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Harvesting the Littoral Landscape During the Late Holocene: New Perspectives from Northern San Diego County

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For some time, an interpretation of coastal occupation in the San Diego area of southern California, herein termed the Coastal Decline Model, has held center stage despite limited and patchy empirical data. This reconstruction, based largely on the Batiquitos Lagoon fieldwork of the 1960s to 1980s, posits a major depopulation of the coast during the Late Holocene as estuarine subsistence productivity declined under the impact of rapid siltation. Recent investigations at nine shell midden sites along the coast of Camp Pendleton Marine Corps Base in the northern portion of this region challenge prior inferences. In this area, emerging trends in settlement and subsistence strategies suggest critical shifts took place during the Middle to Late Holocene. Specifically, three new results contradict key test implications of the Coastal Decline Model: (1) numerous coastal sites are now dated to the Late Holocene when marine transgression is thought to have "shut down" extensive coastal occupation; (2) Late Holocene sites are not typically smaller and/or more reflective of short-term or single season occupation than earlier sites; and (3) shellfish remain important to the coastal economy throughout the Holocene. It is argued that resource intensification played a major role in the continued occupation of this portion of coastal southern California.

EXPLAINING why changes occurred in prehistoric coastal settlement and subsistence patterns has been a recurring topic in southern California archaeology. Previous interpretations of diachronic trends in prehistoric coastal adaptations in San Diego County have generally been linked to changes in coastal geography and associated fluctuations in resource availability within the littoral zone. The prevailing paradigm for understanding local adaptations, termed herein as the "Coastal Decline Model," asserts that after 3,500 B.P., a decrease in littoral resources resulted in either a major decline in the size of coastal populations and the use of the coastal area, or a total abandonment with a shift to an inland-oriented settlement and subsistence system (e.g., Warren et al. 1961; Crabtree et al. 1963; Warren and Pavesic 1963; Warren 1964, 1968; Moratto 1984:154; Gallegos 1985, 1987, 1992; Jones 1991, 1992; Christenson 1992; Masters and Gallegos 1997).

The purpose of this article is to examine this existing model of prehistoric adaptations in San Diego County, which is reevaluated using the results of new research along the coastal zone of the northern third of the county, where excavations at nine shell middens in this area are used to refine perceptions of coastal adaptations (Byrd et al. 1995; Byrd 1996, 1997; Reddy et al. 1996). It is argued that exploitation of littoral resources from near-coast base camps remained an integral aspect of adaptations in this northern region during the Late Holocene. Although strategies differed between local settings, they represented aspects of a diachronic trend in hunter-gatherer intensification.

In general, California prehistory conforms to a worldwide correlation between marine settings and Late Holocene settlement permanence (Hayden 1981; Waselkov 1987; Yesner 1987). Yet in regional overviews, San Diego County is generally referred to as the major California exception in this trend toward sedentism and intensification of the procurement of littoral resources (Christenson 1992; Jones 1992:22). Shellfish exploitation is considered to have played a prominent role in Early and Middle Holocene occupation of the southern California coast, with its emphasis slowly declining in comparison to other resources, particularly fish and acorns (Jones 1991, 1992). This trend continued in the Late Holocene with an increase in hunting and fishing (Moss and Erlandson 1995:19). The pace of these developments is considered to be related to local variation in resources and their potential for intensification, particularly with respect to seed plants, acorns, fish, and hunting of terrestrial and marine fauna (Basgall 1987; Bouey 1987; Jones 1992; Raab 1992, 1996; Broughton 1994; Glassow 1996). These temporal changes in habitat and resource abundance are linked to global climatic events, particularly sea level rise (Bickel 1978; Nardin et al. 1981; Masters and Flemming 1983).

Jones (1992) argued that during the Late Holocene in California, sedentism was possible in most island and littoral contexts only with extensive reliance on offshore fisheries and rookeries. This is particularly the case for the southern coast of California, an area that is dominated by open coasts and sandy beaches, which are generally considered to have the poorest potential for littoral resources (both for annual and seasonal abundance) (Jones 1991). Jones (1992:22) further stated that San Diego County stands as a major exception to the diachronic trend toward settlement permanence along the coast (see Christenson [1992] for a detailed discussion of southern San Diego County).

COASTAL SETTING AND PALEOECOLOGY

The shoreline of San Diego County extends for 130 km. with drainages of varied catchment size occurring every 10 to 15 km. (Fig. 1). The Tijuana River, Sweetwater River and associated San Diego Bay, and the San Diego River dominate the southern third of the coastline, while the central portion includes several small drainage catchments with prominent lagoons. The northern third extends from San Mateo Creek to the San Luis Rey River and encompasses Camp Pendleton Marine Corps Base and three of the county's four largest drainage catchments. Drainage catchment size is an important variable in understanding the dynamics of human coastal adaptations, and is discussed further below.

Camp Pendleton Marine Corps Base extends for 28 km. along the coast at the north end of the county. Within the base is a series of drainages, the largest of which are the Santa Margarita River at the south end of the base and San Mateo and San Onofre creeks, whose mouths are within 1.5 km. of each other at the north end of the base. Until recently, the channels of these drainage systems were generally open to the ocean due to high discharge. The base also includes a number of medium and small size drainages, of which the most well known is Las Flores Creek (also termed Las Pulgas) in the center of the base. Due to lower discharge, these smaller systems either end in sloughs or form alluvial fans on the Pleistocene coastal terraces at the base of the hills (Waters 1996a).

The paleoecology of this portion of the southern California coastline differed dramatically from what it is today (Inman 1983; see also Orme 1993; Masters 1994; Kern 1995; Waters 1996a, 1996b). Fast-paced sea level rise during the Late Pleistocene and Early Holocene shifted the shoreline eastward, inundating valley floors and in some places creating steep and narrow bays. Shorelines were primarily rocky with

