrickson 1992:40; White et al. 2000) were present on the northern Sonoma Coast by at least 2000 BC (Origer 1987). Bear, rabbit, birds, fish, and probably other game were exploited by mobile foragers with a band sociopolitical organization. This initial Middle Holocene use persisted through the Late Holocene. By AD 1000, people employing a generalized Augustine pattern lifeway, arrived on the northern Sonoma Coast. While those with an Augustine pattern lifeway initially coexisted with Mendocino pattern communities, they eventually displaced them. A third group, expressing a relatively sedentary Berkeley pattern residential lifeway, used the southern Sonoma Coast beginning about 500 BC.

Variation in tool assemblages, subsistence systems, and interaction spheres suggest that the Augustine pattern was not an in situ cultural replacement north of the Russian River. Changes in diet marking the arrival of the Augustine pattern appear influenced by changes that transpired elsewhere. Similarly, the initial appearance of the Berkeley pattern on the southern Sonoma Coast seems to represent the movement of a culture first developed elsewhere.

Cultural transitions around AD 1000 in the southern area are less clear than those in the north, but seem to reflect in situ developments. Augustine pattern artifacts have been recovered from nearly all the coastal residential sites, but no discrete components have been identified. Obsidian hydration and sourcing do not show a shift in source ratios through time, suggesting that Berkeley and Augustine pattern occupants had the same interaction sphere. Further, shellfish and faunal assemblages do not show shifts in subsistence strategy through time. Thus, the Augustine pattern seems to have appeared on the southern Sonoma Coast about AD 1000, but the continuation of preexisting interaction spheres and subsistence strategies suggest that this was an in situ development.

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Late Holocene Emergence of Marine-focused Economies in Northwest California

William R. Hildebrandt and Valerie A. Levulett

Northwest California, as we define it here, conforms to the present day boundaries of Del Norte and Humboldt Counties, extending from the California-Oregon border south about 250 km to Shelter Cove (figure 16.1). It is a mountainous region with elongate ranges and valleys that trend in a northwesterly direction. Annual rainfall is high, creating numerous salmon-bearing streams that were of major economic importance to local Native American people. The combination of high rainfall and topographic diversity created a complex mosaic of vegetation consisting largely of coniferous forest, open prairies, and mixed hardwood forest. These habitats yielded a variety of important subsistence resources, including Roosevelt elk and black-tail deer, as well as tanbark oak acorns, which are the most nutritious of all acorn varieties in California (Baumhoff 1978).

North of Cape Mendocino, the coastline follows a north-south orientation, cross-cutting several major ridge systems. Many of these ridges form extensive headlands, many reaching more than ten km out to sea. Some of the offshore rocks supported major pinniped breeding grounds, also of great importance to local people. South of Cape Mendocino, in contrast, the coastline parallels the geomorphic structure of the land, resulting in a series of underwater reefs and a near absence of offshore rocks. Geomorphic studies of several terraces and old beach lines indicate that sections of this coast have risen at a rate of 4 to 5 m per 1000 years, allowing archaeologists to observe land surfaces that were minimally affected by Holocene sea level rise (Hildebrandt and Levulett 1997; Lajoie et al. 1982; McLaughlin et al. 1983).

A series of estuaries and lagoons provide a significant contrast to this otherwise rugged coastal environment. Humboldt Bay is the most important estuary in the region, covering approximately 80 km^2. It is protected from the ocean by a 20-km long sand spit and bounded on its interior by extensive tracts of coastal salt marsh. Unlike the coastal terraces south of Cape Mendocino, lands around Humboldt Bay have experienced a great deal of subsidence due to several major tectonic events. Analysis of sediment cores from the bay has revealed high salt marsh peats interbedded with deeper intertidal bay mud, clearly evidencing severe subsidence throughout the Holocene (Clarke and Carver 1992; Jacoby et al. 1989). These developments have significantly reduced archaeological visibility in the local area (Eidsness 1993; Fitzgerald and Ozaki 1993; Simons 1993; see also Minor 1997).

Relatively high densities of Native American peoples occupied the region at the time of European contact. They spoke several languages and dialects of the Athapascan, Algic, and Hokan stocks (figure 16.2), and occupied permanent coastal and riverine settlements (Baumhoff 1958, 1963). Many of these settlements were supported by the development of oceangoing canoes, composite harpoons, large communal fish weirs, and redwood smoke houses, which maximized the procurement and storage of marine mammals and fish. Individual ownership of these capital-intensive technologies was linked to differential wealth and power within the population, resulting in a stratified community organization that characterized much of northwest California (Fredrickson 1984; Gould 1975; Kroeber 1925).

Archaeological research throughout the area indicates that a great deal of socioeconomic change took place during the Late Holocene. It is hypothesized that sedentary villages were first established in riverine settings at around 1000 BC, supported by the intensive utilization of salmon and acorns (Hildebrandt and Hayes 1993). Along the outer coast, in contrast, permanent villages were not established until after about AD 1000 when the use of marine foods reached maximum levels of intensity.

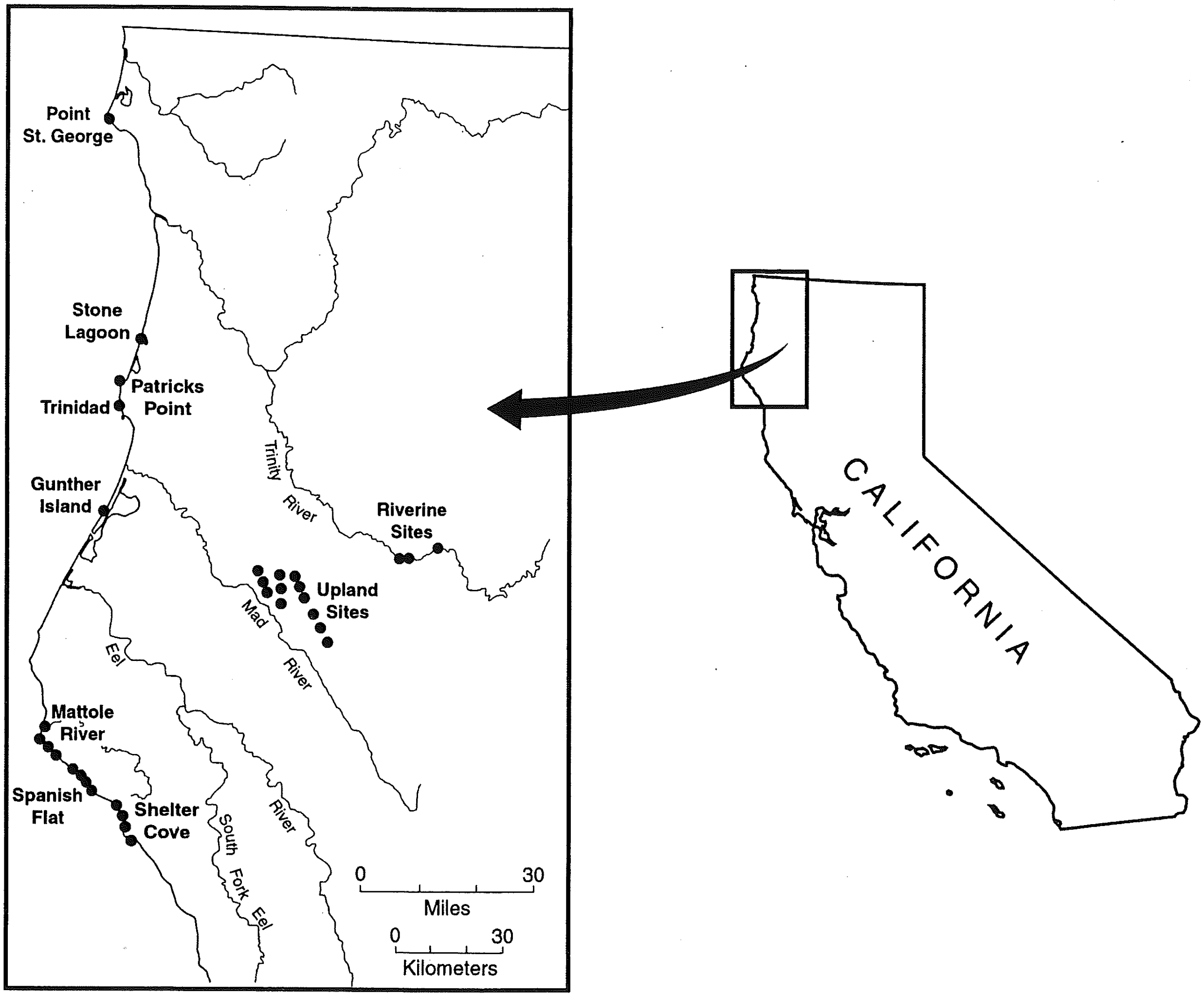

Figure 16.1 Key archaeological sites in northwest California

In this chapter, we review archaeological evidence for these changes and compare it with developments observed at other selected locations along the California Coast. We begin with an analysis of chronological data from both interior and coastal settings, providing an up-to-date summary of the settlement chronology of northwest California. A detailed review of artifact assemblages from several important Late Holocene sites is then presented, followed by a review of faunal remains from many of these deposits. These data provide the information necessary to characterize North Coast adaptations, with particular emphasis on the emergence of marine-focused economies and complex sociopolitical organization observed at European contact. With respect to the latter issue, we focus on how the development of oceangoing watercraft increased access to remote resource tracts, and how the differential ownership of this technology facilitated social ranking among the local people (see also Arnold 1995a). These topics are further addressed through a formal analysis of grave associations from a large cemetery population uncovered at the Gunther Island site, and by an interregional discussion of oceangoing canoe technology and its linkage to the intensity of marine resource use. The chapter ends with a review of ethnolinguistic distributions and their relationship to latitudinal differences in the initiation of intensive marine resource use.

Archaeological collections from 20 coastal sites form the basis of this study. They include Point St. George (DNO-11; Gould 1966), Stone Lagoon (HUM-129; Milburn et al. 1979), Patrick's Point (HUM-118; Elsasser and Heizer 1966), Trinidad (HUM-169; Elsasser and Heizer 1966), Gunther Island (HUM-67; Elsasser and Heizer 1964; Loud 1918), Humboldt Bay (HUM-351; Eidsness 1993), Mattole River (HUM-175, HUM-176, HUM-177, HUM-270; Levulett 1985; Levulett and Hildebrandt 1987), Spanish Flat (HUM-276, HUM-277, HUM-279, HUM-281, HUM-303, HUM-305; Levulett 1985; Levulett and Hildebrandt 1987; Waechter 1990), and Shelter Cove (HUM-182, HUM-184, HUM-186, HUM-307; Levulett 1985; Levulett and Hildebrandt 1987; Waechter 1993).

SETTLEMENT CHRONOLOGY

Unlike much of the Central and Southern California Coast, where evidence of Early and Middle Holocene occupation is relatively common, significant use of coastal environments in Northern California is not evidenced until late in the Holocene. Several researchers have suggested that the lack of early sites on the North Coast may simply represent a visibility problem, as only limited amounts of excavation have taken place in the region, and many of the older sites have probably been inundated or eroded by Holocene sea level rise (Arnold 1991b; Erlandson and Colten 1991b; Jones 1991; Lyman 1991; Moss and Erlandson 1998a). Hildebrandt and Levulett (1997), in contrast, argue that the north-to-south differences in the antiquity of coastal use are largely due to latitudinal gradients in the productivity of adjacent terrestrial habitats. In Southern California, where terrestrial productivity was relatively low, early peoples focused on the use of marine foods much earlier than in the north, where abundant deer, elk, and anadromous fishes resulted in more interior-focused economies.

To better evaluate the accuracy of these alternative viewpoints, the following discussion provides a settlement chronology for northwest California through the analysis of projectile point data and obsidian hydration readings from interior riverine, interior mountain, and outer coastal environments. These data are derived from archaeological sites located on a series of stream terraces along the Mattole and Trinity river drainages within 10 and 60 km of the coast (Eidsness 1993; Hildebrandt and Levulett 1997; Sundahl 1988; Sundahl and Henn 1993), along the Pilot Ridge-South Fork Mountain system roughly 50 to 60 km from the coast (Hildebrandt and Hayes 1983, 1993), and the coastal sites previously outlined (figure 16.1).

Three general time periods and adaptive modes are recognized in northwest California (Fredrickson 1984; Hildebrandt and Hayes 1993): Borax Lake pattern (5000 to 1500 BC), Mendocino pattern (1500 BC to AD 500), and Gunther pattern or Late period (post-AD 500). The Borax Lake pattern is represented by the Borax Lake wide-stemmed projectile point (figure 16.3), a large dart point with a wide, square stem that is often indented and basally thinned. The Mendocino pattern includes corner- and side-notched darts of the Mendocino and Willits series, as well as smaller forms of the Trinity series. Because of the relatively small size of Trinity series projectile points, Hayes and Hildebrandt (1985) and Hildebrandt and Hayes (1993) originally assigned these forms to an interval postdating AD 500 following the introduction of the bow and arrow. Subsequent analysis of projectile point morphology and obsidian hydration data from assemblages from Trinity, Shasta, and Modoc Counties have shown that most Trinity series points are simply reworked dart forms that are contemporaneous with Mendocino and

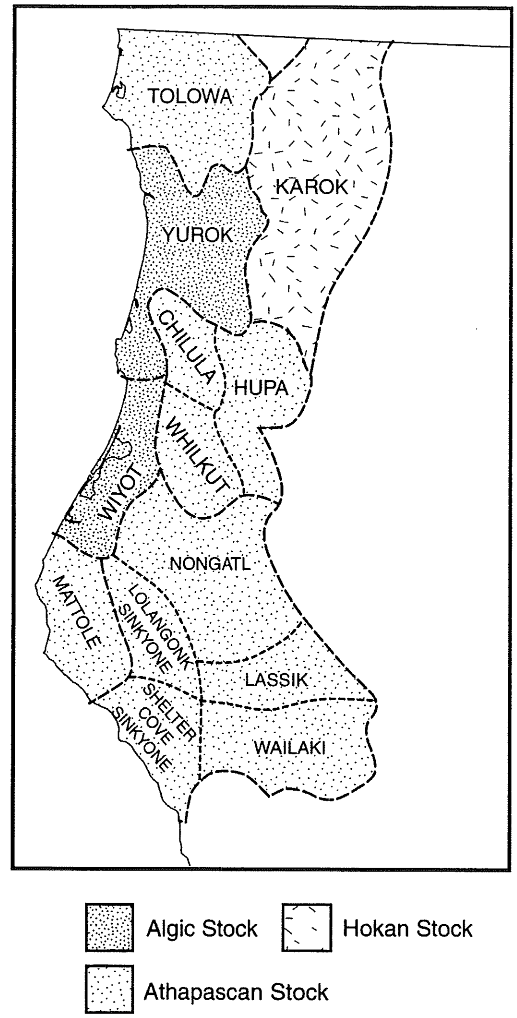

Figure 16.2 Ethnolinguistic groups of northwest California

Willits series points (see Basgall and Hildebrandt 1989; Eidsness 1986; Hildebrandt and Mikkelsen 1994). As a result, the Mendocino pattern (1500 BC to AD 500) is now marked by a generalized point series known as the Willits/Trinity series, which includes the Willits side-notched, Mendocino corner-notched, and Trinity corner- and side-notched forms. The latter includes all of Hayes and Hildebrandt's (1985) subtypes, except contracting stem (XV), diamond-shaped (XXVI), and extremely small corner-notched forms (XVIII). The Gunther pattern/Late period (post-AD 500) is marked by the highly stylized Gunther barbed arrow point with a straight-to-contracting stem and long pointed shoulders or barbs (figure 16.3). This form, an outstanding Late period indicator, is well documented throughout much of Northern California and southern Oregon. A final artifact form of significance to northwest California is the McKee uniface. Originally defined by Baumhoff (1985), it appears to date between about 3000 to 1000 BC, corresponding to the late end of the Borax Lake interval and continuing into early Mendocino pattern assemblages.