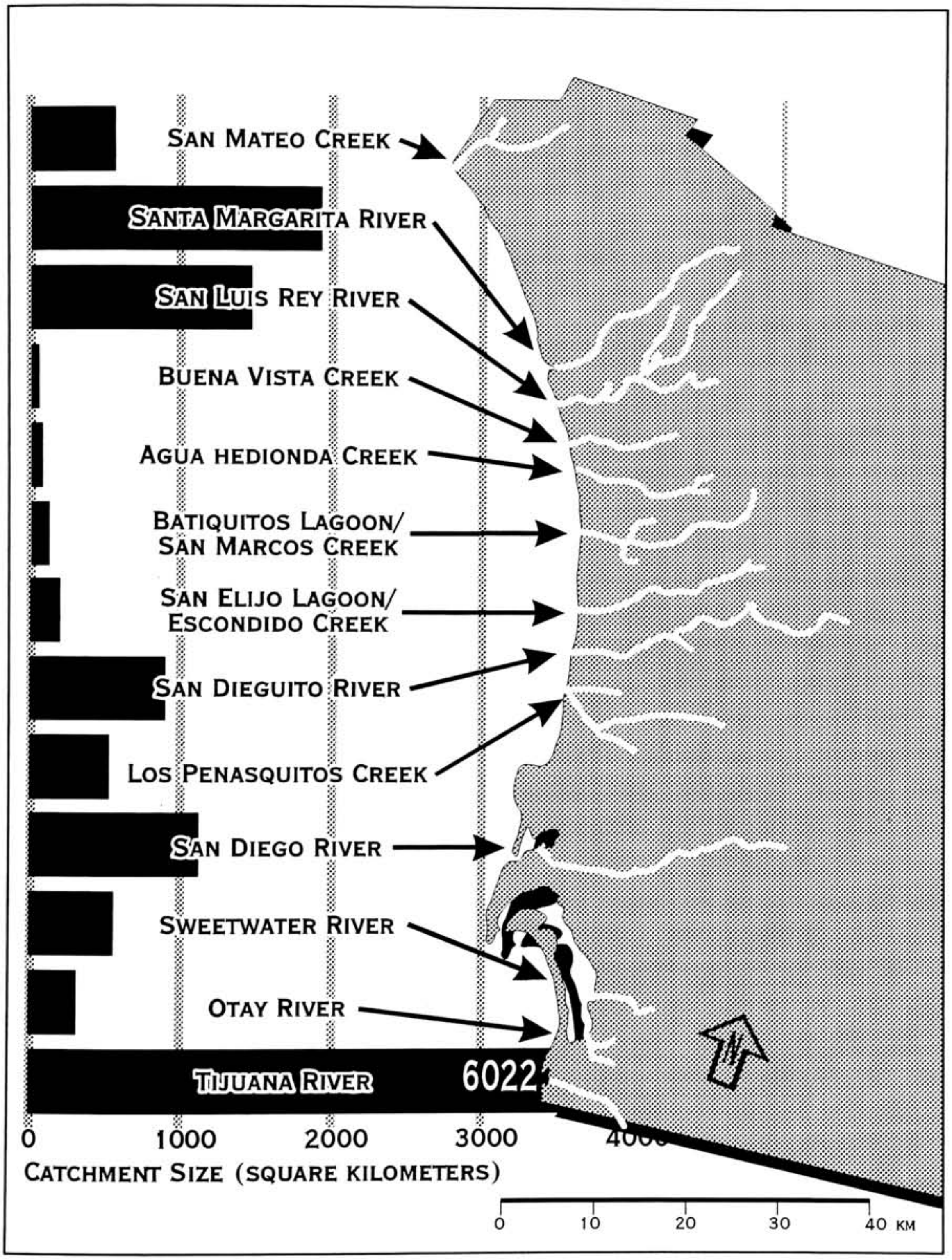

Fig. 1. Western San Diego County showing prominent drainages and drainage catchment size.

small littoral cells as sediments were deposited at bay edges and were rarely discharged to the ocean. These bays evolved into estuaries and lagoons, while rocky shores declined and sandy beaches began to be established as the pace of sea level rise slowed. Large expanses of sandy beaches developed during the Late Holocene, starting first at the north end of county and then spreading southward, ultimately forming the extensive Oceanside littoral cell from Dana Point to La Jolla (Inman 1983). This sequential spread of extensive sandy beaches occurred primarily because the largest drainage systems are situated in the northern portion of the area.

EXISTING COASTAL MODEL FOR SAN DIEGO COUNTY

The present interpretation of coastal adaptations for San Diego County was essentially established by the early 1960s. A series of survey and excavation reports along the coastline provided the data to define local prehistoric adaptations and to identify temporal patterns (Moriarty et al. 1959; Shumway et al. 1961; Warren et al. 1961; Warren and Pavesic 1963; Warren 1964; Moriarty 1966). Initially, there were competing interpretations regarding the nature of coastal adaptations. These debates centered around whether particular lagoons were open for considerable periods of time after 4,000 B.P., and whether human populations continued to flourish along the coastal margin during the Late Holocene (see Shumway et al. [1961:116-117, 124] and Hubbs et al. [1962] for interpretations that were not endorsed by subsequent researchers). In particular, the prehistory of one area, Batiquitos Lagoon at the base of San Marcos Creek in the central portion of the county, has essentially served as the type locality for interpreting the littoral prehistory of San Diego County (Warren et al. 1961; Crabtree et al. 1963; Warren and Pavesic 1963; Warren 1964; Gallegos 1985, 1987).

The prevailing reconstruction of San Diego County coastal adaptations is, at its essence, the argument put forward by Warren and others (Crabtree et al. 1961; Warren et al. 1961; Warren and Pavesic 1963; Warren 1964:186-198, 1968). This reconstruction was applied to all of San Diego County (e.g., Warren 1964:263, Fig. 4), although the data came from only scattered locations along the coastline. In addition, a distinction was often made between the southern third (from Mission Bay or La Jolla southward) and the remainder of the county. Although refinements were made by Warren and others based primarily on new excavations (Warren 1968; Gallegos 1987, 1992; Gallegos and Kyle 1988; Christenson 1992; Warren et al. 1998), the broad perception of coastal adaptations for the last 7,000 years has largely remained unchanged. This is certainly a testimony to the quality of the insights made over a quarter of a century ago. However, it is interesting to note that with the exception of very early occupation (namely the relationship between the San Dieguito and the La Jolla), no alternative interpretations have received widespread acceptance during the last 20 years (but see Shumway et al. 1961:117; Hubbs et al. 1962:22).

A brief summary of the prevailing paradigm for coastal San Diego County follows, with an emphasis on the end of the sequence (i.e., the last 4,000 years) that encompasses the latter portion of the Archaic and the Late Prehistoric periods (Warren et al. 1961:24-28; Crabtree et al. 1963:424; Warren 1964:186-198). It should be pointed out that the initial formation of this model as articulated by Warren (1964) was not environmentally deterministic in nature, but subsequent applications in the context of cultural resource management projects have tended to be more environmentally deterministic in application.

The model states that exploitation of the San Diego County littoral zone began early in the Holocene and was focused around resource-rich bays and estuaries. Shellfish were interpreted as a dietary staple, although plant resources, including nuts and grasses, were also important dietary components. Hunting and fishing were considered to be less important aspects of the subsistence regime. Populations were sizable and probably semisedentary. This adaptive strategy remained essentially unchanged for several thousand years. As Warren et al. (1961:25) stated, "It appears from all available evidence that the La Jolla Complex reached its population and cultural climax between 7000 and 4000 years ago when there was a plentiful supply of shellfish in the lagoons along the coast."

Subsequently, major changes in human adaptations occurred when lagoon silting became so extensive as to cause a decline in associated shellfish populations. This occurred between 4,000 B.P. and 3,000 B.P. at Batiquitos Lagoon and possibly later at other larger lagoons. The decline in littoral shellfish resources, Torrey pine nuts, and drinking water drastically affected human populations and resulted in a major depopulation of the coastal zone. Populations shifted inland to a river valley orientation and intensified exploitation of terrestrial small game and plant resources (possibly including acorns). The coast was either abandoned or subject to only seasonal, short-term occupation. After about 1,600 to 1,200 B.P., a possible slight increase in coastal occupation has also been noted.

Warren and Pavesic (1963:418) contended that

> there is little evidence for a heavy population on the San Diego Coast after about 3,000 years ago, except where permanent fresh water supplies and bays now exist, such as around Mission and San Diego Bays, the Santa Margarita River, and possibly the San Dieguito River. Even at those places, it may be that populations were also declining by 3,500 years ago.

Furthermore, according to Warren (1964:113), "That the lagoons silted in and reduced the food supply of the aboriginal population along the San Diego Coast appears to be an obvious and accepted fact. The disagreement lies in the date when the lagoons silted in to the extent that they could no longer support large populations of shellfish." He added that "there is little evidence for a heavy population on the San Diego Coast after 2000 B.C., except where permanent fresh water supplies and bays now exist" (Warren 1964:113), and that "[t]he reduction or decrease in shellfish supply was an important factor in the decline of the aboriginal populations along the San Diego Coast" (Warren 1964:123).

Warren (1968:7) later succinctly summarized this view:

> It appears that the aboriginal population on the San Diego Coast north of Mission Bay decreased and it is suggested that the center of economic activities and consequently the population center shifted to: (1) inland areas where fresh water and the richer ecological zones of oak parkland, chaparral and pinyon were more easily reached and to (2) the area of Mission and San Diego Bays where the littoral resources still were plentiful. Furthermore it seems likely that the straight sandy beaches of the San Diego coast north of Mission Bay were not as heavily utilized as seal rookeries as the rocky points and islands in the Santa Barbara Channel. Given the limited resources of the littoral zone and the shift inland of population and center of economic activities, the development of a maritime culture was prohibited and nothing comparable to the maritime adaptation of the Campbell Tradition is found on the San Diego coast.

The principal, well-recognized exception to this abandonment was the southern third of the coastline associated with Mission and San Diego bays where occupation continued unaffected by lagoon silting. The San Diego County coastline north of Mission Bay witnessed a major population decline due to a dearth of littoral resources. This new pattern of low-level exploitation of the coast (typically seasonal or short-term occupation) continued until historic contact (Christensen 1992). The ethnohistoric villages noted by early Spanish explorers along the coast north of Mission Bay and recorded by Kroeber (1925) were considered to have been smaller than Middle Holocene settlements and perhaps only seasonally occupied (e.g., Warren et al. 1961; Warren 1964; Koerper et al. 1992).