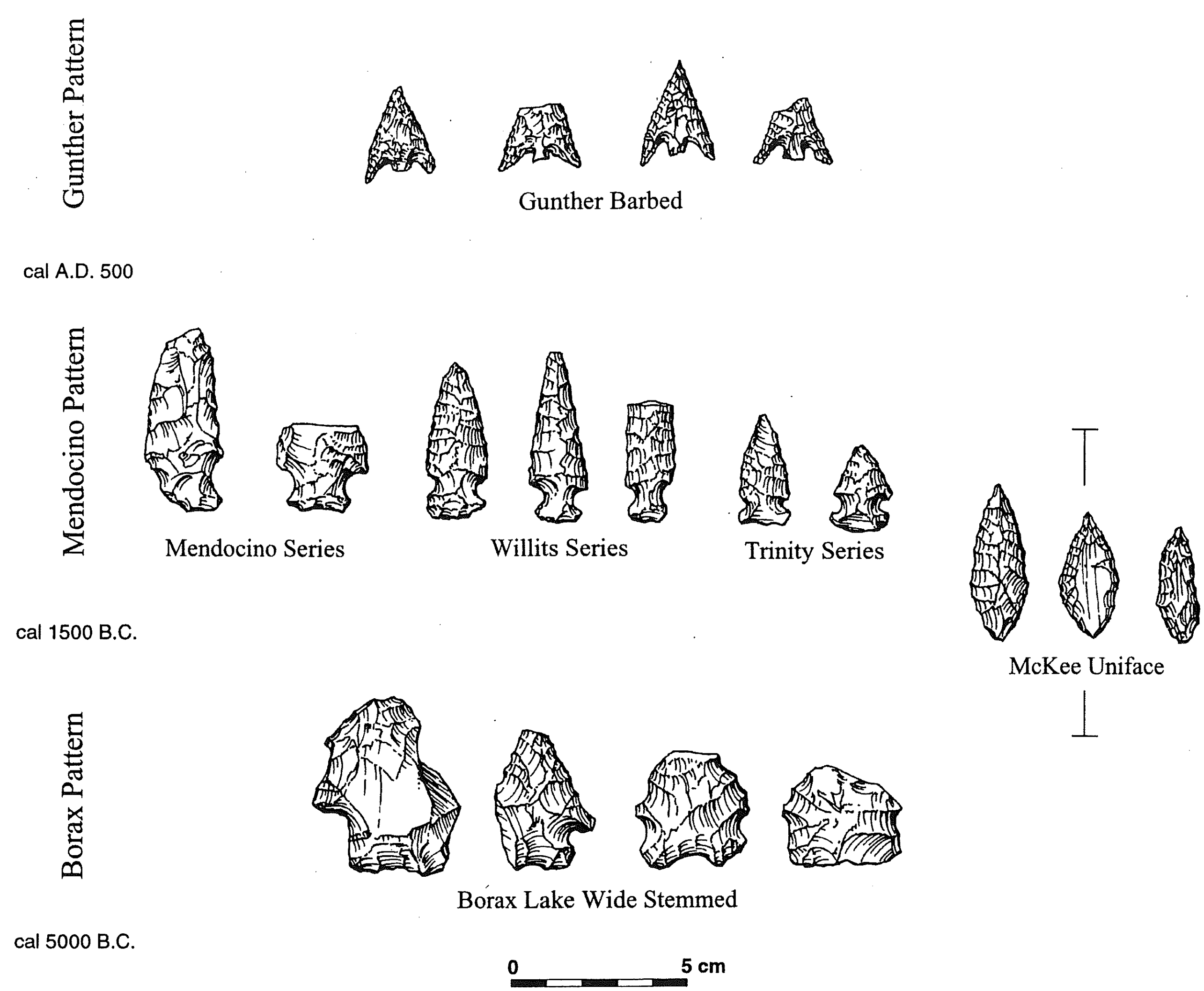

Figure 16.3 Temporally diagnostic projectile points from northwest California. *From Hildebrandt and Hayes 1993*

The settlement chronology of northwest California, as reflected by these temporally diagnostic projectile points, shows a great deal of variability from one environmental setting to the next (table 16.1). Beginning along the interior river valleys, these abundant projectile point types show increased frequency over time. Within the interior mountain ranges (largely the Pilot Ridge-South Fork Mountain system), Borax Lake Wide-stemmed points and the Willits/Trinity series are both abundant, while McKee unifaces and Gunther barbed points are found in much lower frequencies. This reduced frequency is particularly the case for the Gunther barbed point, which represents only 4.1% of the overall assemblage and could reflect a Late period development of sedentary villages along the rivers and a reduced, more specialized use of adjacent upland areas (see Hildebrandt and Hayes 1993). Moving to the coast, an entirely different set of relationships exists. Borax Lake wide-stemmed and McKee unifaces are completely absent, and Willits/Trinity series points are found in relatively small numbers. Instead, coastal projectile point assemblages are dominated by Gunther barbed forms (81.1%), perhaps indicating a rather late expansion into the coastal environment.

Obsidian hydration data from these contexts produce a comparable set of relationships (figure 16.4). Within interior riverine settings, where mean annual temperatures are relatively warm, application of the Basgall and Hildebrandt (1989) hydration rate (developed for the upper Sacramento River Canyon) shows an abundant presence of obsidian throughout the entire chronological sequence. Because of cooler temperatures found along the Pilot Ridge-South Fork Mountain system (where mean annual temperatures are approximately 10.0°C compared to 14.9°C in the Sacramento River Canyon), the rate of hydration is much slower and must be corrected. Using a correction factor of 7% per °C, the Pilot Ridge-South Fork Mountain data again reveal a significant presence of obsidian across all three

Table 16.1 Distribution of temporally diagnostic projectile points across key environmental settings in northwest California.

	GUNTHER BARBED	WILLITS/TRINITY SERIES	MCKEE UNIFACE	BORAX LAKE WIDE STEM	TOTAL
Interior Riverine	284	209	143	66	702
Interior Mountains	10	133	28	74	245
Coast	116	27	–	–	143
TOTAL	410	369	171	140	1090

Table 16.2 Radiocarbon dates from coastal sites in Northwest California[a]

	LAB NO.	CONVENTIONAL ^{14}C DATE[b] (RYBP)	INTERCEPTS (cal AD/BC)	1 SIGMA RANGE (cal AD/BC)
NORTH OF HUMBOLDT BAY				
DNO–11	–	2260 ± 210	BC 377, 266, 264	BC 756–698, 540–525, 525–47
HUM–129	–	215 ± 100	AD 1664, 1785, 1786	AD 1527–1553, 1632–1698, 1723–1816, 1836–1877, 1916–1948
	–	1490 ± 100	AD 598	AD 444–452, 464–511, 525–649
	–	1860 ± 120	AD 131	AD 25–260, 285–323
HUM–118	–	545 ± 115	AD 1407	AD 1298–1448
	–	640 ± 90	AD 1302, 1369, 1382	AD 1290–1398
HUMBOLDT BAY				
HUM–67		1050 ± 200	AD 997	AD 781–1164
SOUTH OF HUMBOLDT BAY				
Mattole River				
HUM–177	UGa–2499	2225 ± 120	BC 355, 288, 257, 247,233, 216, 214	BC 399–144, 143–113
	UGa–2498	1055 ± 75	AD 995	AD 889–1037
	UCR–879	1270 ± 100	AD 719, 746, 768	AD 668–828, 836–867
	UCR–1282	490 ± 60	AD 1430	AD 1334–1335, 1399–1463
	UCR–1281	380 ± 60	AD 1481	AD 1447–1521, 1575–1625
	UCR–878	300 ± 100	AD 1637	AD 1468–1668, 1784–1792
HUM–176	UCR–1280	320 ± 75	AD 1526, 1557, 1631	AD 1492–1642
HUM–175	UCR–1277	510 ± 80	AD 1421	AD 1315–1355, 1388–1467
	UCR–1278	390 ± 75	AD 1476	AD 1441–1522, 1570–1626
Spanish Flat				
HUM–277	UCR–1287	980 ± 100	AD 1025	AD 981–1171, 1179–1182
	UCR–1288	1725 ± 75	AD 262, 277, 337	AD 241–403
	UCR–1289	1640 ± 170	AD 417	AD 242–582, 586–595
	UCR–1290	2505 ± 85	BC 761, 679, 670, 610, 596	BC 786–741, 729–536, 531–523
	UCR–1291	2515 ± 80	BC 762, 677, 672	BC 792–744, 725–535, 528–522
HUM–276	Beta–12645	390 ± 50	AD 1476	AD 1443–1517, 1593–1621
	Beta–12643	290 ± 50	AD 1640	AD 1516–1595, 1619–1657
	Beta–12644	1270 ± 50	AD 719, 746, 768	AD 673–781, 798–804
SHELTER COVE				
HUM–182	UCR–1283	633 ± 70	AD 1303, 1368, 1384	AD 1298–1328, 1344–1394
	UCR–1284	880 ± 70	AD 1163, 1173, 1180	AD 1042–1095, 1117–1140, 1152–1219
HUM–248	UCR–1285	220 ± 65	AD 1662	AD 1532–1547, 1634–1690, 1729–1811, 1922–1946
	UCR–1286	860 ± 70	AD 1192, 1199, 1208	AD 1050–1087, 1122–1136, 1156–1254
HUM–307	Beta–12641	350 ± 50	AD 1516, 1599, 1616	AD 1483–1525, 1556–1629
	Beta–12642	1190 ± 100	AD 784, 787, 833, 836, 877	AD 719–747, 767–904, 914–965

Note: [a] all dates derived from charcoal; [b] data gathered from Levulett and Hildebrandt (1987: 23–24; 115; 139).

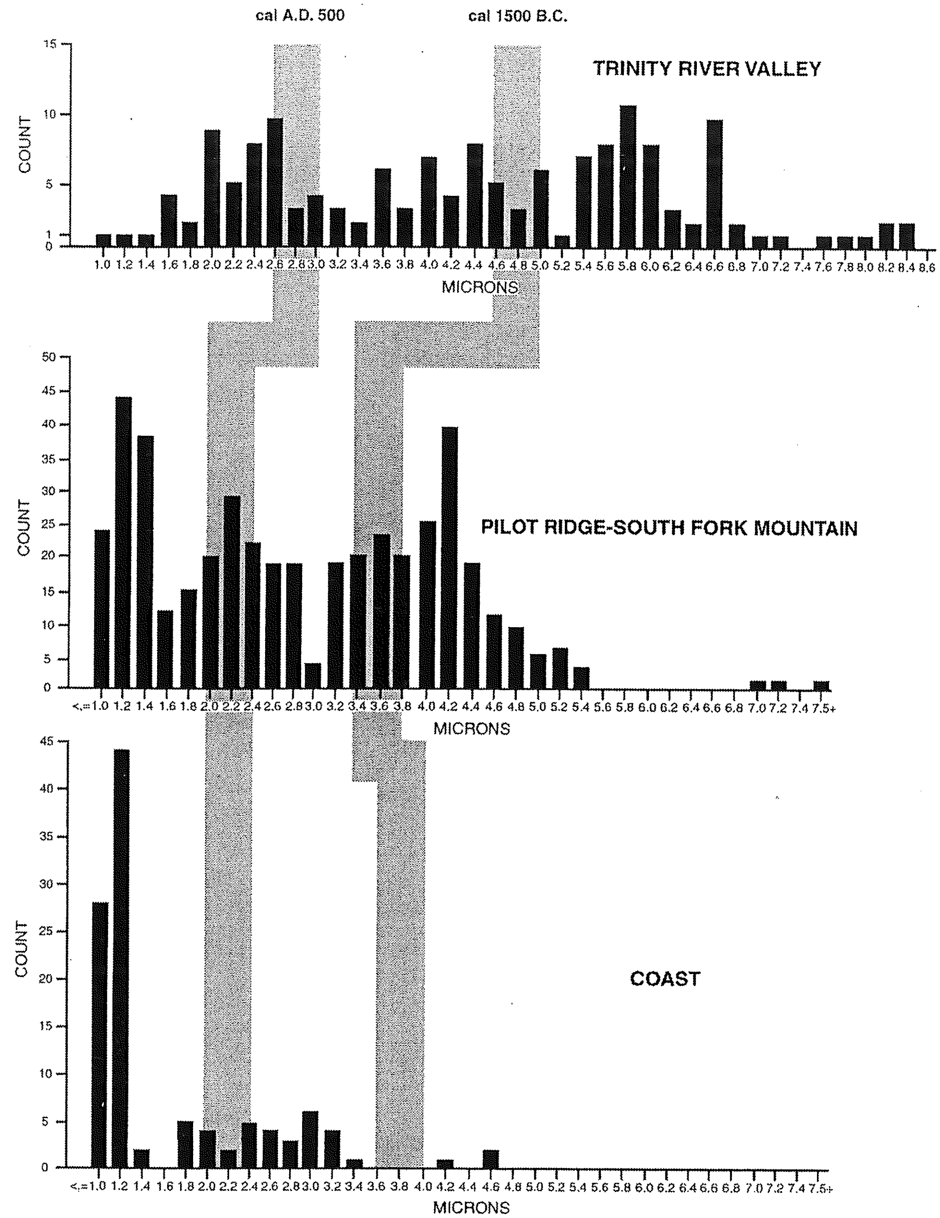

Figure 16.4 Composite profile of obsidian hydration readings from key environmental settings in northwest California

temporal intervals. Moving to the coast, where a mean annual temperature of 11.1°C is comparable to Pilot Ridge-South Fork Mountain, hydration readings corresponding to the Borax Lake pattern are almost absent and show only minimal increases during the Mendocino pattern interval. On the other hand, obsidian hydration readings are abundant during the Late period.

Radiocarbon dates from coastal sites parallel the patterns reflected in the projectile point and obsidian hydration data (table 16.2; figure 16.5). Borax Lake pattern dates are totally absent, Mendocino pattern assays are present in low numbers, and Gunther pattern dates steadily increase over time. Notwithstanding issues of sea level change, tectonic subsidence, archaeological sampling, and the like, the combination of projectile points, obsidian hydration data, and radiocarbon dates seems to confirm a model of relatively low-level coastal use prior to about AD 500 and a subsequent proliferation of occupation after that date.

ARTIFACT ASSEMBLAGES FROM IMPORTANT NORTH COAST SITES

The following discussion provides a detailed review of artifact assemblages, organized by pattern and location, from 20 sites situated along the California North Coast. Information was obtained from published articles and monographs, PhD dissertations, and unpublished reports. In some cases, due to insufficient artifact descriptions from certain sites, exact quantities of some artifact classes are not available. Nevertheless, these data document the rich and varied cultural adaptations that occurred on the North Coast and allow comparative study of assemblages in California and other parts of the world.

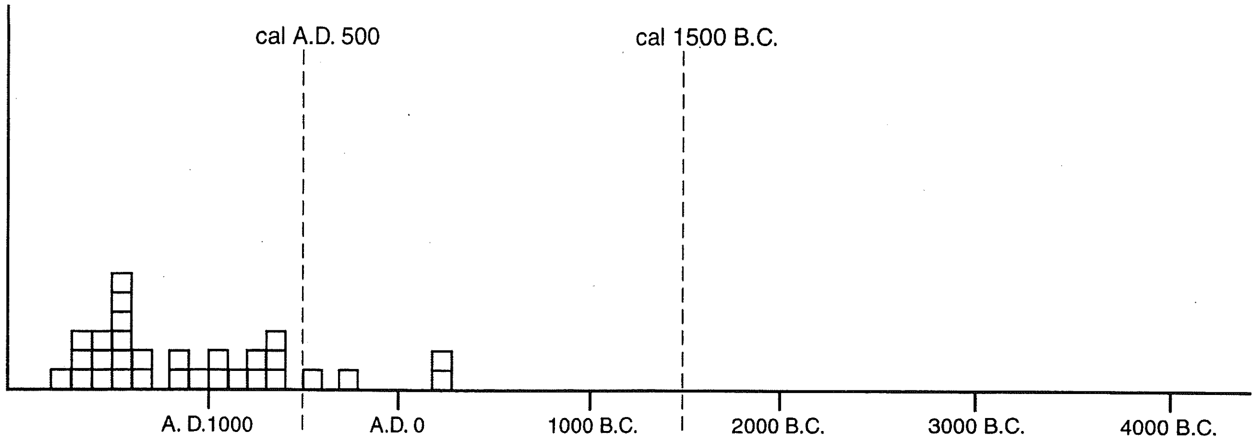

Figure 16.5 Calibrated radiocarbon dates from coastal sites in northwest California

Only one Borax Lake pattern component, located 1.5 km inland, has been encountered along the California North Coast (HUM-513/H). Preliminary investigations at the site produced flaked and ground stone tools but no vertebrate or invertebrate faunal remains (Roscoe 1995). Because of the lack of shellfish and the abundant prairie and marshland habitats in the area, Roscoe (1995) concluded that the hunting and butchering of large game (predominately Roosevelt elk) was the primary activity.

Coastal adaptations during Mendocino pattern times are formally documented at four sites, while Gunther pattern/Late period materials are represented at 19 locations. Because of the important environmental differences that exist along this stretch of coast, Gunther pattern/Late period assemblages are organized into three geographic groups: north of Humboldt Bay, sites on Humboldt Bay, and sites along the King Range Coast south of Humboldt Bay.

Mendocino Pattern (1500 BC–AD 500) Artifact Assemblages from Coastal Sites

Only three of the four Mendocino pattern sites produced assemblages with significant numbers of artifacts: DNO-11 at Point St. George (Gould 1966); HUM-351 adjacent to Humboldt Bay (Eidsness 1993), and HUM-277 at the mouth of Randall Creek along the King Range Coast (Levulett 1985). The fourth site (HUM-177B), located at the mouth of the Mattole River, yielded a calibrated radiocarbon date of 250 cal. BC (2225 $\pm$ 120 RYBP; table 16.2). Unfortunately, the associated assemblage was restricted to debitage (Levulett and Hildebrandt 1987). The three primary sites produced rather simple assemblages, probably a reflection of short-term occupations (table 16.3). Projectile points, although showing some intrusive Gunther barbed specimens, are dominated by the Willits/Trinity series and various leaf-shaped and small contracting stem forms. Other flaked stone tools include bifaces, flake tools, and little else, while only a handful of ground and battered stone implements was recovered. The relatively simple assemblage at DNO-11, coupled with an abundance of flaked stone debitage and very low densities of marine subsistence debris, led Gould (1966) to conclude that this Mendocino pattern component probably represented a small temporary camp occupied by interior peoples focused on collecting locally abundant, high-quality chert. Eidsness (1993) came to a similar conclusion, suggesting that materials from HUM-351 represented a temporary camp associated with a larger residential base probably located on a

Table 16.3 Mendocino pattern (1500 BC-AD 500) artifact frequencies from coastal sites in northwest California.

	DNO-11	HUM-351	HUM-277	TOTAL
Flaked Stone				
Projectile points				
Gunther series	1	2	4	7
Leaf shape	4	-	-	4
Willits/Trinity series	1	4	14	19
Other	7	1	1	9
Concave-base harpoon/arrow				
Harpoon tip	-	-	-	-
Arrow point	-	-	1	1
Undifferentiated	-	-	-	-
Bifaces	9	5	19	33
Drills	-	2	2	4
Flake tools	3	20	24	47
Choppers	-	5	-	5
Ground/Battered Stone				
Mortars				
Bowl	-	-	-	-
Hopper	-	-	2	2
Pestles	1	-	1	2
Hammerstones	-	1	1	2
TOTAL	26	40	69	135

nearby watercourse. Although Levulett (1985) encountered greater evidence for intertidal shellfish collecting and fishing at HUM-277 than did Gould (1966) or Eidsness (1993), the overall character of the assemblage, combined with the limited number of coastal sites dating to this interval, led her to conclude that marine resource procurement activities played a limited role in the larger terrestrially oriented subsistence-settlement pattern system.

Gunther Pattern (Post-AD 500) Assemblages North of Humboldt Bay

After AD 500, several major changes occurred in the archaeological record, particularly at Humboldt Bay and areas to the north. Not only does the number of sites proliferate, but artifact assemblages become much more diversified, reflecting the construction of permanent houses and dugout canoes, harvest of a wide variety of marine foods, and in some cases, differential wealth and power among local populations. Four major village sites contribute to the Gunther pattern archaeological record north of Humboldt Bay: DNO-11 at Point St. George (Gould 1966), HUM-129 at Stone Lagoon (Milburn et al. 1979), HUM-118 at Patrick's Point (Elsasser and Heizer 1966), and HUM-169 at Trinidad (Elsasser and Heizer 1964).

All these assemblages include high frequencies of Gunther barbed projectile points, followed by lesser numbers of leaf-shaped forms and only a handful of other types. Triangular, concave base projectiles are common and served as stone tips on bone and antler composite harpoons. The larger specimens were used to hunt seals and sea lions, while the smaller forms were used with fish harpoons (see Bennyhoff 1950; Jobson and Hildebrandt 1980; Kroeber and Barrett 1960; Lyman et al. 1988). Unfortunately, it is not possible to classify correctly most of the flaked stone harpoon tips at HUM-118 and HUM-169, because Elsasser and Heizer (1966) classified them as a single type according to shape but not size. Solving this problem requires reanalysis of collections housed at the Hearst Museum, University of California, Berkeley. Other flaked stone tools include bifaces, flake tools, cobble choppers, and drills.

The ground and battered stone assemblages from these sites are characterized by numerous pestles and hammerstones, but very few mortars. Mauls are found in significant numbers at HUM-169 but are rare or absent elsewhere. Notched net sinkers are also abundant at HUM-169 and HUM-129; most are small, elliptical, side-notched pebbles often found as caches and features, probably representing stored nets (Elsasser and Heizer 1966; Milburn et al. 1979). They were used for fishing and, according to Margaret Lara, a Yurok elder from the Stone Lagoon area, as part of a "net with floats and sinkers ...set for diving ducks,

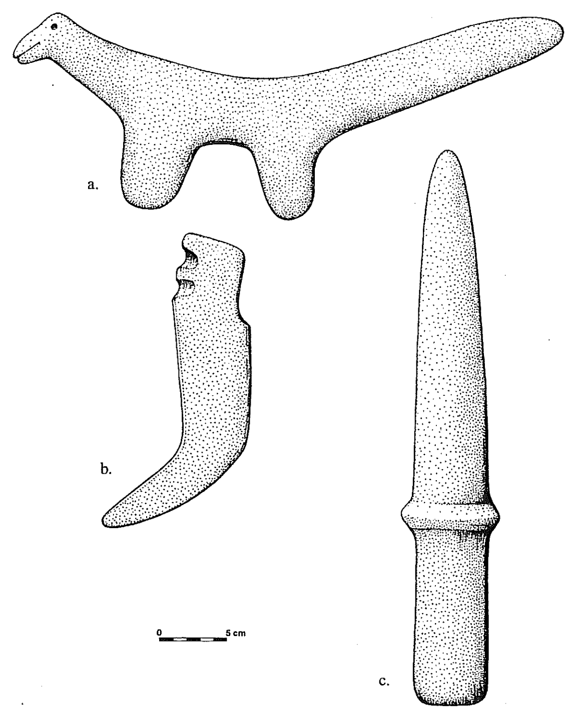

Figure 16.6 *a,* Zooform club; *b,* stone adze handle; *c,* flanged pestle

which were caught in its meshes while diving for food; the ducks drowned in the net and were retrieved the next day" (Milburn et al. 1979:179).

Polished stone artifacts are plentiful, in some cases representing spectacular pieces of art. Steatite bowls are common and were used as grease catchers or for a limited range of cooking activities. Zooform clubs are finely fashioned, highly polished artifacts that served as special wealth items (Elsasser and Heizer 1964:27; figure 16.6a). Stone adze handles have "one end curved and the other recessed to receive a shell blade which was lashed on" and used for woodworking activities (Elsasser and Heizer 1964:26; figure 16.6b).

A wide range of bone and antler implements is present at each site and represents one of the most spectacular classes of artifacts in the region. Elk antler wedges were predominantly used for splitting redwood for the construction of houses and other structures, as well as for chiseling dugout canoes (figure 16.7a). The abundance of bone and antler harpoons clearly reflects an intense focus on the utilization of marine resources. Harpoons usually have unilateral barbs with either a slotted tip to hold the stone points or simple tips that were ground and polished into a sharp point (figure 16.7b, c). Toggle harpoon pieces are also present, as are a variety of bipointed objects, including gorge fishhooks. Other bone and antler tools include large numbers of gouges, flakers, needles, and awls, all of which reflect manufacturing and maintenance activities associated with residential occupations.

Shell artifacts, in contrast, are rare at these sites, limited to 40 spire-ground *Olivella* specimens. As discussed in more detail below (see "Late Period (Post-AD 500) assemblages South of Humbolt Bay"), these items tend to be limited to mortuary contexts throughout northwest California but are rare elsewhere.

Gunther pattern sites also show a high degree of structural complexity, as all deposits have well-defined activity areas, including the remains of houses, cemetery areas, and artifact caches. House structures, discovered at DNO-11, HUM-129, and HUM-169, are represented by redwood timbers; some have stone patios built outside their entrance. During his initial excavations in midden soils at DNO-11, Gould (1966) had hoped to find houses and voiced concern to local Tolowa people regarding the lack of such evidence. They all laughed and told him that "them old-timers never put their houses in the garbage-dump" (Gould 1966:43) and directed him to dig on a sandy slope near the midden, where no evidence of archaeological material was seen. Within 20 minutes of digging they found the remains of a redwood plank house with a blue clay floor and a central hearth. Based on these findings and a review of several ethnographic accounts, Gould (1978:130) described Tolowa family houses as "square structures with an outer wall of upright redwood planks extending about 15 feet on each side and a square interior pit about two to three feet deep and about 10 feet on each side" (figure 16.8).

Gunther Pattern (Post-AD 500) Assemblage from Humboldt Bay

The Humboldt Bay area is represented by a single Gunther pattern site located on Gunther Island (HUM-67). It is separated from the more northerly sites because (1) it is located in a unique environmental setting, (2) nearly all excavations were focused on a cemetery area, and (3) quantitative

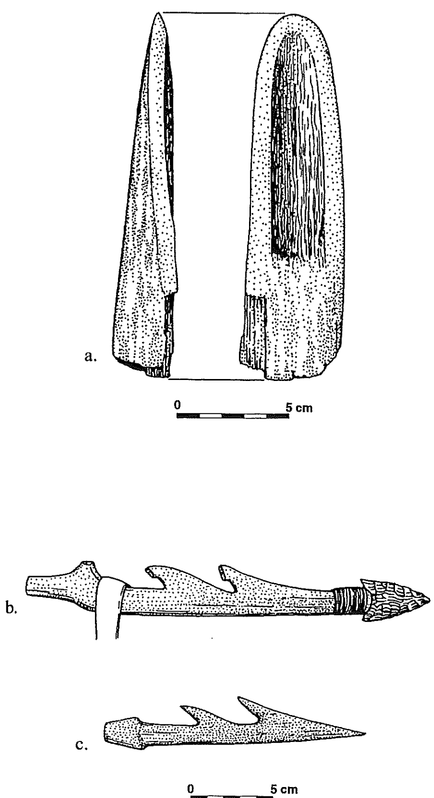

Figure 16.7 *a*, elk antler wedge; *b*, *c*, composite harpoons

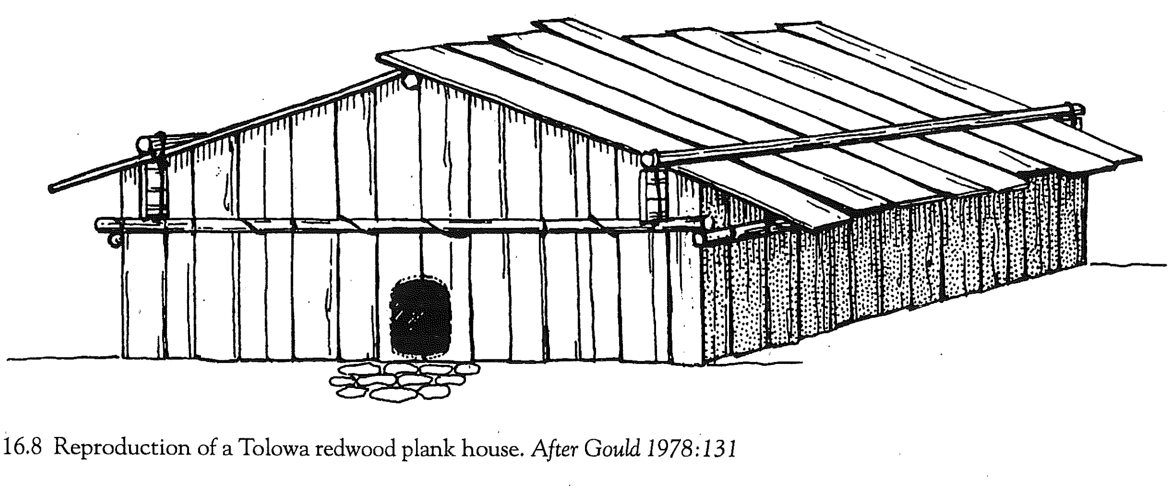

Figure 16.8 Reproduction of a Tolowa redwood plank house. *After Gould 1978:131*

Table 16.4 Gunther Pattern/Late Period (post-cal AD 500) artifact assemblages from coastal sites in northwest California.