Since the early 1960s, other Late Holocene coastal exceptions to this reconstruction have been documented (e.g., Gallegos 1992). As mentioned above, Warren (1964, 1968) initially pointed out that the Santa Margarita River, and possibly the San Dieguito River, may have had sufficient water to enable large populations to persist for a longer period of time each year. Further, Gallegos (1992) asserted that occupation persisted throughout the prehistoric sequence at the Penasquitos Lagoon/Sorrento Valley area. However, the northern third of San Diego County has rarely been explicitly addressed owing to the lack of direct evidence.

Despite the growing number of documented exceptions to the existing reconstruction, alternative models of regional prehistoric dynamics have not gained credence. Instead, the model continues to be perceived as a viable paradigm for interpreting littoral adaptive dynamics. Examination of recent reviews of coastal San Diego County archaeology reveal that the Coastal Decline Model remains the primary paradigmatic framework shaping the types of questions being posed by archaeologists and the perceptions of the trajectory of prehistoric adaptations. As Smith and Moriarty (1985:40) noted in reviewing the cultural history of the area,

> [t]he majority of archaeological research concerning paleo-environmental factors in the San Diego County manifestations of the Milling Stone Horizon has been centered around lagoon ecology. Interpretation varies slightly from author to author, but in general attempts have been made to draw correlations between the various states of lagoon ecology and the resulting fluctuations in population size, settlement patterns, and subsistence patterns.

Smith and Moriarty (1985:323-324) then hypothesized that

> [t]he greatly diminished marine environment forced the La Jolla Complex to move southward, where marine environments along the Baja California coast and the Gulf of California could continue to support a La Jolla subsistence pattern. Also the final period of occupation by the La Jolla Complex along the San Diego coast may have taken place along San Diego Bay.

In a synthesis of the archaeology of Batiquitos Lagoon, Gallegos (1987:30) explained that

> [a]fter 7500 years before present, coastal shellfish sites are more common, suggesting a somewhat sedentary lifestyle focused primarily on shellfish and hard seed resources. From 3500 to 1500, is a period of abandonment or depopulation of the Batiquitos Lagoon region, followed by a reoccupation by Yuman/Kumeyaay circa 1500 years B.P. to the present.

In a subsequent review of the pre-1,300 B.P. archaeological record of coastal San Diego County, Gallegos (1992:213) maintained that

> [w]ith ocean level stabilizing ca. 3500 B.P., siltation of coastal lagoons occurred, with concomitant degradation of shellfish habitat and depopulation/abandonment of coastal lagoon sites. This occupation hiatus is reflected in a distinctive gap in radiocarbon dated sites for Batiquitos, San Elijo, San Dieguito, La Jolla and Tijuana Lagoons.

A recent synthesis of the Middle Holocene archaeology of coastal San Diego County (Masters and Gallegos 1996:21) revealed that the key hypothesis generated by the Coastal Decline Model of the 1960s continues to dominate perceptions of coastal adaptations:

> With a few exceptions, therefore, the model of environmental change on the coast at the close of the Middle Holocene . . . continues to serve San Diego County well. The cultural response to declining coastal productivity at the end of the Middle Holocene remains an issue for continuing research. Did coastal populations intensify use of inland resources to replace lagoonal resources? Or did they migrate out of the region or suffer population collapse? . . . The apparent shift in settlement pattern after 3500 RYBP relies, of course, on how representative the sample of dated sites (fig. 2.3) is of total Middle Holocene sites. . . . Where a nearly complete record of sites exists at Batiquitos Lagoon, the archaeological evidence supports the model of environmental and settlement pattern changes at the end of the Middle

> Holocene. . . . With the collapse of the north county lagoon ecosystems about 3500 RYBP, the San Diego maritime tradition survived and continued into the Late Holocene in two very different localities, San Diego Bay, and Los Peñasquitos Lagoon, both remaining tidally flushed lagoons with access to offshore fisheries.

To summarize, the Coast Decline Model, with its tight linkage between littoral productivity, human population density, and cultural developments, has remained the primary interpretive framework in San Diego County. As such, this reconstruction, although often more implicit than explicit, continues to shape perceptions of local littoral adaptations. For example, current perceptions are that Middle Holocene coastal shell midden sites in much of San Diego County were generally created by moderate to large populations during multiseasonal occupational events, while Late Holocene coastal sites, if present at all, were formed by smaller populations during shorter, probably seasonal events, as a means of supplementing primary subsistence activities in inland areas, possibly during famine periods. Of course, not all archaeologists in the region stringently adhere to all aspects of this reconstruction. The key point is that there are no viable alternative models to guide the direction of archaeological research in the region.

Thus, three test expectations of the "Coastal Decline Model" are proposed. First, there should be a dearth of coastal sites postdating 4,000 B.P. (and certainly fewer than the number of pre-4,000 B.P. sites). Second, post-4,000 B.P. sites should be small and typically reveal either short-term or single season occupation; sites with evidence of multiple seasons of occupation should be absent. Third, shellfish use should decline significantly after 4,000 B.P. This reconstruction of San Diego County coastal adaptations can be tested with new preliminary results from the northern third of the county—an area that has consistently been included in reconstructions of coastal San Diego County (see Warren 1964:Fig. 4; Gallegos 1992:Fig. 12.1; Masters and Gallegos 1997:Fig. 2.3), but from which primary data have been lacking.

APPLICATION OF THE COASTAL DECLINE MODEL TO NORTHERN SAN DIEGO COUNTY

Prior to 1993, the coastal zone of the northern third of the county was poorly known. The only major archaeological excavations were undertaken in the 1960s and early 1970s at the north end of Camp Pendleton Marine Corps Base (CA-SDI-1074 at the mouth of San Onofre Creek [Chace 1975] and CA-ORA-22 [Cook and White 1977] north of San Mateo Creek), and at CA-SDI-4536 along Las Flores Creek (Ezell 1975).

Beginning in 1993, four projects have resulted in the excavation of a suite of coastal shell middens on Camp Pendleton (Byrd et al. 1995; Reddy et al. 1996; Byrd 1996, 1997). A total of nine sites was test excavated, two of which have spatially discrete and temporally distinct occupation components, and one at which two stratigraphically and temporally distinct phases were exposed in an alluvial bank (Reddy et al. 1996). The results of these projects are utilized herein to test the Coastal Decline Model.

Five of these sites are situated at the north end of the Camp Pendleton, three along San Mateo Creek (CA-SDI-8435, -13,324, and -13,325) and two along San Onofre Creek (CA-SDI-1074 and -4411) (Fig. 2). The other four sites occur at the center of the base, one along Horno Canyon (CA-SDI-4538), and three within the Las Flores Creek drainage catchment (CA-SDI-811, -10,726, and -10,728). Of these nine sites, only two (CA-SDI-10,726 and -10,728) occur on ridge tops (both overlooking Las Flores Creek); the remainder are in alluvial valley floor settings.