	NORTH OF HUMBOLDT BAY				HUMBOLDT BAY	SOUTH OF HUMBOLDT BAY		
	DNO-11	HUM-129	HUM-118	HUM-169	HUM-67	MATTOLE R.	SPANISH FL.	SHELTER C.
Flaked stone								
Projectile points								
Gunther series	11	40	10	24	**	6	11	12
Leaf-shape	4	-	24	10	+	-	1	-
Other	-	9	-	2	+	-	2	2
Willits/Trinity	-	3	1	-	-	-	1	3
Concave-base harpoon/arrow								
Harpoon/tip	12	12	10*	12*	+	-	-	2
Arrow point	7	12	5*	1*	+	-	1	-
Undifferentiated	-	-	126	42	+	-	-	-
Ceremonial blades	-	3	5	-	64	-	-	-
Bifaces	11	9	81	27	85	16	12	13
Drills	4	16	14	4	12	-	-	2
Flake tools	7	+	306	-	7	29	24	21
Choppers	+	139	122	55	-	62	7	21
Ground/Battered Stone								
Mortars								
Bowl	-	-	-	-	-	2	-	-
Hopper	+	1	-	5	1	2	1	1
Pestles								
Simple	20	1	-	21	20	1	1	3
Flanged	1	2	-	-	10	-	-	-
Undifferentiated	-	-	-	-	15	-	-	-
Hammerstones	-	28	-	51	7	28	12	18
Mauls	-	2	-	9	21	1	-	-
Net sinkers								
Notched	25	1167	-	335	138	-	-	-
Grooved	-	-	-	-	53	-		
Polished stone								
Stone bowls								
Steatite	-	29	22	47	7	-	-	-
Other	-	-	7	-	6	-	-	-
Zooform clubs	-	-	9	-	31	-	-	-
Adze handles	4	-	+	2	29	-	-	-
Steatite pipe fragments	2	5	-	1	7	-	-	-
Bone and antler								
Wedges	43	72	63	51	51	2	1	4
Simple harpoons								
Large	7	3	45	20	5	-	-	-
Small	1	3	24	6	8	-	-	-
Other	-	-	-	13	5	-	-	-
Composite harpoons								
Toggle pieces	-	6	6	26	-	1	2	2
Bipointed bone								
Pins	-	12	-	10	-	-	-	-
Gorge hooks	2	4	1	4	-	2	1	5
Miscellaneous bone tools								
Awls/Pins	23	64	58	63	12	7	5	14
Gouges	-	28	-	-	31	-	-	-
Flakes	-	11	58	66	-	1	-	7
Needles	-	30	3	16	-	5	2	-
Curved/angular fish hooks	3	-	4	-	18	-	-	-
Shell artifacts								
Dentalium	1	-	-	-	>37	-	-	-
Olivella								
End ground	-	-	?	40	>250	-	6	54
Tiny saucers	-	-	?	-	49	-	-	-
Clam disk	1	-	-	-	-	1	42	482
Abalone ornaments	-	-	-	16	>296	-	-	1

* Harpoon tips distinguished from arrow points based on published illustrations, other items are undifferentiated
** Entire assemblage is undifferentiated.

control over the assemblage is problematic. L.L. Loud (1918), who first worked at the site in 1913, produced one of the best reports ever written about the region. Based on Loud's findings, a local dentist named H. H. Stuart leased the island from its owner and conducted his own excavations at the site. Stuart's work also focused on the cemetery area. Although his field notes appear accurate and comprehensive, a significant portion of the assemblage was lost during subsequent years. Because of the obvious importance of this site, Elsasser and Heizer (1966) reviewed Stuart's remaining collections and field notes and published a summary of findings, attempting to quantify data from both the Loud and Stuart excavations.

The artifact assemblage from HUM-67 is similar to those outlined above, except for the higher frequency of items used for ceremonial purposes and to signify wealth (table 16.4). Flaked stone tools are quite abundant and are dominated by Gunther barbed and concave base projectile points, but the actual proportion of these items is unknown. Other utilitarian items include bifaces, drills, and flake tools. The most spectacular attribute of the flaked stone assemblage is the large number of ceremonial obsidian blades (n=64). These bifacially flaked blades, which range between 25 and 50 cm long (Elsasser and Heizer 1964), were used as part of the White Deerskin Dance (Kroeber 1925). They also represented important markers of wealth and social rank, which is clearly evidenced by their distribution across the burial population at the site (see "Late Period (Post-AD 500) assemblages South of Humbolt Bay" below; R. Hughes 1978).

Similar to the sites farther north, the ground and battered stone assemblage is characterized by abundant pestles, net sinkers, and a conspicuous lack of mortars (table 16.4). Numerous highly stylized flanged pestles were found as well (figure 16.6c). Zoomorphic clubs (n=31) and adze handles (n=29) were found in unusually high frequencies, probably due to the mortuary association of the assemblage.

Antler wedges are abundant, while simple harpoons, toggle harpoon parts, gorge hooks, and other bone implements are either absent or found in relatively low frequencies. Shell beads and ornaments, in contrast to other Gunther pattern sites, are plentiful, including *Dentalium* beads, spire-ground *Olivella* beads, tiny saucer *Olivella* beads, and a variety of abalone ornaments. The exact quantities of these items are difficult to ascertain, because data for several burials are limited to presence/absence information.

Late Period (Post-AD 500) Assemblages South of Humboldt Bay

Archaeological materials south of Humboldt Bay are derived from excavations at 13 sites along the King Range Coast (Levulett 1985; Levulett and Hildebrandt 1987; Waechter 1990, 1993). Artifact assemblages generated by this work differ substantially from those farther north, particularly with respect to maritime technologies, woodworking tools, and ceremonial objects (table 16.4). As a result, we do not consider them part of Fredrickson's (1984) Gunther pattern, but rather group them with Late period manifestations farther south along the coast. Flaked stone assemblages include projectile points (dominated by Gunther barbed), bifaces, flake tools, and choppers; however, they lack stone harpoon tips, large ceremonial blades, and drills. Milling equipment, mauls, and antler wedges are also quite rare, while small bone implements (for example, gorge hooks, awls, and pins) are found in more significant numbers.

Similar to the northern sites, shell artifacts are abundant only in mortuary contexts. Sites at Spanish Flat and Shelter Cove produced spire-ground *Olivella* and clam disk beads, the latter showing stronger connections to areas farther south (most of the clam disk beads probably originated from Bodega Bay). Also in contrast to the more northerly areas, the bodies in several graves observed along the King Range Coast had been placed on a relatively thick bed of obsidian debitage, possibly showing greater affinities to Late period patterns in the Red Bluff area (Levulett and Hildebrandt 1987).

The relatively limited nature of the coastal King Range assemblages, particularly the absence of permanent house structures, woodworking tools, and a maritime technology reflects a lower degree of occupational intensity than was present at Gunther pattern sites. As discussed in more detail in "Issues of Oceangoing Canoe Use and the Role of Marine Resources" below, these differences in adaptation are probably due to the abundance of offshore rocks and islands north of Humboldt Bay, which provided an incentive to develop oceangoing canoes. Development of a maritime technology facilitated the use of offshore marine mammal breeding grounds, and it provided access to a variety of ocean fish not otherwise available to people restricted to near-shore contexts.

Faunal Remains From Late Period Sites in Northwest California

Although mammal, fish, and shellfish remains are abundant in most sites along the North Coast of California, these materials have not been comprehensively analyzed. Analyses of vertebrate and invertebrate faunal remains from the King Range have been completed by Hildebrandt (1981, 1984), Levulett (1985), and Levulett and Hildebrandt (1987) using modern methods during both the field and analytical phases of work (for example, 6.0 and 3.0 mm screening, column samples). Collection strategies at the more northerly sites, in contrast, were quite variable. Fine-grained collection procedures were used at HUM-129, but most of the earlier excavations did not use screens (for example, DNO-11) and

TABLE 16.5 Mammalian faunal remains from key Gunther Pattern/Late Period (post-cal AD 500) coastal sites in northwest California (from Hildebrandt and Jones 1992).

	NORTH OF HUMBOLDT BAY			HUMBOLDT BAY	SOUTH OF HUMBOLDT BAY			
	DNO-11	HUM-129	HUM-118	HUM-67	MATTOLE R.	SPANISH FL.	SHELTER C.	TOTAL
Migratory								
Stellar sea lion	253	22	26	21	133	8	36	499
Northern fur seal	1	74	6	-	3	16	5	105
California sea lion	9	4	2	-	10	8	5	38
Resident								
Harbor seal	4	1	-	31	46	-	8	90
Sea otter	38	8	17	15	23	7	33	141
Terrestrial								
Elk	36	27	23	89	16	10	11	212
Deer	8	32	9	30	196	392	281	948
TOTAL	349	168	83	186	427	441	379	2,033

Note: values represent number of identified specimens.

in some cases, only small samples of faunal remains were systematically saved for analysis (for example, HUM-118). As a result, mammalian faunal remains are the only data class that has been systematically analyzed for sites at Humboldt Bay and areas north (see Hildebrandt 1981, 1984; Hildebrandt and Jones 1992). Therefore, the following discussion focuses on Late period hunting patterns, while issues regarding fishing and shellfish gathering are given lower interpretive priority.

Native hunters actively pursued five marine mammal species along the California North Coast. Inter-specific contrasts in the reproductive behavior of these animals are important to consider, because these differences influenced prey availability and the costs associated with their capture (Hildebrandt and Jones 1992; Jones and Hildebrandt 1995). Two reproductive groups are recognized: migratory breeders and resident breeders. Migratory breeders, including Steller sea lion (*Eumetopias jubata*), California sea lion (*Zalophus californianus*), and northern fur seal (*Callorhinus ursinus*), do not regularly breed or give birth in the water. Instead, large dominant males establish territories on offshore rocks and islands in late spring to control harems of the smaller females that arrive later to give birth and breed for the upcoming pupping season. Because pups cannot swim for one to two months, the rookeries remain occupied until midsummer, at which time the animals disperse on their annual migrations. Resident breeders include harbor seal (*Phoca vitulina*) and sea otters (*Enhydra lutris*). Both of these species can breed and give birth in the water, are not migratory, do not form large harems, and have little sexual dimorphism (see Jones and Hildebrandt 1995:83).

Mammalian faunal data summarized in table 16.5 show that sites north of Humboldt Bay, where offshore rocks are abundant, have a much higher percentage of marine (71%) versus terrestrial remains (29%). Of the terrestrial game, elk is more abundant than deer (66 to 34%), and of the marine mammals, migratory breeders predominate over the resident species (82 to 18%). South of Humboldt Bay, where offshore rocks are rare, a contrasting pattern exists. Terrestrial game dominates the faunal assemblage (73%), and deer are much more abundant than elk (95 to 5%). Of the small sample of marine mammals, migratory species have a significant presence at the Mattole River (probably because of small inshore rocks located there), but are rare elsewhere. Gunther Island (HUM-67), which lacks offshore rocks, produced a relatively low frequency of migratory animals and an abundance of terrestrial game dominated by elk.

Detailed fish bone analyses are available only from the King Range sites and Point St. George. The southern sites show a predominance of intertidal species with a corresponding absence of fishes obtained from pelagic environments (Hildebrandt 1981:148; Levulett 1985). The only possible exception is Pacific hake (n=50; 1.2% of the assemblage), which is highly pelagic as an adult but spawns in intertidal settings. At Point St. George, in contrast, Gould (1966:85) noted a significant presence of turkey-red rockfish and vermillion rockfish. Both fishes favor rocky habitats over 30 fathoms deep and were probably caught from canoes during forays to the rocks located off Point St. George (for example, Northwest Seal Rock, 11 km offshore).

These data are fully consistent with the artifact findings outlined above (the abundance of stone harpoon tips, bone and antler harpoons, and other bone fishing gear) and clearly reflect a greater maritime focus among the peoples north of Humboldt Bay than those to the south. Based on these findings, Hildebrandt (1981, 1984) concluded that the abundant offshore rocks north of Humboldt Bay led northern groups to develop a technology capable of harvesting the rich marine mammal resources available in these settings (that is, the oceangoing canoe-harpoon complex). Moreover, the construction, maintenance, and use of large seagoing boats was possible only through the organization of workers supported by capital controlled by a few wealthy people.

Table 16.6. Distribution of wealth items across the burial population at the Gunther Island site (HUM-67).*

	CREMATIONS				PRIMARY INTERMENTS				TOTAL
	ADULT (n=76)	CHILD (n=12)	ADOL. (n=2)	UNKNOWN (n=29)	ADULT (n=19)	CHILD (n=0)	ADOL. (n=1)	UNKNOWN (n=2)	
Large obsidian blades	11	2	2	1	1	-	-	-	17
Small obsidian blades	10	2	-	7	1	-	-	-	20
Dentalium	10	5	-	1	1	-	-	-	17
Olivella beads	11	4	1	1	-	-	-	-	17
Abalone ornaments	28	8	2	12	4	-	1	1	56
Total # of burials w/assoc.	49	11	2	12	7	-	1	1	83

* Data derived from 141 burials
Adol. = Adolescent

According to Gould (1968:16-17)

> ...it was incumbent upon the man who wanted the canoe built that he provide his assistants with gifts of food while they worked for him. At times when additional labor was called for (for example, when the redwood log was hauled up out of the water, or when launching took place), the headman would call together all his relatives both affinal and consanguineal, to assist (in construction); usually the headman was the only person in the village who could afford to feed large numbers of people in this manner, so it is not surprising that only wealthy headmen owned such boats.