The first expectation of the Coastal Decline Model is that coastal sites postdating 4,000 B.P. should be rare or absent. Thirty-three radiocarbon dates from these nine archaeological sites,

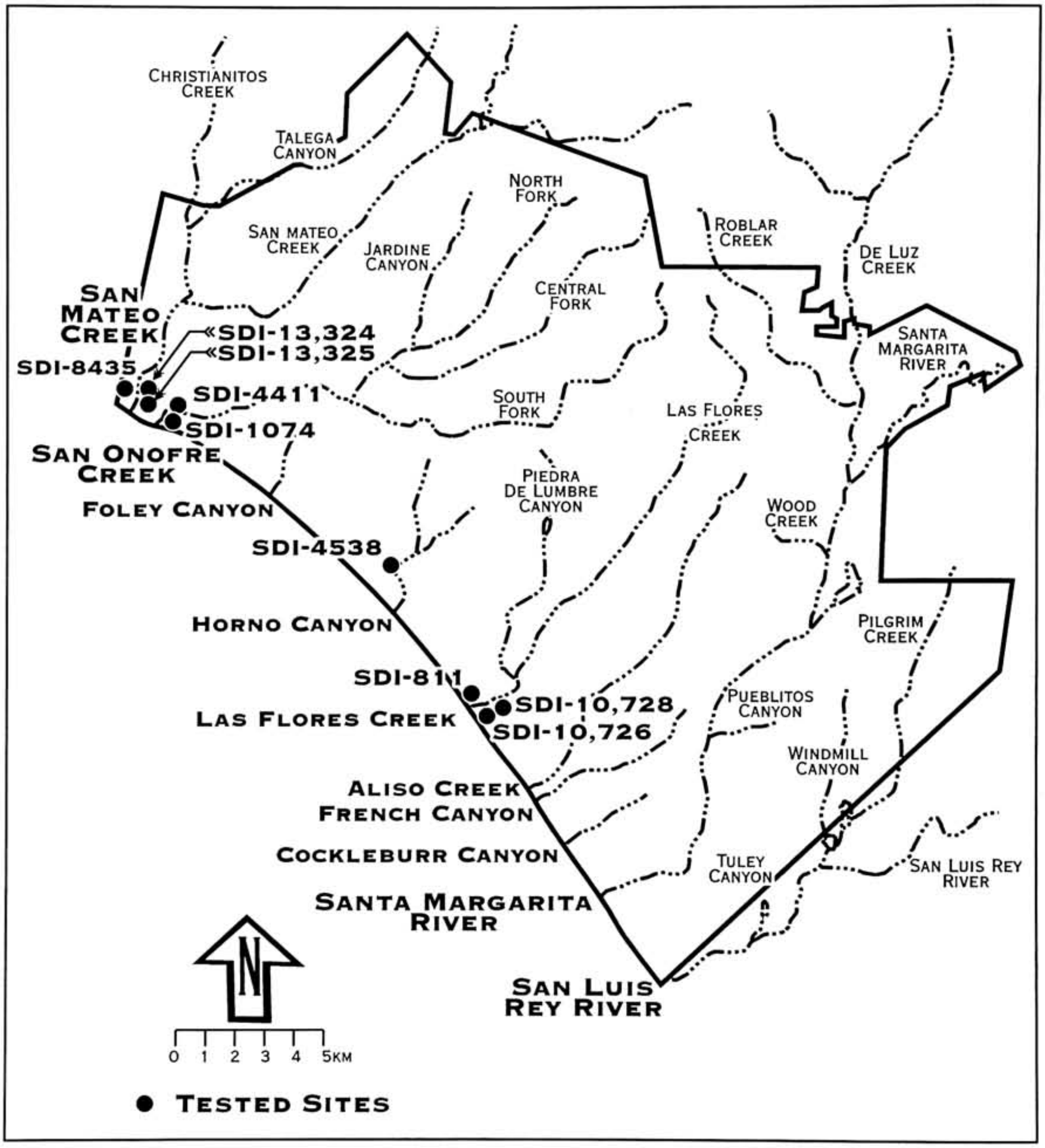

Fig. 2. Location of prehistoric sites recently excavated on coastal Camp Pendleton.

including two sites that each have two major periods of occupation, reveal a broad range of occupation (Fig. 3, Table 1). These include two early Archaic Period occupation episodes (at CA-SDI-10,726 Locus B and -10,728 Locus A). The remaining occupations events are dispersed over the last 4,000 years (CA-SDI-811, -1074, -4411, -4538, -8435, -10,726 Locus A, -10,726 Locus B Upper, -10,728 Locus A Upper, -10,728 Locus B, -13,324, and -13,325). Clearly, prehistoric exploitation of the Camp Pendleton coastal zone continued after 4,000 B.P. Within this time frame, the most intensive occupation, based on the number of sites (not the number of

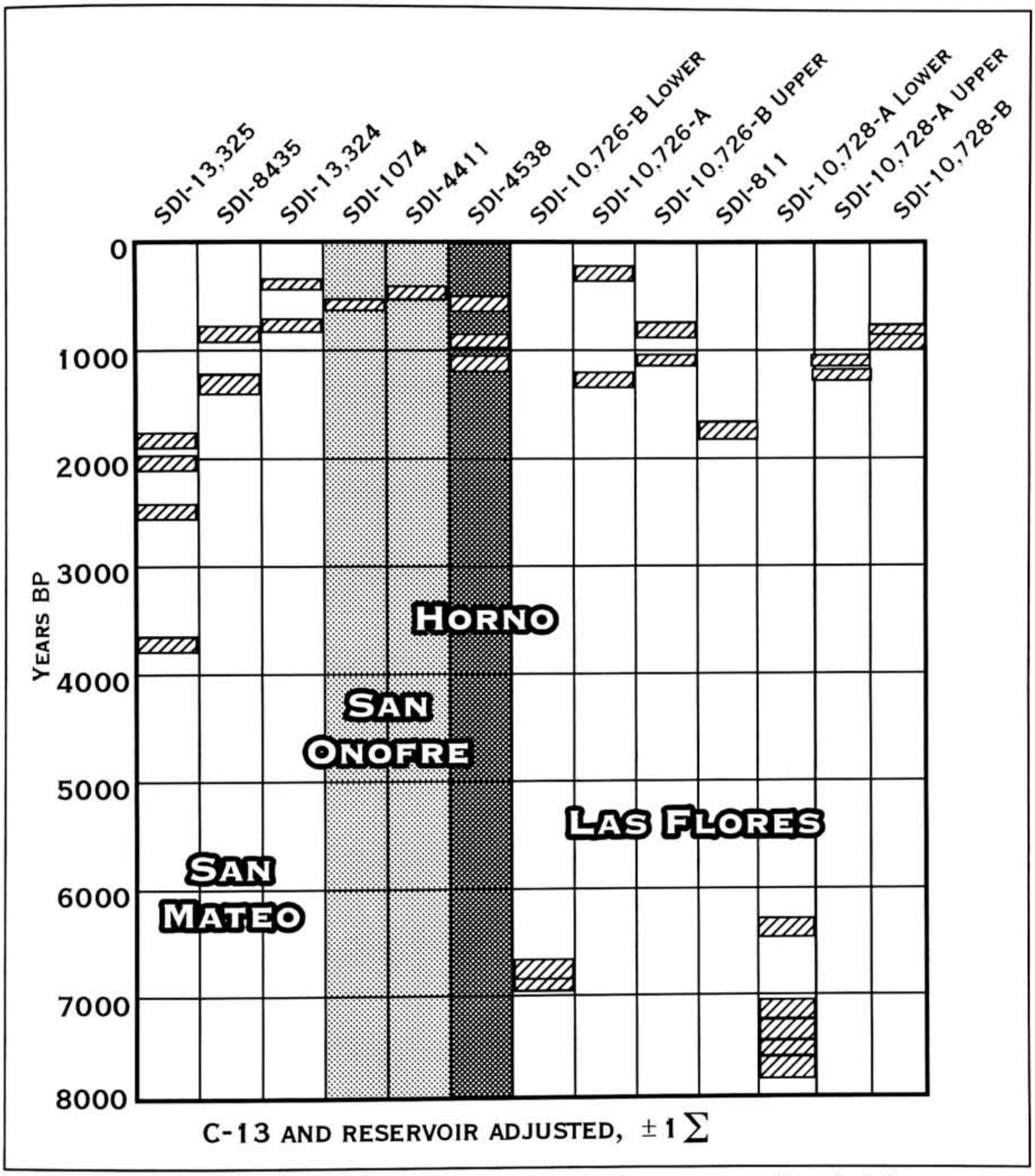

Fig. 3. Radiocarbon dates from relevant coastal sites, identified by watercourse (these include assays from 11 charcoal samples and 20 shellfish samples).

radiocarbon dates, which simply documents the intensity of the dating program), is documented from 1,800 B.P. onward, particularly after 1,200 B.P.