Wealthy families also owned important resource areas, including acorn groves, river eddies for obtaining fish, and portions of offshore rookeries (Drucker 1937b; Goddard 1903; Goldschmidt 1951a; Kroeber 1925; Waterman 1920). South of Humboldt Bay, where there was a greater focus on terrestrial resources not requiring the same kind of capital investment, the archaeological and ethnographic records show little evidence for sedentary villages along the coast and a lower degree of social stratification (Elsasser 1978; Levulett 1985).

ISSUES OF SOCIOECONOMIC COMPLEXITY

Individual wealth and socioeconomic stratification were very important to the Native people who occupied the shores of Humboldt Bay and the coastal region to the north (for example, the Wiyot, Yurok, and Tolowa). Unlike much of Central and Southern California populations, they lacked tribelet organization, as originally defined by Kroeber (1925). Instead, Goldschmidt (1951a) argued that the concept of village and tribe was essentially nonexistent; the individual and immediate family took precedence. "Though persons were identified by their village of residence and their tribe of origin, neither of these groups had any direct claim upon the action of the individual" (Goldschmidt 1951a:507). There was a universal concept of privately and individually owned property, money was the predominant form of exchange (for example, *Dentalium*), and differential wealth indicated a person's class affiliation, which could be inherited from one's parents.

As discussed previously, large obsidian bifaces were one of the most important articles of wealth among the Wiyot, Yurok, and Tolowa. X-ray fluorescence analysis of several specimens (R. Hughes 1978) revealed that most of these items originated from distant, more exotic obsidian sources (for example, Warner Mountains, Glass Buttes, Vya) than was the case for more utilitarian items, such as projectile points—the latter originating from the closer Medicine Lake Highlands locality. Many of the exotic obsidians were red or mottled red-and-black, which "undoubtably added immeasurably to the value of these pieces, as well as to the social rank and wealth of their owners" (R. Hughes 1978:61).

Cemetery Population From the Gunther Island Site (HUM-67)

An emphasis on differential wealth and power is reflected in the cemetery at HUM-67 (Elsasser and Heizer 1964; Loud 1918). Elsasser and Heizer (1964) compiled information from 141 of the interments excavated by Stuart. Unfortunately, specific counts for each artifact class are not available for each individual, making it necessary to use presence-absence data in several cases. Despite these problems, the data provide important information about burial practices at the site and illustrate a pattern of social ranking documented by the ethnographic record.

Of the 141 interments described, 119 are cremations and 22 are primary burials (table 16.6). Because of the poor condition of many skeletons (especially the cremations), gender differentiation was rarely possible, but general age determinations were made for almost 80% of the population. Among the identifiable cremations, 76 (84.4%) were adults, 12 (13.3%) were children, and two (2.2%) were adolescents. Adults have an even higher representation among the small

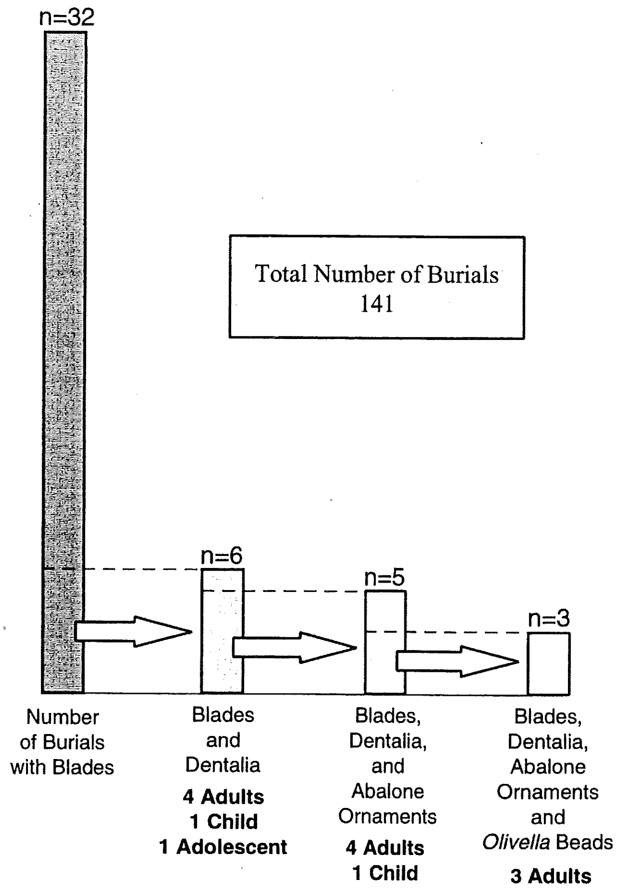

Figure 16.9 Number of individuals buried with multiple items of wealth at the Gunther Island site (HUM-67)

sample of primary interments (n=19; 95.0%) while nonadults are limited to a single adolescent.

As one would expect from a nonegalitarian society, items of wealth occur in only a minority of the burial population (table 16.6). Large obsidian blades are present with only 17 individuals, representing 12.1% of the population. Similar frequencies of association are found for small obsidian blades (n=20; 14.2%), *Dentalium* (n=17; 12.1%), and *Olivella* beads (n=17; 12.2%), while abalone ornaments are more prevalent (n=56; 39.7%), perhaps indicating they were valued less than the other materials. It is also important to note that the above associations are much higher among adults that were cremated (64.5%) versus those that were not (36.8%), perhaps indicating a correlation between status and burial mode.

When evaluating these data according to age, we see that large obsidian blades (14.5%), small obsidian blades (13.2%), *Dentalium* (13.2%), and *Olivella* beads (14.5%) are found in about the same number of adult interments (table 16.6). The significance of the child burial data is more problematic due to the small sample size. Nevertheless, these data show that the percentage of child interments with large obsidian blades (16.7%) and small obsidian blades (16.7%) is roughly the same as the adults, but the frequency of association increases for *Dentalium* (41.7%) and *Olivella* beads (33.3%). Twenty-eight individuals from the adult sample have abalone ornaments (36.8%), but similar to the other artifact classes, these items reach even higher relative frequencies among the children (n=8; 66.7%).

The elite status of select individuals is clearly illustrated when observing the number of interments containing more than one type of wealth item. As illustrated by figure 16.9, 32 individuals were buried with at least large and/or small obsidian blades (22.7% of the population). Of this group, only six (4.3%) were buried with large and/or small obsidian blades and *Dentalium* shell. Only five (3.5%) individuals have obsidian blades, *Dentalium*, and abalone ornaments, while only three (2.1%) have obsidian blades, *Dentalium*, abalone pendants, and *Olivella* beads. Despite this precipitous drop in the number of individuals with multiple types of wealth items, children and adolescents remain in all but the most prestigious group, where all four types of wealth items are present.

These data suggest that a high degree of social ranking existed among the inhabitants of the Gunther Island locality. The relatively high frequency of children with valuable items may also indicate that wealth was inherited, and that certain individuals were given high status at a very young age, prior to developing the ability to achieve such status on their own (see Saxe 1971). It is important to note, however, that this mortuary pattern could also result from a situation where an individual accumulated a significant amount of wealth during his or her lifetime and contributed to the grave of a child (perhaps even a nonrelative). If this were the case, then the presence of wealth items among children would not necessarily reflect a system of inherited wealth (that is, ascribed status) or the high level of sociopolitical complexity that usually accompanies such a system (see Marquardt 1985; Peebles and Kus 1977). Nevertheless, given what we know about the ethnographic record, the mortuary patterns revealed at Gunther Island are fully consistent with a society characterized by socioeconomic ranking and inherited wealth.

ISSUES OF OCEANGOING CANOE USE AND THE ROLE OF MARINE RESOURCES

Archaeological data from sites north of Humboldt Bay reflect an adaptation focused on the consumption of marine foods, including resources requiring the use of watercraft. Artifact assemblages include numerous harpoons used to capture sea mammals, while faunal remains show a dominance of species probably obtained from offshore rocks located up to 11 km from shore. In addition to the ethnographic record, which describes oceangoing dugouts 9.0 to 12.2 m long and 1.5 to 3.0 m wide, the obvious importance of marine resources (particularly sea lions) is reflected by a ceremonial site located on a rock 400 m offshore near Patrick's Point (Heizer 1951b). This rock (HUM-174) has a deposit containing an estimated 1000 sea lion skulls and no other cultural material. The foramen magnum (hole at the base of the cranium) on many of the specimens was purposefully enlarged for possible brain removal and all the observed crania apparently were cleaned before being placed on the rock (that is, no mandibles were present). Although no ethnographic accounts mention this site or the activities associated with it, it surely represents some type of sea lion shrine created by a people with an interest in and knowledge of marine environments that exist well beyond the intertidal zone.

Despite these findings, T. Hudson (1981) argued that the Tolowa and Yurok had little specialized knowledge of the marine environment and their boats were not seaworthy. He based this conclusion on ethnographic reports of canoe design, assuming that oceangoing canoes had the same basic design as those used in riverine settings. In comparing the Tolowa and Chumash, Hudson (1981:272) stated that the Chumash:

> knowledge of marine architecture easily separated their plank-built boats from the humble dugout [of northwest California]. Such socio-cultural differences between these two coastal peoples suggests to me that the Chumash placed far greater value upon marine-related technology and specialized knowledge. It implies that little, if any, specialized marine knowledge and technology was involved among the Tolowa to construct a 'sea lion' dugout ....

More recently, Arnold (1995a) reached a similar conclusion regarding marine adaptations along the California North Coast. Although admitting that both Tolowa and Chumash canoes were used to haul marine mammal meat, Arnold (1995a:739, citing T. Hudson 1981) concluded that "Tolowa dugout canoe hulls were not stable enough for sustained sea lion hunting on the exposed northern coast and were not legitimate oceangoing watercraft...."

These conclusions, which seem strange to people familiar with northwest California archaeology and ethnography, are probably due to a lack of familiarity with the local archaeological record. Hudson's analysis of northwest California oceangoing canoes depends entirely on hypothetical reconstructions based on the smaller river canoes and disregards an oceangoing canoe illustrated by Gould (1968), because it is thought to include historically introduced features (T. Hudson 1981:273). Irrespective of these and other problems with Hudson's (1981) analysis (see also Minor 1997:275), it is our opinion that the Hudson-Arnold perspective should be revised based on the archaeological data presented here that identify (1) common use of large composite harpoons (ethnographically associated with oceangoing canoes); (2) faunal assemblages dominated by marine mammals (particularly migratory breeders); (3) acquisition of deep water fishes; (4) offshore ceremonial sites like HUM-174; (5) the large size of and considerable labor involved in manufacturing the oceangoing dugouts; and (6) social inequalities within the population, perhaps linked to the construction and use of canoes. These findings contradict the notion of a people lacking specialized knowledge of the marine environments and an inability to hunt marine mammals regularly.

Another important issue that may have influenced Hudson (1981) and others in their assessment of the relative importance of the Chumash plank canoe involves the extremely high labor costs associated with its construction. Because of these costs, only wealthy individuals could finance the manufacture and operation of the canoes. Moreover, these activities were highly ritualized and controlled by a male craft guild known as the Brotherhood of the Tomol (T. Hudson, Timbrook, and Rempe 1978). While there is no disputing the high costs and corresponding importance of the *Tomol*, it is crucial to recognize that the vast majority of plank canoes were made from redwood; therefore, people had to wait for driftwood logs to float at least 300 to 400 km down the coast from the north. Because redwood was obviously quite rare in the Santa Barbara Channel, it was split into planks and reassembled into canoes at a very high cost, with the goal of conserving this valuable material. These factors clearly indicate that plank canoes were not intrinsically superior to the "lowly dugout," but were an expensive, labor-intensive alternative used by people with a shortage of high-quality lumber. Moreover, it is important to remember that nearly all of the maritime groups of northwest North America used dugouts for a variety of subsistence purposes, including the hunting of whales.

HISTORICAL LINGUISTICS AND THE PRIORITY OF COASTAL OCCUPATION

Although we have documented a fairly strong marine focus among Late Holocene peoples living along Humboldt Bay and areas north, the relatively late emergence of coastal occupations along the North Coast compared to that observed along the Central and Southern California Coast is an interesting problem. Many researchers have argued that the people of northwest California may have used coastal resources much earlier than the current archaeological record reveals, and that a variety of factors, including Holocene sea level rise, tectonic subsidence, and inadequate excavation samples, have obscured our ability to document this fact (see Erlandson, Tveskov, and Byram 1998; T. Jones 1991; Moss and Erlandson 1995). Hildebrandt and Levulett

(1997), in contrast, have argued that the existing record, though not perfect, may actually be a relatively accurate reflection of reality, and that the origin of coastal resource use along the entire California Coast is in large part determined by conditions in the interior. In Southern California, where terrestrial and riverine productivity was relatively low, people focused on marine foods much earlier than in the north, where the abundance of anadromous fish, Roosevelt elk, deer, and other resources lowered the comparative value of coastal foods.

The limited time depth of the North Coast archaeological record (for example, the Gunther pattern) has also sparked the interest of historical linguists, particularly given the high degree of linguistic diversity that developed in the area. The combination of these two phenomena (that is, shallow time depth and linguistic diversity) led Whistler (1979) to develop a diffusionist model of prehistoric development. The original inhabitants of the area were thought to be ancestral Karok (of the Hokan stock), who had an interior subsistence focus. About AD 900, the Wiyot and (soon thereafter) the Yurok (both speakers of Algic languages) entered the area. It appears they originated from the Columbia River Plateau, judging from similar cultural traits found in both areas (see also Fredrickson 1984; Moratto 1984:565). The Wiyot occupied the previously underused coast and estuary habitats of Humboldt Bay, while the Yurok occupied the lower Klamath and adjacent coastal lands. These intrusions were made possible by their superior and relatively exotic technological abilities to fish, build boats, and store salmon. Finally, Athapascan peoples are thought to have entered the region about AD 1300. Except for the Hupa, these groups occupied mainly peripheral areas, bringing with them knowledge of forest and riverine environments as well as the toggle harpoon and sinew-backed bow (see Fredrickson 1984).

This model was challenged by Gmoser (1993), who argued that the riverine-coastal interface had one of the highest resource potentials in the region and therefore should have been occupied for a long time. Given the presence of the Wiyot and Yurok in these areas, Gmoser (1993) suggested that Whistler's (1979) original reconstructions might have been incorrectly influenced by the late nature of the coastal archaeological record. Gmoser therefore proposed that Wiyot and Yurok should be considered linguistic isolates and given a considerably greater time depth than originally thought.

If our current knowledge of the coastal archaeological record is correct, the major discontinuity between the simple Mendocino pattern adaptations and the complex marine orientation of the Gunther pattern seems to indicate a site-unit intrusion (see Warren 1968) and therefore supports Whistler's overall model. Such a scenario also reveals an interesting contrast with developments along the south Coast and may reflect differential origins of coastal resource use. Chumash languages are considered quite ancient (either as members of the Hokan stock or a linguistic isolate), and most researchers think ancestral Chumash speakers occupied the Santa Barbara Channel for a long time. More recent groups took up residence in surrounding areas, occupying habitats with lower subsistence productivity (for example, Tatavium, Yokuts, and Tongva), although the wetland areas of the lower San Joaquin Valley may represent a separate climax area comparable to that of the coast. Moving to northwest California, Whistler's model reveals the opposite pattern: Hokan groups are on the interior, while the more recent Algic and Athapascan groups occupy the coast. This general difference in land use priority is also reflected by the distribution of Yurok settlements, where there are more villages along interior riverine settings than on the coast (see Pilling 1978:139), and by Baumhoff's (1963) higher population density estimates for riverine settings than for those on the coast. Both of these findings are in direct contrast to population distributions in Chumash territory, where coastal habitats supported the highest population density. Finally, it is interesting to note that Kroeber (1939:28) also concluded, based on the spatial distribution of cultural traits, that people of northwest California were "originally a river or river mouth culture, later a beach culture, and only finally and in part a seagoing one."

CONCLUSIONS

Based on the archaeological record as we currently understand it, marine-focused economies apparently did not develop along the California North Coast until after AD 500. This adaptive mode, as expressed by the Gunther pattern (Fredrickson 1984), was limited to the ethnographic territories of the Wiyot, Yurok, and Tolowa, and was characterized by a subsistence economy dependent on a wide variety of marine resources, some of which were obtained through the use of oceangoing canoes. Although living on the coast, these groups used a variety of terrestrial (for example, acorn, elk, deer) and riverine (such as steelhead trout, salmon, lamprey eels) resources that were obtained through direct access to or exchange with neighboring groups. Capital-intensive extractive technologies (oceangoing canoes, large fish weirs) and permanent processing and storage facilities were integral to this adaptation and tightly linked to a nonegalitarian socioeconomic organization in which wealthy individuals controlled such enterprises. This ranked social order is well documented in the ethnographic record and is clearly different from the tribelet level of organization found elsewhere in California, as emphasis was placed on individual and family aggrandizement as opposed to group affiliation. A prehistoric example of this type of ranked social organization is documented by the cemetery population at Gunther Island, where only a few individuals, a significant proportion of whom was children, were buried with items of wealth (for example, large obsidian blades, *Dentalium*, abalone ornaments, and *Olivella* beads).

A different type of adaptation developed south of Humboldt Bay. Rather than establish permanent villages on the coast, the inhabitants appear to have used marine resources within a larger, more terrestrially oriented system. Little or no evidence exists for the oceangoing canoe-composite harpoon complex, and many other attributes found among the more northerly Gunther pattern assemblages are also missing (for example, woodworking technology, steatite bowl manufacture, large ceremonial blades, *Dentalium*). These differences are at least partially due to the abundance of offshore rocks in areas to the north and the lack thereof in areas to the south. Dugout canoes were used to reach the offshore rocks, allowing people to exploit the sea mammals, birds, shellfish, and deep-water fisheries. Such a fishery was also important to the Santa Barbara Channel Chumash, but essentially ignored by other groups in California that lacked adjacent offshore rocks and islands.

Whether or not the Gunther pattern should be considered a true maritime adaptation has been a subject of recent debate among Oregon archaeologists. Although Lyman (1991:76) stated that maritime cultures are distinguished from littoral cultures by virtue of having seaworthy boats and "attendant technologies [that] are specifically applicable and adapted for exploiting sea resources," he questioned the utility of North Coast dugouts (citing T. Hudson 1981) and argued that pinniped rookeries could have been exploited on the mainland. Hildebrandt and Jones (1992; Jones and Hildebrandt 1995) provided ample evidence that the latter was not the case in late prehistoric time (see also Erlandson, Tveskov, and Byram 1998:12). Combined with the data presented here, these arguments indicate that the Gunther pattern reflects a maritime-oriented economy that should, at the very least, be distinguished from coastal adaptations elsewhere in Northern and Central California. Minor (1997:275) agreed, concluding that the coastal people of Northern California and Southern Oregon engaged in a variety of offshore tasks—sea mammal hunting, shellfish gathering, deep water fishing, and other activities such as individual quests for power on distant offshore rocks—clearly separating them from their neighbors along the Central California Coast.

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CHAPTER 17

Cultural Change, Continuity, and Variability Along the Late Holocene California Coast

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The California Coast, excluding peninsular Baja California, extends for roughly 2000 km from north to south, from Oregon to the Mexican border. On continental or global scales, it is a land of broad similarities. Blessed with a mild Mediterranean climate and bathed by the vast Pacific Ocean, it is a narrow ribbon of relatively mountainous landscapes and seascapes. The steep topography, both on and off shore, creates a vertical stacking of closely spaced habitats that support a concentrated and diverse array of marine and terrestrial resources. This diversity and productivity of food and other resources appears to have provided a relatively reliable subsistence base for coastal populations that expanded for millennia, filling the landscape with people who became increasingly complex and technologically sophisticated through time.

By the Late Holocene, archaeological evidence from a variety of areas along the California Coast suggests that the balance between what human populations required to survive and what the natural environment could provide was becoming increasingly tenuous. In most of these same areas, increasing evidence for periodic resource stress appears to be associated with (and related to) accelerated cultural changes, economic intensification, and increasing human impact on local resources. All along the California Coast evidence of population growth and an acceleration of Late Holocene cultural change appears to fit this generalized story. In various areas, however, the adaptive responses of individual social groups seem to have varied considerably.

Prior to European contact, ecological commonalities—including the nearly universal availability of acorns, pinon nuts, deer, rabbits, sea otters, pinnipeds, kelp bed communities, mussels, clams, and other resources—long fostered indigenous cultural similarities within the region, leading anthropologists to define a reasonably coherent California culture area (e.g., Kroeber 1925; Heizer 1978). On this scale of analysis, such broad technological and sociopolitical similarities among linguistically diverse Native California cultures can be seen as convergent adaptive responses to similar habitats and resources. Clearly, however, such cultural convergence is also the result of the vast information network and intensive socioeconomic interaction that linked Native Californian societies for millennia prior to European contact. The magnitude and nature of such interaction varied through space and time, spanning at least 9000 years, but it also seems to have generally increased as the number of people on the landscape grew.

As long as the notion of a California culture area has been with us, so, too, has the recognition that this general concept obscures a tremendous wealth of cultural diversity, including one of the most diverse linguistic landscapes in Native North America. Examining the archaeology of the California Coast at a finer scale of resolution—something this volume was specifically designed to accomplish—allows us to look through the broad similarities in Native California cultures and focus on the underlying cultural variability inherent in the region. This cultural variation, evident in linguistic, ethnohistoric, and archaeological records, is a product of California's long and complex human history. We now know, for instance, that the California Coast has been occupied for at least 12,000 years and that multiple migrations and discrete developmental trajectories contributed to the cultural tapestry of Native California.

This cultural diversity is also a product of the environmental variability inherent within the region. Despite its broad similarities, the California Coast encompasses nearly 10 degrees of latitude (32 to 42°N), with substantial local and regional variation in climate, rainfall, terrestrial and marine productivity, and specific ecological communities.

This variability is evident on the land, from the arid coastal terraces and seasonal drainages of San Diego and the southern Channel Islands to the coniferous rain forests and large perennial rivers of Northern California, as well as the vast transitional terrain between these extremes. It is also evident in the sea, from the wave-battered shorelines of the Central and North Coasts, to the expansive and protected estuarine habitats of San Francisco Bay, to the isolated and terrestrially impoverished coasts of the Channel Islands.

Inevitably, syntheses of the archaeology of Native California and its coastal zone encounter the tension among emphasizing general similarities between groups within a region and the many exceptions to such generalizations (Moss and Erlandson 1995). During the 1960s and 1970s, some of the primary tenets of processual archaeology discouraged "culture history" and encouraged broad synthesis, global comparisons, and the development of historically detached general theory. As we move into a new millennium, regional synthesis and general theory continue to be important components of the modern archaeologist's tool box. The last two decades, however, have seen an increasing emphasis on reconstructing the specific historical patterns and developmental trajectories of particular human societies. Recent shifts in archaeology, anthropology, the social sciences, and society encourage an increased emphasis on studying the specific historical foundations of cultures, with less emphasis on sweeping generalization. These shifts are fueled, in part, by the pressing need to make archaeology more relevant and meaningful to the general public and to the indigenous communities whose past we study.

In organizing this volume, our primary goals were to provide an opportunity for archaeologists to explore the diversity of maritime adaptations along the California Coast during the Late Holocene. We encouraged contributors to examine the influence of environmental variation, both spatial and temporal, in shaping those adaptations, and to discuss some of the variables involved in the emergence of cultural complexity among the maritime societies documented in early historical and ethnographic accounts. In the preceding chapters, 31 archaeologists contributed to 15 regional summaries of the environments and archaeology of the California Coast. These summaries illustrate both the general adaptive similarities of California's maritime peoples and the considerable local and regional variations in the environments, adaptations, and developmental trajectories of these Native American societies.

In this chapter, I discuss a variety of issues related to the Late Holocene in coastal California. Rather than remark on individual chapters, I have organized my comments conceptually, addressing the nature of Late Holocene cultural and environmental records and their influence on archaeological interpretations, technological and economic changes of the past 3500 years, current issues in interpreting the complexity of California's maritime peoples, and the current status of archaeology in California. Throughout, I highlight gaps in our current knowledge and suggest avenues of future research that may be fruitful in years to come.

LATE HOLOCENE ARCHAEOLOGICAL RECORDS

Archaeologically, California has one of the most thoroughly studied coastlines on earth. Geographically, however, the amount of research accomplished continues to vary up and down the coast (see T. Jones 1991), with the South Coast most intensively studied, the Central Coast somewhat less so, and the North Coast relatively poorly known. Unfortunately, the coastline of Baja California remains a virtual black hole where little systematic research has been done and few comparative data are available. More and better archaeological data are desperately needed from coastal sites in Northern California and Baja California, along with some of the more poorly documented Channel Islands such as Anacapa, Santa Barbara, and Santa Catalina. Data from these areas will add to the diversity evident in the archaeological record and provide a broader comparative framework that can be used to contextualize the data we have from the better known areas of the coast.

The quantity and quality of paleoenvironmental and historical records also varies along the California Coast. Some of the best records come from the South Coast, where extensive paleoecological research has been done in both terrestrial and marine environments and where Spanish accounts began in the 1500s and blossomed in the late 1700s and early 1800s. The larger Santa Barbara Channel area, with varved paleoecological records spanning its entire human history, with a long tradition of relatively intensive archaeological research, and where John Peabody Harrington collected over 200 boxes of notes on the Chumash in the early 1900s, provides a level of resolution that may be among the finest in the world.

The variable quantity and quality of environmental and archaeological data available from various areas of the California Coast contribute to the structure of the volume—the larger number of chapters from the South Coast, for instance, and the finer geographic focus of these chapters. For several chapters, the large volume of archaeological data available for the Late Holocene poses problems not encountered in previous volumes regarding the Early and Middle Holocene (see Erlandson and Colten 1991a; Erlandson and Glassow 1997). Where earlier volumes provided more or less comprehensive treatments of Early and Middle Holocene records for various areas, many of us have had to revert to case study approaches in summarizing Late Holocene developments, which may obscure some local variation.

Along with spatial variation in the quantity and quality of data, there are also regional differences in the types of data available. These differences are largely a product of the distinctive developmental trajectories of individual tribes. In the Santa Barbara Channel area, for example, the Chumash and their predecessors buried their dead (often in substantial cemeteries) for over 9000 years. Because people were often buried with numerous utilitarian and ceremonial artifacts, such cemeteries have been the focus of archaeological excavations for over a century. Although controversial today, analysis of burial patterns, grave associations, and skeletal indicators of health are valuable sources of information concerning the development of social complexity, migration and trade patterns, cultural continuity and change, paleopathology, and other research issues. Due to the long history of cemetery excavations in the Santa Barbara Channel area, the high density of its human populations, and the analytical efforts of archaeologists and biological anthropologists, knowledge of Chumash social organization and health patterns is extensive (e.g., C. Goldberg 1993; Hollimon 1990; C. King 1990; Lambert 1993; Martz 1984; Walker 1986, 1989a). Far fewer data are available from neighboring areas, partly because less archaeological work has been done, but also because of the widespread Late Holocene practice of cremation among the Tongva and other California tribes. As is clearly evident in this volume, the differential availability of cemetery collections and related research affect the kind of data that can be used in various areas to address issues of cultural complexity, social organization, sedentism, resource stress, health patterns, and other topics.

Although the focus of this volume is on the last 3500 years, California's maritime peoples have great antiquity, at least along the South and Central Coasts where they settled the northern Channel Islands by at least 10,000 BC (see Erlandson et al. 1996; J. Johnson et al. 2000). In these circumscribed coastal environments, Native societies grew and clearly prospered for millennia, leaving a rich record of their cultural history. For the entire California Coast, Breschini, Haversat, and Erlandson (1996) listed over 1000 ^{14}C dated sites, including a few terminal Pleistocene (10,000 to 12,000 RYBP) sites; over 100 sites dated to the Early Holocene (10,000 to 6700 RYBP), well over 200 Middle Holocene (6700 to 3350 RYBP) sites; and roughly 700 sites dated to the Late Holocene (3350 to 0 RYBP). Along with many sites investigated in the past five years and sites not yet ^{14}C dated or reported on, these represent a vast reservoir of information with which to study the development of California's maritime peoples. The antiquity of coastal occupation, the large number of early sites, and the dramatic growth in the number of sites over time also remind us that the Late Holocene cultures of the California Coast are the product of a long evolutionary process, one marked by dramatic population growth and successful adaptations to cultural and environmental challenges over the millennia.

Despite the relatively large number of Early and Middle Holocene sites, there are still time periods that remain relatively poorly known. Erlandson (1997a:2) and Glassow (1997c:160) lamented the general dearth of archaeological data from the Middle Holocene and the problems this posed for understanding the development of California's maritime cultures. Many of the chapters in this volume suggest that this gap continues into the early portions of the Late Holocene. Koerper, Mason, and Peterson (chapter 5) refer to the period between about 4000 and 3000 years ago as the "black box" of Orange County archaeology, and Raab et al. (chapter 2, fig. 2.2) show relatively few dated sites on San Clemente Island between about 4000 and 2000 years ago. Gamble and Russell (chapter 7), Kennett and Conlee (chapter 9), Erlandson and Rick (chapter 10), and Glassow (chapter 11) all note a similar pattern for the larger Santa Barbara Channel area, and figures presented by Jones and Furneau (chapter 12) show relatively few Monterey Coast sites dated between about 3500 and 2000 years ago. Finally, Hildebrandt and Levulett (chapter 16) show that no coastal sites in northwestern California have produced ^{14}C dates in excess of about 2500 years, and few sites older than about 1500 years are known from the Oregon Coast (Erlandson and Moss 1999:438; Moss and Erlandson 1998a).