These results directly contradict the Coastal Decline Model. Of course, this is a small, nonrandom site sample. Furthermore, ten additional radiocarbon dates from four nonarchaeological

Table 1
RADIOCARBON RESULTS FROM ARCHAEOLOGICAL SITES ALONG COASTAL CAMP PENDLETON

Site No.	Provenience	Lab No. (Beta Analytic)	Sample Type	^{13}C Adjusted and Reservoir Corrected B.P. (± 1 sigma)	Calibrated date ± 2 sigma (95% probability)[a]	Reference
CA-SDI-811	Unit 1, 40-80 cm.	84170	*Donax gouldii* shell	1,725 ± 70	A.D. 565-815	Byrd 1996
CA-SDI-811	Unit 1, 70-80 cm.	76211	*D. gouldii* shell	1,560 ± 50	A.D. 730-970	Byrd 1996
CA-SDI-811	Unit 2, 80-90 cm.	76212	*D. gouldii* shell	1,740 ± 80	A.D. 530-820	Byrd 1996
CA-SDI-1074	Unit 3, 40-50 cm.	71126	charcoal	580 ± 50	A.D. 1300-1430	Byrd et al. 1995
CA-SDI-1074	Unit 4, 60-70 cm.	71127 (CAMS-12058)	charcoal	610 ± 60	A.D. 1280-1430	Byrd et al. 1995
CA-SDI-4411	Unit 1, 30-40 cm.	71128 (CAMS-12059)	charcoal	470 ± 60	A.D. 1400-1510 A.D. 1590-1620	Byrd et al. 1995
CA-SDI-4538	Locus A, Unit 1, 40-50 cm.	76213	*D. gouldii* shell	910 ± 60	A.D. 1345-1515	Byrd 1996
CA-SDI-4538	Locus A, Unit 1, 40-50 cm.	84168	charcoal	570 ± 70	A.D. 1290-1450	Byrd 1996
CA-SDI-4538	Locus A, Unit 5, 40-50 cm.	84169	charcoal	940 ± 70	A.D. 985-1250	Byrd 1996
CA-SDI-4538	Locus A, Unit 5, 40-50 cm.	76214	*D. gouldii* shell	1,120 ± 70	A.D. 1170-1405	Byrd 1996
CA-SDI-8435	Hearth, lower level	84214	charcoal	1,310 ± 90	A.D. 600-905	Reddy et al. 1996
CA-SDI-8435	Unit IIId, upper phase	85409	organic sediment	840 ± 70	A.D. 1030-1290	Reddy et al. 1996
CA-SDI-10,726, Locus A	Unit 1, 70-80 cm.	76215	*D. gouldii* shell	1,270 ± 70	A.D. 1015-1285	Byrd 1996
CA-SDI-10,726, Locus A	Unit 1, 70-80 cm.	84167	charcoal	290 ± 70	A.D. 1450-1685 A.D. 1740-1810 A.D. 1930-1950	Byrd 1996
CA-SDI-10,726, Locus B Upper	Unit 5, 10-20 cm.	76216	*D. gouldii* shell	810 ± 70	A.D. 1420-1660	Byrd 1996
CA-SDI-10,726, Locus B Lower	Unit 5, 60-70 cm.	76217	*Chione* shell	6,750 ± 90	5,435-5,100 B.C.	Byrd 1996
CA-SDI-10,726, Locus B Upper	Unit 5, 60-70 cm.	76218	charcoal	1,090 ± 50	A.D. 875-1025	Byrd 1996

Table 1 (continued)
RADIOCARBON RESULTS FROM ARCHAEOLOGICAL SITES ALONG COASTAL CAMP PENDLETON

Site No.	Provenience	Lab No. (Beta Analytic)	Sample Type	^{13}C Adjusted and Reservoir Corrected B.P. (± 1 sigma)	Calibrated date ± 2 sigma (95% probability)[a]	Reference
CA-SDI-10,726, Locus B Lower	Unit 5, 90-100 cm.	84166	*Chione* shell	6,870 ± 80	5,520-5,245 B.C.	Byrd 1996
CA-SDI-10,728, Locus A Lower	Unit 3, Dep. 1, 0-10 cm.	92913	*Chione* shells	7,500 ± 60	6,065-5,845 B.C.	Byrd 1997
CA-SDI-10,728, Locus A Lower	Unit 3, Dep. 1, 30-40 cm.	91243	*Chione* shells	7,200 ± 90	5,845-5,510 B.C.	Byrd 1997
CA-SDI-10,728, Locus A Lower	Unit 3, Dep. 4, 60-77 cm.	91244	*Chione* shells	7,760 ± 100	6,415-6,000 B.C.	Byrd 1997
CA-SDI-10,728, Locus A Lower	Unit 3, Dep. 5, 70-93 cm.	92914	*Chione* shells	7,365 ± 85	5,980-5,655 B.C.	Byrd 1997
CA-SDI-10,728, Locus A Upper	Unit 5, Dep. 1, 0-10 cm.	92915	*D. gouldii* shells	1,060 ± 70	A.D. 1230-1435	Byrd 1997
CA-SDI-10,728, Locus A Upper	Unit 5, Dep. 1, 40-50 cm.	92917	*D. gouldii* shells	1,020 ± 70	A.D. 1265-1455	Byrd 1997
CA-SDI-10,728, Locus A Lower	Unit 5, Dep. 1, 40-50 cm.	92916	*Chione* shells	6,350 ± 90	5,055-4,665 B.C.	Byrd 1997
CA-SDI-10,728	Unit 1, Dep. 1, 20-30 cm.	91245	*D. gouldii* shells	780 ± 70	A.D. 1435-1675	Byrd 1997
CA-SDI-10,728	Unit 2, Dep. 1, 20-30 cm.	91246	*D. gouldii* shells	870 ± 70	A.D. 1375-1600	Byrd 1997
CA-SDI-13,324	Unit 5, 90 cm.	84365	charcoal	770 ± 60	A.D. 1175-1305	Reddy et al. 1996
CA-SDI-13,324	Unit 7, 70-80 cm.	84366	charcoal	390 ± 50	A.D. 1430-1645	Reddy et al. 1996
CA-SDI-13,325	Unit 1, 70-80 cm.	71130	charcoal	2,490 ± 70	800-400 B.C.	Byrd et al. 1995
CA-SDI-13,325	Unit 1, 70-80 cm.	72206	*Protothaca* shells	2,040 ± 70	A.D. 190-530	Byrd et al. 1995
CA-SDI-13,325	Unit 2, 60-70 cm.	71131	charcoal	3,720 ± 70	2,310-1,910 B.C.	Byrd et al. 1995
CA-SDI-13,325	Unit 2, 60-70 cm.	72207	*Protothaca* shell	1,830 ± 70	A.D. 440-700	Byrd et al. 1995

[a] From Stuiver et al. (1993).

Holocene alluvial deposits in San Mateo Creek and Las Flores Creek are well distributed between 4,300 B.P. and 500 B.P. (Waters et al. n.d.; Byrd 1996; Reddy et al. 1996; Waters 1996a, 1996b; Pearl and Waters 1998; see Table 2); no pre-4,300 B.P. dates have been obtained. Since the sites discussed herein are primarily from alluvial settings, then the sample is clearly biased for the later portion of the sequence. Although these results indicate that exposed alluvial sediments in this region only extend back to 4,300 B.P., it is possible that earlier, more deeply buried deposits may also be present. Nevertheless, the results do demonstrate that coastal occupation persisted after 4,000 B.P.

The second expectation is that post-4,000 B.P. sites should be small and reveal only short-term, single season occupation. Permanent or multiple season sites should be absent. Determining site size and extent of occupation is difficult, particularly due to geomorphic processes. However, by comparing variables between occupation events, it is possible to obtain at least an impression of the relative degree of occupation intensity, which is adequate for the purposes of this study. Note that both CA-SDI-10,726 Locus B and CA-SDI-10,728 Locus A have upper Late Prehistoric Period components dominated by *Donax gouldii* shellfish overlying an Early Archaic Period occupation. These two Late Prehistoric Period components are excluded for subsequent discussion to ensure that postdepositional mixing is not influencing interpretations.