For much of the California Coast, it seems, a major gap continues to be the nature of Late Holocene adaptations prior to about 2000 to 3000 years ago. Like the general dearth of data from Middle Holocene sites, this gap poses problems for understanding and explaining the emergence of sociopolitical and economic complexity among Native California's maritime cultures. To understand the time depth and historical development of complexity among California's coastal tribes, we must better understand the cultural developments and demographic changes that took place between about 5000 and 2000 years ago.

CULTURAL VARIATION ALONG THE CALIFORNIA COAST

At the time of European colonization, coastal California was home to at least 18 different "tribes" (Heizer 1978:ix). These coastal societies, sometimes more closely related culturally to their interior neighbors than those of the coast, spoke at least 12 languages (and many more dialects) from at least 6 language stocks (Shipley 1978:81). Understanding how this complex cultural mosaic came to be, and how such linguistic and ethnic variability correlates with cultural changes evident in the archaeological record, continues to be one of the most challenging problems facing those who study California's past. These challenges are evident throughout the California Coast: in reconstructing the timing and effects of the Uto-Aztecan incursion or "Shoshonean wedge" along the South Coast, in understanding the development and meaning of various cultural horizons or patterns in the greater San Francisco Bay region, or in documenting the migration of Athapaskan peoples to the Northern California and southern Oregon Coasts. Progress has been made in all these areas, but identifying the archaeological correlates of actual migrations in ancient California and distinguishing them from cases of diffusionary culture change remains notoriously difficult (see R. Hughes 1992).

One of the things that impresses me most about this volume is the variability evident in the archaeology of the California Coast. While California's coastal peoples shared a variety of traits, there were also significant differences in population densities, settlement and subsistence patterns, material culture, sociopolitical organization, and other lifeways. Such variability is evident on a number of different scales. It is clearly evident in the differences between groups living in the arid landscapes of San Diego County versus those living in the coniferous rainforest communities of the North Coast. It is also evident on regional levels, however, in variation between adaptations to the lowland and protected estuarine environments of San Francisco Bay versus the steep outer coast habitats of the Big Sur area, or between the mainland Tongva (Gabrielino) of the Los Angeles Basin and their relatives occupying the terrestrially impoverished and relatively isolated southern Channel Islands. This diversity is also clearly evident on finer scales of resolution, probably all along the California Coast. It may be best documented for the Chumash people of the larger Santa Barbara Channel area and adjacent interior valleys. Among the maritime Chumash alone, the evidence shows substantial adaptive variation among Channel Island groups versus those of the relatively protected mainland coast and estuaries versus those of the exposed northern Santa Barbara Coast. Although often generically portrayed as maritime and culturally complex fishing peoples, archaeological data clearly show that Chumash adaptations varied considerably in different coastal areas, not to mention the adjacent interior. As Chumash populations grew and increased in complexity, greater economic specialization developed, accentuating local adaptive variations among groups.

Although only hinted at in this volume, the adaptive responses of Native Californians were even more complex and varied than these examples imply. If we were to sample a variety of contemporaneous Late Holocene sites along virtually any small stretch of the California Coast, we would almost certainly find considerable and meaningful variation in the adaptive responses of individual social groups. As more and more data accumulate from various areas of the California Coast, the evidence for such local cultural diversity becomes increasingly compelling. This fact provides new methodological challenges for archaeologists, calling into question some of our basic assumptions about the supposed redundancy of archaeological data and the need to sample or preserve just a fraction of the sites in a region to understand the variability inherent in the archaeological record. Instead of seeking just broad patterns of cultural development, we should emphasize the highly significant and interesting local variations through space and time.

Nowhere is this natural tension between exploring general similarities versus specific cultural variability more evident than in the archaeology of the Late Holocene along the California Coast. As Raab et al. noted in chapter 2:

> The data we have presented suggest that a diverse mosaic of responses to cultural and natural environments probably emerged during the Late Holocene in coastal California, including a wide spectrum of gradations in cultural complexity. Resource intensification and climatic deterioration may have imposed widespread stresses on the Late Holocene Coast, but these hardly seem to have produced the same adaptive outcomes.... Documenting this kind of variability, and seeking to explain it in a regional comparative framework might be a productive research direction in the new millennium.

Late Holocene Technological Changes

Along the southern and central portions of the California Coast, with their long and relatively extensive records of coastal adaptations, technological and other cultural changes clearly accelerate through time. The Early Holocene is characterized by what appears to be relatively slow technological change, with considerable evidence for an adaptive conservatism that spans several millennia. By the Middle Holocene, the pace of technological change speeds up—at least in places—but still seems relatively moderate. By the Late Holocene, however, technological and economic change accelerates considerably, with the progressive appearance of elaborated shell bead and ornament assemblages, circular or j-shaped shell fishhooks, the bow and arrow, intensive trade and craft specialization, bigger and better boats, monetary economies, an so on. Accurately tracking this acceleration of culture change requires increasing chronological resolution through time. Currently, the poorly defined chronology for the origin and spread of many key technological developments limits our ability to gauge the magnitude and significance of those technological changes that are better defined.

What is evident all along the California Coast prior to European contact is that Late Holocene technological changes were associated with a general elaboration and diversification of material culture. These changes appear to be related to a variety of stimuli, including environmental changes, population growth, resource stress, territorial circumscription, and good old human ingenuity. These stimuli resulted in innovation, migration, economic and sociopolitical competition, and an increased exchange of goods and ideas; a growing emphasis on developing symbols of group identity as interaction and social complexity increased; and the increasing opportunity for leaders to formalize their authority and power under such circumstances. The general elaboration of material culture reflects both the development of new artifact types and the refinement of existing tool types, such as mortars and pestles, which tend to become more symmetrical and standardized through time. The latter refinements involved increases in the amount of labor invested in production or improvements in the efficiency with which goods were produced or distributed. As Jeanne Arnold and her colleagues have documented for the island Chumash, one result of such production changes was a general trend towards more intensive exchange and competition, more formalized craft specialization, greater divisions of labor among members of society, and more opportunities for individuals or groups to control production and distribution and to accumulate wealth and power (see Munns and Arnold, chapter 8, with references).

Fishing Technology. While there is not sufficient space here to catalog all the technological changes of the Late Holocene, some of the most important are related to the development of marine fishing. One of these is the appearance of the single-piece shell fishhook along the South and Central Coasts. Except for a single questionable date for a specimen from Eel Point on San Clemente Island (Salls 1988), direct dating of circular shell or bone fishhooks suggests that they may appear about 2700 to 3000 years ago on the Orange County Coast (Koerper, Prior et al. 1995). They may have appeared slightly earlier on the southern Channel Islands and perhaps somewhat later in the Santa Barbara Channel area (Rick et al. 2002), but the chronology of their invention and diffusion is still not well defined. The appearance of these hooks is sometimes linked to a dramatic expansion of the range and productivity of marine fishing, but they appear to be an outgrowth of earlier gorge and composite hook types (Erlandson and Rick, chapter 10; Rick et al. 2002). Along the California Coast, in general, there seems to have been an intensification of fisheries through time, but there is also considerable evidence for variation in the intensity of fishing through space and time, including some Middle and Early Holocene sites where fishing appears to have been an economic mainstay (Rick 1999; Rick, Erlandson, and Vellanoweth 2001; Vellanoweth and Erlandson 1999).

Another technological innovation that may have increased the productivity of Late Holocene fishing and other maritime activities was the development of the large, sophisticated seagoing boats used along the Southern and Northern California Coasts (see Arnold 1995a; Gamble and Russell, chapter 7; Hildebrandt and Levulett, chapter 16). The terminal Pleistocene colonization of the Channel Islands shows that seaworthy boats were used by some coastal peoples for at least 12,000 years (Erlandson et al. 1996). Nonetheless, the development of larger boats, such as the tomols used by the Chumash and Tongva or the oceangoing dugouts of the Tolowa, may have significantly increased the accessibility of offshore habitats, the efficiency with which large loads of fish and other resources could be transported, and the differential distribution of wealth and power within Native societies.

Wood-stake weirs, widely used in the estuaries and rivers of the Northern California Coast and the broader Northwest Coast, were a third innovation in fishing technology. As far as I know, little archaeological research has been done concerning fishing weirs on the Northern California Coast, but ethnohistoric sources indicate that fish weirs were widely used in the area. Commonly linked to intensification and the development of cultural complexity on the broader Northwest Coast, estuarine weirs have been a focus of recent research on the Oregon Coast where questions have been raised about whether they were communal, required large amounts of labor to build or maintain, or produced large fish yields of limited duration that required unusual logistical efforts (Byram 1998; Erlandson, Tveskov, and Byram 1998). In southeast Alaska and British Columbia, the earliest estuarine weirs now appear to predate 2500 to 3000 BC (Moss and Erlandson 1998b), but the oldest fish weir currently known for the Oregon Coast dates to the transition between the Middle and Late Holocene, about 1400 BC. It is not clear whether this lesser antiquity is a real cultural pattern or a result of differential preservation or visibility (see Erlandson and Moss 1999:439; Erlandson, Tveskov, and Byram 1998). With an impressive body of data regarding intertidal weirs emerging from Oregon, British Columbia, and southeast Alaska, collecting comparative data by locating, mapping, and dating similar weirs along the Northern California Coast should be a high priority.

Bow and Arrow. Another key technological development along the California Coast was the introduction of the bow and arrow, which appears to have occurred between about AD 400 or 600 on the South Coast and possibly somewhat later farther north (see Koerper, Mason, and Peterson, chapter 5; Kennett and Conlee, chapter 9). Despite much discussion over the years, a precise chronology for the introduction and spread of the bow and arrow has yet to be established, primarily because of stratigraphic mixing in most mainland sites and the relative rarity of arrow points in stratified Channel Island sites. When it was introduced, the bow and arrow almost certainly had significant effects on the productivity and character of hunting strategies, patterns of chipped stone resource use, and violence and warfare. Clearly related changes in hunting patterns are poorly documented, however, largely because of the poor chronological resolution and stratigraphic mixing caused by burrowing rodents. A reduced need for the larger cobbles or flakes required to produce dart points may have increased the use of some lithic sources where only smaller clasts were available, the reuse of percussion flakes discarded at older sites, and the emphasis on pressure flaking. Finally, although it is often assumed the bow and arrow dramatically altered interpersonal and intergroup relations, data from the Santa Barbara Channel area suggest its effects were more complex than a simple increase in warfare and violence. Among the coastal Chumash, for instance, the occurrence of projectile wounds and related mortality appears to increase substantially before the introduction of the bow and arrow, then decline substantially after about AD 1300 (Lambert 1994). A careful analysis of the chronology of the introduction and spread of the bow and arrow in California, along with a thoughtful synthesis of its effects on resource use, warfare, and territorial boundaries, would be a valuable addition to our knowledge of California archaeology.

Beads and Ornaments. Across much of California and the Far West, there are many general similarities in the types of beads and ornaments Native peoples used (see Bennyhoff and Hughes 1987; C. King 1990). Many of these bead types were made by coastal peoples from marine shells, then traded over vast distances. While the production, use, and trade of shell beads and ornaments has an antiquity of at least 10,000 years, there is a general trend towards the diversification and greater abundance of such artifact types over time, particularly during the Late Holocene. Such shell artifacts were used for a variety of purposes: some were for general decorative use; others were restricted to individuals of higher status or particular groups; and some were used as a form of money that fueled the development of specialized industries, occupational specialization, economic exchange, differential accumulations of wealth, social stratification, and regional interaction (see Arnold 1987, 1992a; Bennyhoff and Hughes 1987; C. King 1990).

In California, most studies of shell beads and ornaments have been descriptive and classificatory, with an emphasis on the use of shell beads as relatively sensitive chronological markers. One of the more interesting uses of shell beads and ornaments, one underemphasized in the California archaeological literature, is their role as markers of social and ethnic identity both within and among social groups. Such uses probably became more and more important through time as populations grew, landscapes filled with people, village or town sizes increased, societies became increasingly hierarchical, interaction within and between groups intensified, and greater regulation of human behavior became necessary. By the Late Holocene, when such pressures were generally increasing along the California Coast, a plethora of beads, ornaments, and other distinctive artifact types or styles developed in part to serve as ready markers of social status, wealth, and group affiliation. More detailed and thoughtful analyses of the role of shell beads as social markers (see, for example, C. King 1990) in Native California is also long overdue.

The spatial distribution of shell beads in general, like that of distinctive obsidians and other mineral types, has also been widely used in California to reconstruct regional or interregional patterns of production and trade (see Bennyhoff and Hughes 1987). Study of the spatial distributions of specific bead types may also help define regional interaction spheres and their development through time (see Howard and Raab 1993). Significant limiting factors in understanding diachronic patterns of long-distance exchange involving shell artifacts from the California Coast have been (1) chronological uncertainties in the age range of key bead and ornament types and (2) our inability to determine the specific geographic origin of many *Olivella*, abalone, and other shell artifacts. Increasingly, the first problem is being addressed through AMS ^{14}C dating of individual shell artifacts (see Vellanoweth 2000), high precision ^{14}C dating where statistical errors can be reduced to ± 15 years or less, and by the calibration of ^{14}C dates to calendar years. Little or no progress has been made on the second problem, at least to my knowledge, but the analysis of oxygen or other isotope signatures may provide the means to determine whether *Olivella* or *Haliotis* artifacts from Great Basin, Columbia Plateau, and Southwest sites originated from Southern California, Central California, or the southern portion of the Northwest Coast. This, too, is a problem worthy of future research.

New Technologies: Evolutionary or Revolutionary?

Current evidence suggests that numerous technological changes were Late Holocene developments, but many of these "new" artifact forms clearly emerge from earlier analogs. As Erlandson and Rick noted in chapter 10, circular fishhooks evolved from composite forms; large seagoing boats emerged from smaller, less elaborate, and less labor-intensive watercraft; and the bow and arrow improved on the atlatl and other projectile technologies. Such technological developments clearly were significant aspects of Late Holocene cultural evolution, but they are also extensions of long-standing trends towards technological diversification and elaboration. From this perspective, where change and continuity are given equal weight, the development of Late Holocene technologies along the California Coast can be seen as evolutionary rather than revolutionary. This does not mean that such developments did not have dramatic effects on California's maritime societies, but we should be mindful of such evolutionary precursors in evaluating the nature and impact of technological transitions.

The additive and increasingly diversified nature of Late Holocene technologies is also consistent with general evidence for trans-Holocene population growth and economic intensification along the California Coast. Several chapters in this volume suggest, however, that such developments were neither universal or inevitable, and that adaptive responses to resource stress varied through space and time. Understanding the full range of California Indian responses to environmental and social stresses, and the relative success of various strategies in different situations, may have direct relevance to modern American society as we try to manage our dwindling coastal resources more effectively and to stem the growing tide of human-induced extinctions and ecological perturbations.

THE COMPLEXITY CONCEPT

Anthropological models of cultural complexity are almost universally linked to classification schemes that rank cultures into a variety of evolutionary stages. Classifying human cultures, both archaeological and historical, has a long history in anthropology, beginning with the ethnocentric evolutionary schemes of 19th century scholars. L. H. Morgan (1877) wrote, for example, that all human societies developed through various stages of complexity, from savagery to barbarism to civilization. No special knowledge is required to guess where western European peoples were placed in such classificatory schemes or where California Indians fell. Intended or not, such early models contributed to the persecution of many indigenous peoples around the world. More sophisticated, and less value-laden, schemes were developed by Leslie White (1959), M. Fried (1967), Elman Service (1975), and others who defined more objective criteria for classifying cultures into evolutionary stages, such as bands, tribes, chiefdoms or intermediate societies, and states or civilizations. Each of these stages represents an increase in the size and organizational complexity of human societies.

Due to their highly elaborate material cultures, high population densities, sedentism, and comparatively complex social, economic, and political organization, the Native cultures of the California Coast have long been considered unusual among hunter-gatherer societies. Not surprisingly, the rich and diverse archaeological record of these cultures has been of great interest to scholars around the world, and California archaeologists have made significant contributions to the archaeology of complex hunter-gatherers and maritime societies in general. Over the past 20 years, "cultural complexity" has become one of the major organizing principles among American archaeologists, and examining issues related to the evolution of California's complex maritime societies has increased dramatically.

The chronicles of early European visitors to the Pacific Coast of North America, recorded during the 16th to 19th centuries AD, indicate that much of the coast was thickly populated by people who lived in large, relatively permanent settlements. Ethnohistoric accounts indicate that most (if not all) of California's coastal peoples had diversified and intensive economies in which aquatic and terrestrial resources played important and complementary roles. Relatively complex in their sociopolitical organization, they also had elaborate material cultures oriented towards a wide range of hunting, fishing, collecting, manufacturing, and ceremonial pursuits. They actively participated in extensive social and commercial networks, exchanging goods and ideas over a region that ultimately encompassed much of western North America. As Terry Jones pointed out in chapter 1 and as many of the chapters in this volume illustrate, the complexity of California's coastal tribes (as defined by anthropologists) varied significantly at the time of European contact.

Why did California's coastal tribes become complex and how complex were they? How did such complexity vary through space and time? What changes in demography, subsistence, technology, and sociopolitical organization are evident in the archaeological record? What forces influenced these changes and how did transitions from early and presumably egalitarian societies to the stratified and elaborated Late Holocene societies occur? Some of these questions are relatively simple, and with such a vast database available, the answers should be approachable. Yet the continuing search for answers has, at times, been both elusive and contentious. A significant part of the problem lies in the uneven nature of ethnohistorical and archaeological data for various tribal groups of coastal California. For the historic occupants of San Nicolas Island, for instance, there is virtually no ethnohistoric record, and archaeological parallels with their relatively well-documented Chumash or Tongva neighbors are intriguing but sketchy (see Vellanoweth, Martz, and Schwartz, chapter 6). The unhappy fact remains that many California Indian societies were devastated by European contact before accurate or detailed accounts of their precontact life ways were recorded. Although Arnold and others have made great progress in defining the archaeological correlates of cultural complexity, inferences like those made for the Chumash are much more difficult in the absence of comparable ethnographic records.

To some degree, the problem also lies in our human tendency to classify things into dichotomous frameworks or arbitrary types, such as bands, tribes, chiefdoms, and states. I tend to agree with Tainter (1996:14; see also R. H. McGuire 1996), whose formative years as an archaeologist were spent on the Southern California Coast, who suggested that all human societies are complex to greater or lesser degrees and that it is fruitless to debate whether particular societies were or were not complex. The levels of complexity humans devise to organize themselves occur in a bewildering array of continuous variation through space and time. Such organizing structures can also be extremely fluid, varying by season or circumstance due to changes in natural or social environments, including variations in group size or makeup, the nature of internal or external threats, and the charisma of individuals. This diversity and fluidity, especially when dealing with constellations of traits, also contributes to the difficulty in defining the nature and causes of cultural complexity along the California Coast.

Our archaeological theories and models are full of artificial polarities: simple versus complex, foragers versus collectors, agriculturalists versus hunter-gatherers, maritime versus terrestrial, commoners versus elites, gradual versus punctuated, and my own Gardens of Eden versus Gates of Hell (Erlandson 1994). Such classifications tend to simplify the diversity evident in past cultures. The problems associated with such schemes are evident in recent debates about whether cultural evolution along the California Coast was gradual or punctuated. To me, regardless of how biological evolution takes place (a topic still hotly debated), common sense suggests that cultural evolution in human societies occurs through a combination of gradual change punctuated by periods of more rapid change. Deciding which process is most important to cultural evolution depends on the time period with which we are concerned, the traits we choose to measure, the resolution of the archaeological record, and our own preconceptions.

By critiquing aspects of the concept of cultural complexity, I do not mean to imply that classification schemes, models, or theories of the development of cultural complexity do not play a useful role in archaeology. Clearly, we build and test models to help us interpret the archaeological record and reconstruct human history. We should try, however, to construct models that adequately represent the complexity of human behavior and social systems, and then remember that our models still represent simplified abstractions of reality.

What the archaeological and ethnohistoric records from the California Coast suggest to me is that cultural complexity clearly varied substantially through both space and time. In much of the south and central Coast areas, from at least the Santa Barbara Channel to San Francisco Bay, there are significant cultural changes associated with what is commonly referred to as the Middle-to-Late Transition period. There is no consensus concerning the precise timing or nature of this transition, but there is little question that significant cultural changes, including new technologies and organizational schemes, emerged along large parts of the California Coast between about AD 500 and AD 1400. The cause of these changes seems most likely to involve a variety of factors, including population pressure, environmental perturbations (i.e., the Medieval Climatic Anomaly), resource stress, territorial circumscription, and in some cases, the aspirations of emerging elites. The chapters in this volume also suggest that the specific patterns of Late Holocene cultural change along the California Coast varied from area to area, and that no single model or explanatory framework is likely to account adequately for the diverse cultural responses of various coastal peoples.

Ultimately, the cultural variability among California's coastal tribes is due to numerous factors, including ethnic and linguistic differences among groups, the development of discrete local or regional interaction spheres that operated in specific areas, and the proximity of some groups (e.g., North Coast) to adjacent culture areas (i.e., the Northwest Coast), as well as variation in the geographic distance between groups, environmental factors contributing to greater or lesser isolation from neighboring groups, and local and regional differences in the productivity and availability of various resources. Both these similarities and differences should be of interest to archaeologists, but the differences become increasingly apparent through the Late Holocene with the emergence of the diverse Native American cultures that occupied the area at the time of European contact.

CALIFORNIA ARCHAEOLOGY AT THE MILLENNIUM

As an archaeologist now living outside of California, it is no longer as easy for me to stay in touch with current trends as before or to periodically "take the pulse" of California archaeology. At times, I have been critical of some of those trends, particularly what I perceive as the use of outmoded or simplistic models of human behavior and the tendency to polarize arguments or classify complex phenomena into arbitrary and simplified schemes (see Erlandson and Yesner 1992; Erlandson 1999b, 2001). After reading the chapters in this volume, however, I find much to be encouraged and optimistic about in considering the current status of archaeology along the California Coast. I am impressed by the diversity of approaches being used by California archaeologists, by the sheer magnitude and generally high quality of the research being done, by the continuing constructive debate that marks a healthy discipline, and by the emerging recognition of just how complex and varied the history of Native California is. Although not touched upon in this volume, I am also encouraged by the efforts of many California archaeologists to break down the artificial boundaries between "prehistoric" and "historic" archaeology (see Lightfoot 1995), to develop cooperative and collaborative relationships with the descendants of California's coastal tribes, and to demonstrate the relevance of their research to the general public. Finally, I have been deeply impressed by the commitment of many archaeologists working along the California Coast, including many doing research almost exclusively in CRM contexts, to publish their research in journals or books that provide California archaeology with regional, national, and international exposure.

Rising to the Critical Challenge

Not long ago some eminent scholars suggested that California archaeology was in a sort of scholarly doldrums as far as publication of substantive books and articles was concerned (e.g., Chartkoff 1997). Their point was not that California archaeologists had ceased to publish but that an overwhelming proportion of the research results from California was relatively inaccessible as technical reports and other "gray literature" housed primarily in the files of agencies or regional archaeological information centers. Given the large number of California archaeologists and the vast sums of money being spent on archaeology in California, the number of books and essays published by prominent presses and refereed journals was relatively small.

To some, the bibliography for this volume may seem to support this view, with numerous unpublished technical reports cited, many of which are difficult or expensive to access. Tremendous progress has been made since 1984, however, when two important syntheses of California archaeology were published (Chartkoff and Chartkoff 1984; Moratto 1984). Since then, numerous books, monographs, and edited volumes have been published on the archaeology of the California Coast or California as a whole. Equally impressive is the revival of publication in national or international journals of the research led by archaeologists working on the California Coast. Data from coastal California have contributed significantly to a variety of theoretical, methodological, and data articles published in American Antiquity, American Anthropologist, Antiquity, Current Anthropology, Journal of Anthropological Archaeology, Journal of Archaeological Science, as well as journals of historical archaeology and biological anthropology.

Archaeologists working along the California Coast have clearly risen to the critical challenge. Our research has contributed to a variety of archaeological issues: site formation processes, dating methods and chronology building, shell midden sampling and analytical methods, the antiquity and nature of coastal adaptations, precontact exchange and economic specialization, development of complexity among hunter-gatherers; hunter-gatherer health and disease issues; the effects of European colonialism on indigenous societies; and others. Far too much of the archaeology done is still relegated to the gray literature, but the recent publication record of archaeologists working along the California Coast suggests that California archaeology is in a state of renaissance.

Focus on Variation

Further evidence of the dynamism of California archaeology is found in the diversity of approaches used by various contributors to this volume. Such variation arises from a combination of regional differences in the amounts and types of data available, differences in the sociopolitical or economic complexity of various coastal peoples, and theoretical or philosophical differences among researchers. Such variation is evident in the emphasis on basic descriptive or cultural historical work of some authors, in the now traditional processual approaches of others concerned primarily with hunter-gatherer cultural ecology, and in the more postprocessual or synthetic approaches of those who place more emphasis on human agency in the appearance of greater sociopolitical differentiation and other cultural changes. No one of these approaches is right or wrong—indeed all are essential—but the presence of multiple approaches to studying the past is yet another sign that the archaeology of the California Coast is in good hands.

With its 12,000 year sequence of Native American occupation, its long history of archaeological research, its substantial body of paleoenvironmental and ethnographic data, and its ecological diversity and complex culture history, the California Coast is an ideal laboratory for studying issues related to the development of maritime societies. As the chapters in this volume clearly show, some of the most relevant issues include maritime cultural ecology, the relationship between environmental variation and human adaptations, and the development of cultural complexity. California has sometimes been described as a "land of contrast," a description that applies to its coastal zone and cultural history, as well. In this concluding essay, I have emphasized the spatial and temporal variability inherent in both the natural and cultural landscapes of the California Coast. In doing so, I have suggested that understanding the differing human responses to such variation should be a major focus of analysis for archaeologists in decades to come. Documenting this diversity requires a variety of both paleoenvironmental and archaeological data from localities all along the California Coast. As chapters in this volume have demonstrated, the patterns of ecological change and cultural response evident at Batiquitos Lagoon cannot necessarily be extrapolated to nearby estuarine basins, much less to the northern San Diego Coast. Just as clearly, cultural changes among the island Chumash will vary in interesting and important ways from those of the mainland Chumash, and even more so from their Tongva or Salinan neighbors.

Only by documenting the diversity in environmental changes and their effects on humans, human impacts on local and regional ecosystems, and human responses to both environmental and cultural challenges can we understand the true complexity and richness of the history of California's maritime peoples prior to European contact. Only by reconstructing that long and diverse history, moreover, can we understand the true effects of post-contact colonialism on California's Native American societies and ecological communities. As its fisheries continue their general decline, as whole coastal ecosystems continue to deteriorate, and as the list of extinct or endangered species continues to grow, understanding the long history of human interaction with California's coastal environments becomes ever more important (see Jackson et al. 2001). The best and most direct evidence of that long history lies in the thousands of archaeological sites located along California's golden shores.

The Pressing Need for Preservation

If I am generally optimistic about the state of California archaeology, I cannot ignore what I perceive as its single greatest problem. The bad news is that archaeological sites along the California Coast continue to be lost at an alarming rate. Sites all along the coast are subject to serious coastal and riverine erosion, damage that is rarely seriously studied much less mitigated (Erlandson and Moss 1999). These effects are often viewed as natural, inevitable, or simply too monumental to be dealt with given our limited time and budgets. Such characterizations ignore the clear human component to such impacts, which have been exacerbated by the damming of rivers, channelization of streams, construction of jetties and breakwaters, loss of vegetation through overgrazing, and quite possibly sea level rise associated with global warming. Even if the effects of coastal and riverine erosion are often inevitable, this should not excuse us from the responsibility of documenting what is being lost. As California's history slides into the sea, we cannot afford to ignore the problem or to simply watch it go.

Every year hundreds of sites along the coast are also lost to development. Despite the fact that state laws protect significant archaeological sites, many are destroyed without adequate (or any) sampling or preserving portions for future research. This is particularly true for relatively small or low-density sites (Glassow 1985), many of which are destroyed without ever determining how old they are or what they contain. At the Society for California Archaeology meetings in recent years, I have heard a number of prominent archaeologists bemoan the fact that whole areas along the San Diego, Orange County, and Los Angeles County Coasts, as well as the San Francisco Bay Area, are either or soon will be nearly devoid of intact archaeological sites. The situation in many other rapidly developing coastal areas is almost as dire. The continuing destruction of the archaeological record of the California Coast is a tragedy of monumental proportions. As archaeologists, we often make a living by excavating sites, and clearly not every site can or will be preserved. In evaluating sites, however, we must be careful not to dismiss small or low-density deposits without adequately documenting their age, contents, and function. We must also work harder to ensure that preservation is a mitigation option for a larger sample of sites (or at least the more significant portions of sites) so that future archaeologists will have an archaeological record to investigate with their more sophisticated methods and theories.

Understanding the diversity of the archaeological record of the California Coast, we must remind ourselves that every site has a new and different story to tell, that such sites are the history of a nearly forgotten people, and that our mission as archaeologists should not be just to study the past but to preserve it. One of the most compelling justifications for continuing to do archaeology is the variability evident in the archaeological record and the lessons modern society can learn by understanding the cultures and environments of the past. By connecting ourselves explicitly to the history of California, its Native American tribes, the multiethnic communities that developed after contact, and the ecological problems we face today, we can more effectively make a case for continuing or strengthening the legal protection for archaeological sites and funding for high-quality archaeological research.

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