The two Early Archaic Period occupations at CA-SDI-10,726 Locus B and CA-SDI-10,728 Locus A have intact cultural deposits covering 5,000 m.^{2} and 19,000 m.^{2} In contrast, the eight post-4,000 B.P. occupations include three sites of similar size (CA-SDI-1074, -13,324, and -13,325), three that are much smaller (CA-SDI-4411, -10,726 Locus A, and -10,728 Locus B), and two that exceed 100,000 m.^{2} (CA-SDI-811 and -4538). For all sites, midden depth ranges from 35 cm. to 100 cm. There is no correlation between time period and midden depth, with both early and later sites having thick midden deposits. Notably, the two largest Late Holocene sites have mean midden depths of 50 cm. and 70 cm. These results indicate that post-4,000 B.P. sites are varied in size and intensity of occupation, and include several sites that are more extensive than the two sites with pre-4,000 B.P. occupations. Ongoing investigations at a series of small shell scatters and shell middens in the littoral zone have revealed an additional aspect of Late Holocene littoral settlement dynamics (Reddy 1997a).

Multiple lines of evidence were used to assess variation between sites with respect to seasonality and yearly length of occupation (Byrd et al. 1995:169-174; Byrd 1996:316-328, 1997:140-142). These include archeobotanical remains, fish otoliths, and seasonally available fish (Hudson 1995, 1996; Klug and Popper 1995; Reddy 1996, 1997b; Wake 1997). A number of interpretive issues must be kept in mind when discussing seasonality and yearly length of occupation as they relate to the sites discussed above (Tartaglia 1976; Monks 1981; Quintero 1987; Kelly 1995).

First, sample sizes at these sites are varied; stronger patterns would undoubtedly emerge with larger sample sizes. Second, the annual duration of occupation may have varied during the time periods that each site was occupied, as hunter-gatherers will return to the same location at different seasons and for different lengths of time. Postdepositional disturbance makes distinguishing such patterns extremely difficult. Third, evidence of seasonally available resources only indicates that the inhabitants of the site collected certain resources during any particular season. When dealing with seasonally occupied sites, if food resources could be stored, then it is possible that they were collected elsewhere and brought to the site as stored resources, particularly since such foodstuffs are typically consumed in seasons subsequent to the harvest.

Table 2
RADIOCARBON RESULTS OF GEOMORPHIC SECTIONS FROM CAMP PENDLETON[a]

Site	Provenience	Lab No. (Beta Analytic)	^{13}C Adjusted and Reservoir Corrected B.P. (± 1 sigma)	Calibrated date ± 2 sigma (95% probability)[b]	Reference
Las Flores Creek, Locality 1	Stratigraphic Unit IV, 100 cm.	75375	1,800 ± 80	A.D. 60-420	Byrd 1996
Las Flores Creek, Locality 1	Stratigraphic Unit IIIB, 170 cm.	76432	2,610 ± 80	905-515 B.C.	Byrd 1996
Las Flores Creek, Locality 1	Stratigraphic Unit Ib, 370 cm.	75376	4,230 ± 60	2,929-2,610 B.C.	Byrd 1996
Las Flores Creek, Locality 2	Unit IV	89977	490 ± 60	A.D. 1325-1340 A.D. 1390-1495	Pearl and Waters 1998
Las Flores Creek, Locality 2	Unit II	89976	1,850 ± 80	A.D. 5-390	Pearl and Waters 1998
Las Flores Creek, Locality 2	Unit I	89975	3,200 ± 100	1,685-1,250 B.C.	Pearl and Waters 1998
Las Flores Creek, Locality 3	Unit I	89979	1,370 ± 70	A.D. 575-790	Pearl and Waters 1998
Las Flores Creek, Locality 3	Unit II	89978	2,470 ± 80	805-385 B.C.	Pearl and Waters 1998
San Mateo Creek, Locality 4	Trench 7	84210	560 ± 50	A.D. 1300-1440	Reddy et al. 1996
San Mateo Creek, Locality 1	Natural Exposure 1, Unit IIIb	84212	3,810 ± 60	2,455-2,035 B.C.	Reddy et al. 1996

[a] All samples are from organic sediment.
[b] From Stuiver et al. (1993).

Fourth, winter generally has the fewest seasonal markers. Finally, the absence of occupational evidence during a particular season does not conclusively demonstrate that no occupation occurred during that season. Since many resources can be exploited throughout the year (particularly faunal resources), it is possible that discrete evidence for any one season may simply be lacking. Keeping these caveats in mind, the results of these analyses are summarized below (for detailed discussions, please refer to the original reports).

Each post-4,000 B.P. site included in this study yielded food resources procured during multiple seasons. Late spring and summer resources predominated, with fall resources present at several sites, including the two largest (CA-SDI-811 and -4538). Only trace indications of winter resources were evident, with a notable absence of evidence for fishing during the winter. Paleoethnobotanical data for spring-summer resources included grasses, small seeds, and legumes, while the fall resources included acorns and several other resources (Klug and Popper 1995; Reddy 1996, 1997b). It should be pointed out that these carbonized paleobotanical remains are the result of cultural activities and not independent natural events, as demonstrated by the absence of such material in samples taken directly beyond site boundaries (Reddy 1997b).

Seasonal fishing in the summer, spring, and/or fall is primarily indicated by the recovery of barracuda, bonito, skipjack tuna, true tuna, anchovy, and jackmackerel (Hudson 1995, 1996; Wake 1997). These species, representing from 10% to 25% of the overall fish samples, would have been captured in open waters offshore. Most of the fish remains recovered (75% to

90%), however, are primarily represented by nearshore species which could have been available year round (for example, Tartaglia [1976: 68] suggested that white croaker has a peak availability from May to August). Seasonality analysis was conducted primarily on drum family white croaker otoliths and, to a lesser extent, queenfish otoliths from CA-SDI-811, -4538, -13,325, and -10,726 Locus B (Hudson 1995, 1996). The results provided evidence of annual fishing over a seven-month period from March through September, with a peak from mid-May through June. There is a notable absence of fishing during the winter, particularly early October through early March.

In sum, post-4,000 B.P. coastal occupation included large sites with moderate to thick middens that yielded seasonality evidence for multiple seasons of occupation. Therefore, the second expectation is not met, since the evidence indicates that Late Holocene occupation along the coast was not limited to small sites with short-term, single season occupation.

The third expectation of the Coastal Decline Model is that exploitation of shellfish declined significantly in quantity and became of minor importance after 4,000 B.P. To test this proposition, shellfish recovered from early and later occupation horizons were quantified and compared. Although the precise dietary contribution and relative ranking of shellfish versus other resources undoubtedly changed over time, this issue is not under consideration, and is beyond the scope of this article. The focus here is on determining whether shellfish remained an important aspect of the subsistence strategy (part of the integral package of key resources) or whether it became only a minor component, based on the subsistence remains recovered. To address this issue, shellfish density was examined based on mean shell weight per square meter and maximum shell weight per 10 cm. level. Although there is a number of different ways to calculate shellfish density, the comparisons employed here are appropriate for the questions posed, particularly since midden thickness does not significantly vary between early and late sites; hence, total shell weight per excavated square meter can be used.

At this juncture, two points need to be made. First, large quantities of shellfish were recovered at both early and later sites (Fig. 4). Although the early occupations have some of the greatest densities (with mean shell weights of 17.2 and 11.6 kg. per square meter and maximum shell weight per 10-cm. level of 7.2 and 4.4 kg.), they are also the only sites in nonalluvial settings. In other words, one might expect that shell density per volume would be greater in contexts where geogenic deposition was low. The post-4,000 B.P. sites, mostly in alluvial settings, vary considerably with respect to mean shell weights. Mean shell weight values per square meter range from 1.5 to 41.2 kg., with maximum shell weight per 10-cm. level ranging from 0.3 to 14.8 kg. Summary means for post-4,000 B.P. sites are 12.7 kg. per square meter and 3.9 kg. per 10-cm. level. Thus, mean values at post-4,000 B.P. sites are only slightly less than those obtained from Early Archaic Period sites. This indicates either that shellfish exploitation was slightly less extensive at post-4,000 B.P. sites or that alluviation in these larger drainages played a greater role in the accumulation of on-site sediment volume (thereby reducing densities). Regardless, the key inference to be derived is that shellfish persisted as a viable economic strategy at littoral sites after 4,000 B.P., particularly in the central drainages.

The second point is that there is local variation in shellfish quantities after 4,000 B.P. Later sites in the northern area (CA-SDI-1074, -4411, -13,324, and -13,325) have significantly lower shellfish densities than those from sites in the central area (CA-SDI-811, -4538, -10,726 Locus A, and -10,728 Locus B). Northern post-4,000 B.P. sites have mean shell weights ranging from 1.5 to 6.3 kg. per square meter and

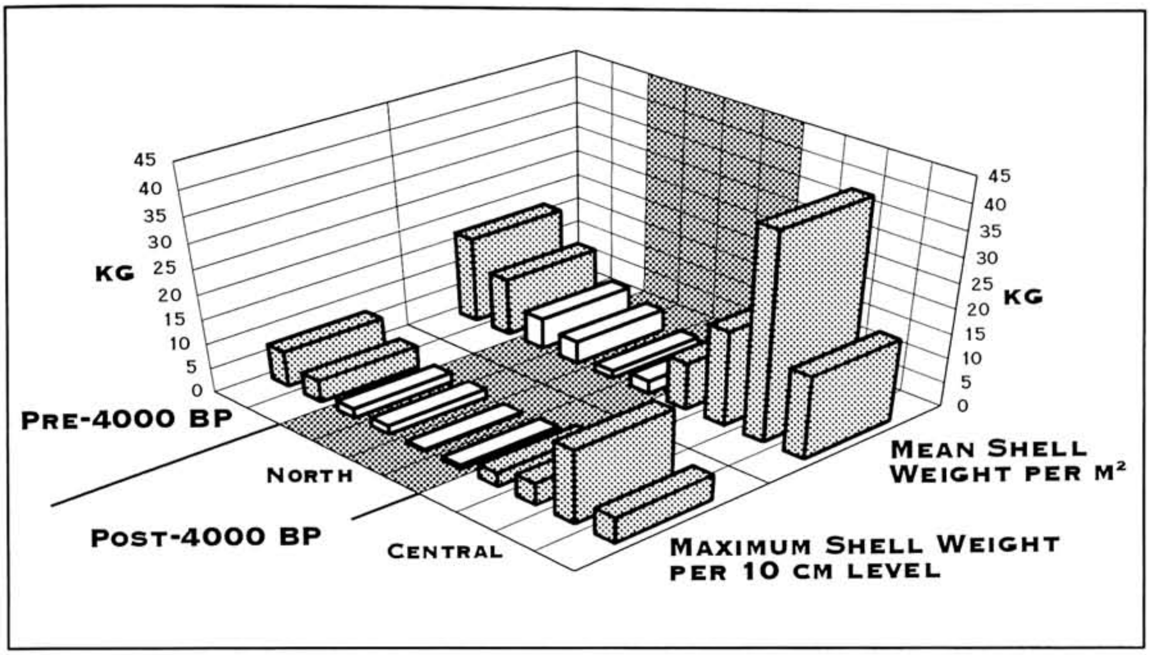

Fig. 4. Shellfish density from excavated coastal sites organized by time period and area.

maximum shell weights per 10-cm. level ranging from 0.33 to 1.9 kg., while central area post-4,000 B.P. sites have mean shell weights ranging from 9.6 to 41.2 kg. per square meter and maximum shell weights per 10-cm. level ranging from 2.8 to 14.8 kg. Summary means for post-4,000 B.P. sites in the northern area are 3.7 kg. per square meter and 1.2 kg. per 10-cm. level, while central area post-4,000 B.P. sites have summary means of 21.7 kg. per square meter and 6.8 kg. per 10-cm. level.

The types of shellfish species exploited also varied over time and between drainages when MNI (minimum number of individual) frequencies for different shellfish species were examined (Fig. 5). In the central portion of the base, gastropods are uncommon. The two Early Archaic Period sites have a diverse range of species, and are dominated by lagoonal *Chione* and *Argopecten*. Notably, *Ostrea lurida*, a bay/estuary rock-clinging species, occurs in the basal levels and declines in quantity over time.

Differences occur between the north and central areas after 4,000 B.P. In the central area, the later sites (all postdating 2,000 B.P.) are almost exclusively represented by the sandy beach species *Donax gouldii*. Based on the discovery of unexcavated sites with *Chione* exposed in earlier alluvial deposits, the silting in of the estuary/lagoon at Las Flores may have been largely completed by 3,000 B.P. In contrast, the northern area revealed a very different ecological history and procurement strategy. Overall, gastropods are much more prevalent and *Donax gouldii* less important. *Protothaca* and *Tegula* dominate the post-4,000 B.P. sequence in both drainages. The habitat of *Protothaca* is primarily sheltered sand and gravel contexts and along rocky points such as San Mateo, while *Tegula* occurs in intertidal areas of rocky shorelines. *Mytilus*, a nonburrowing, exposed rocky shore/bay species, dominates the "other" category in the San Mateo area. Exploitation of *Donax gouldii* occurs only at late sites in the San Onofre drainage.

These trends indicate that a viable bay and rocky area ecology existed during the last 4,000 years in the San Onofre/San Mateo littoral area.

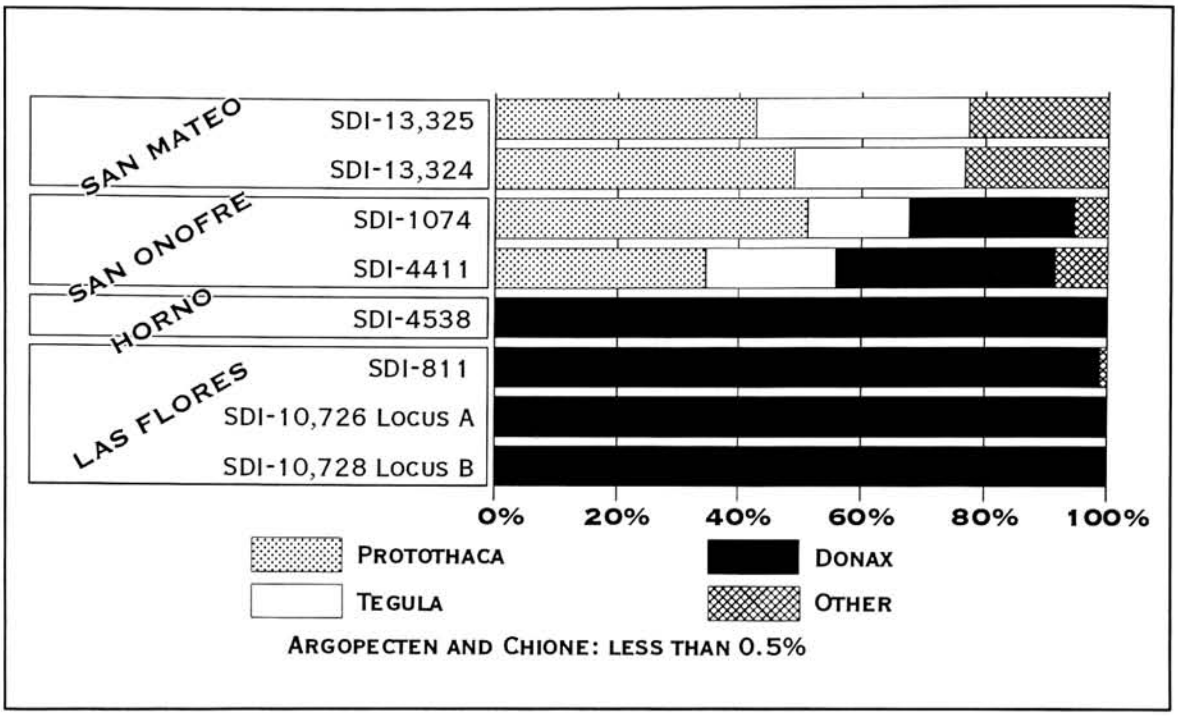

Fig. 5. Shellfish MNI (minimum number of individuals) for post-4000 B.P. excavated sites.

Settlements in the San Mateo drainage focused exclusively on species from this niche throughout the relevant prehistoric sequence. Late settlements in the San Onofre drainage also exploited *Donax gouldii* available on the sandy beaches directly to the south. In the central portion of the base, the decline of lagoonal ecology, as well as *Chione* and *Argopecten*, occurred after 4,000 B.P. However, this did not result in a cessation of shellfish exploitation, but rather a shift to an intensification of *Donax gouldii* exploitation, particularly during the last 2,000 years. Therefore, in contrast to most previous expectations, locally available shellfish continued to be an important resource that was often subjected to intensive exploitation after 4,000 B.P.

Fishing is also considered to have been only a minor component of the economy during later times in San Diego County, as terrestrial exploitation strategies dominated. Although sampling variation is a major issue that needs to be controlled, several comments can be made regarding fish. First, all excavated sites yielded evidence of procurement of ocean fish, and several sites yielded considerable quantities of fish remains. The most prominent are CA-SDI-811 along the shoreline of Las Flores Creek and CA-SDI-13,325 at San Mateo Creek. Fishing included primarily nearshore species, along with some open ocean fish. In addition, shell fishhooks were recovered from sites along San Mateo Creek (CA-SDI-13,324 and -13,325) and at San Onofre Creek (CA-SDI-1074). Sea mammals were uncommon except at one site along San Mateo Creek (CA-SDI-13,325). Thus, ocean vertebrates, primarily fish, were a strong economic option at some coastal sites, although the relative importance varied between sites.

CONCLUSIONS: NEW PERSPECTIVES ON OLD PROBLEMS

The results of recent excavations at Camp Pendleton along the northern coast of San Diego County conflict with three expectations of the most prevalent prehistoric reconstruction for the San Diego County coastal zone: the majority of sites postdate, rather than predate, 4,000 B.P.; midden sites with evidence of multiple seasons of occupation are not absent after 4,000 B.P., but instead are well-documented; and exploitation of shellfish resources did not decline but rather continued to be an integral aspect of prehistoric economies after 4,000 B.P. As such, these results share more in common with Late Holocene settlement directly to the north in Orange County where exploitation of littoral resources continued during this time frame (e.g., Ross 1969; Koerper 1981; Moratto 1984:156-165; Mitchell 1991; Koerper et al. 1996). These patterns, which are considered to support a "Coastal Intensification Model," also correlate with Late Holocene hunter-gatherer intensification documented in other portions of California (e.g., Broughton 1994; Glassow 1996; Raab 1996; Wohlgemuth 1996). The importance of intensive utilization of littoral resources within hunter-gatherer subsistence regimes corresponds to worldwide diachronic trends in coastal adaptations (Hayden 1981; Waselkov 1987; Yesner 1987).

Although the sample of sites is limited, the extent of excavations restricted, and the results preliminary and subject to further validation (particularly with respect to the Early Holocene), they call into question the viability of the Coastal Decline Model and demonstrate the need to continually challenge the underlying paradigmatic framework that guides the design of archaeological research and regional reconstructions. The results also raise several issues that deserve comment. Most importantly, why do these results in northern San Diego County differ from those in central San Diego County (notably at Batiquitos and some of the other nearby lagoons)? Two explanations are offered: differences in the physical character of associated drainages and the degree of shoreline change.

The first explanation involves regional differences in paleogeography and resource potential, which played a role in the trajectory of human adaptations. In the northern third of San Diego County, larger drainages are more prevalent, with diverse and dynamic littoral ecologies (see Fig. 1). In some places, viable bay and rocky shore contexts persisted for longer periods of time. The northern area also has a shallower coastal gradient that provided the ideal ecological setting for sandy beach resources, such as *Donax gouldii*, to flourish in the Late Holocene. Thus, northern small and medium drainages were also viable littoral niches. In contrast, small drainage catchments characterize the central coastline of San Diego County. Typically, carrying capacity would have been less. These small drainages were also more likely to have silted over more quickly and earlier since they lacked the discharge flow to flush their systems. Therefore, continued sea level rise would have had a greater effect on resource potential and human adaptive responses in this central area.

The second explanation (i.e., degree of shoreline change) concerns the great difference in site preservation and site discovery potential between the two portions of the county and the two time periods under consideration, which has biased perceptions of the relative importance of littoral resources during the Early Holocene versus the Late Holocene. Initial archaeological investigations naturally gravitated to the well-preserved, highly visible shell midden sites clustered around lagoons in the central portion of the county, and excavations focused on these sites (Moriarty et al. 1959; Shumway et al. 1961; Warren et al. 1961; Crabtree et al. 1963; Warren and Pavesic 1963; Warren 1964; Moriarty 1966; Gallegos 1985, 1987).

It is now apparent that site preservation, particularly of Early Archaic Period sites, is much greater in the central portion of the county than elsewhere. At 7,000 B.P., the paleoshoreline in the central third of the county was only about half a kilometer from the modern shoreline; in the northern third of the county, it was approximately 2.5 km. from the modern shoreline (Fig. 6). Thus, only a fraction of the Early Holocene coastal zone is eroded or submerged adjacent to the small lagoons in the central region, while a 2.5 km. strip of the paleocoastline in the northern region is now either eroded away or submerged. The narrow, steeper valleys of the central coastline created long, extended lagoons that made the adjacent, slightly inland hilltops the most viable location for Early Holocene sites. On the other hand, Early Holocene occupation of valley floors was possible in the larger and wider drainages of the northern area. The enhanced visibility of early sites in the central area, coupled with the overall higher probability of valley floor sites being buried by alluviation, may have played a role in biasing perceptions of diachronic trends in prehistoric coastal occupation.

In contrast to the high visibility of Early Holocene sites in the central portion of the county, Late Holocene occupations typically occur in two contexts that are less archaeologically visible. They generally represent either the upper occupation levels of ridgetop sites whose lower levels contain earlier Holocene occupation or are situated in alluvial valley floor settings. In the case of the former, these occupation horizons have sometimes been of less research interest to archaeologists owing to their more disturbed nature, the difficulty in separating associated material culture from immediately underlying occupation levels, and a research orientation that has emphasized the earliest occupation events (particularly with respect to analytical focus and selection of material for dating).

Sites located in valley floor settings, a common occurrence for Late Holocene occupation in the northern portion of the county, are much more likely to be either partially or completely buried by alluvium; hence, their discovery is more difficult and reconstruction of overall settlement patterns requires more rigorous investigation. This pattern of buried Late Holocene occupation in alluvial settings may also hold true for the small drainages with lagoons in the central portion of the county, since alluviation has been extensive. It should be pointed out that early researchers recognized this potential bias in their reconstruction of diachronic trends in coastal adaptation: "It is also possible, however, that late sites located on the valley floors have been covered by silt deposit during flooding. . . . That villages located on the floor of the wide valleys near the ocean have been covered by quantities of silt remains a distinct possibility" (Warren et al. 1961:26). In sum, a research orientation focused on Early Holocene occupation sites due to their high visibility and excellent preservation in the central portion of the county, coupled with the lower archaeological visibility of Late Holocene occupation throughout the county, may have significantly affected perceptions of diachronic trends in coastal adaptation.

Ultimately, reconstructions of broader trends in human exploitation of the littoral zone will be enhanced by considering multiple hypotheses when examining the distinctive paleoecology of individual drainages. Localized reconstructions are necessary to understand changes in resource potential and subsequent human responses. Where new data are accumulating (such as from these projects and recent work along the San Luis Rey River [Moratto et al. 1994; Vanderpot et al. 1993]), it is clear that individual drainages had varied paleoecologies and witnessed vibrant, often distinctive, prehistoric adaptations. Perhaps too much emphasis has been placed on smaller systems associated with prominent lagoons in the central third of the county. Certainly, these smaller systems were more easily disrupted, and hence should not be considered to be representative of the region as a whole. Given that post-4,000 B.P. occupation is now well-documented in portions of both the southern and northern thirds of the county, it is possible that the archaeological signatures along

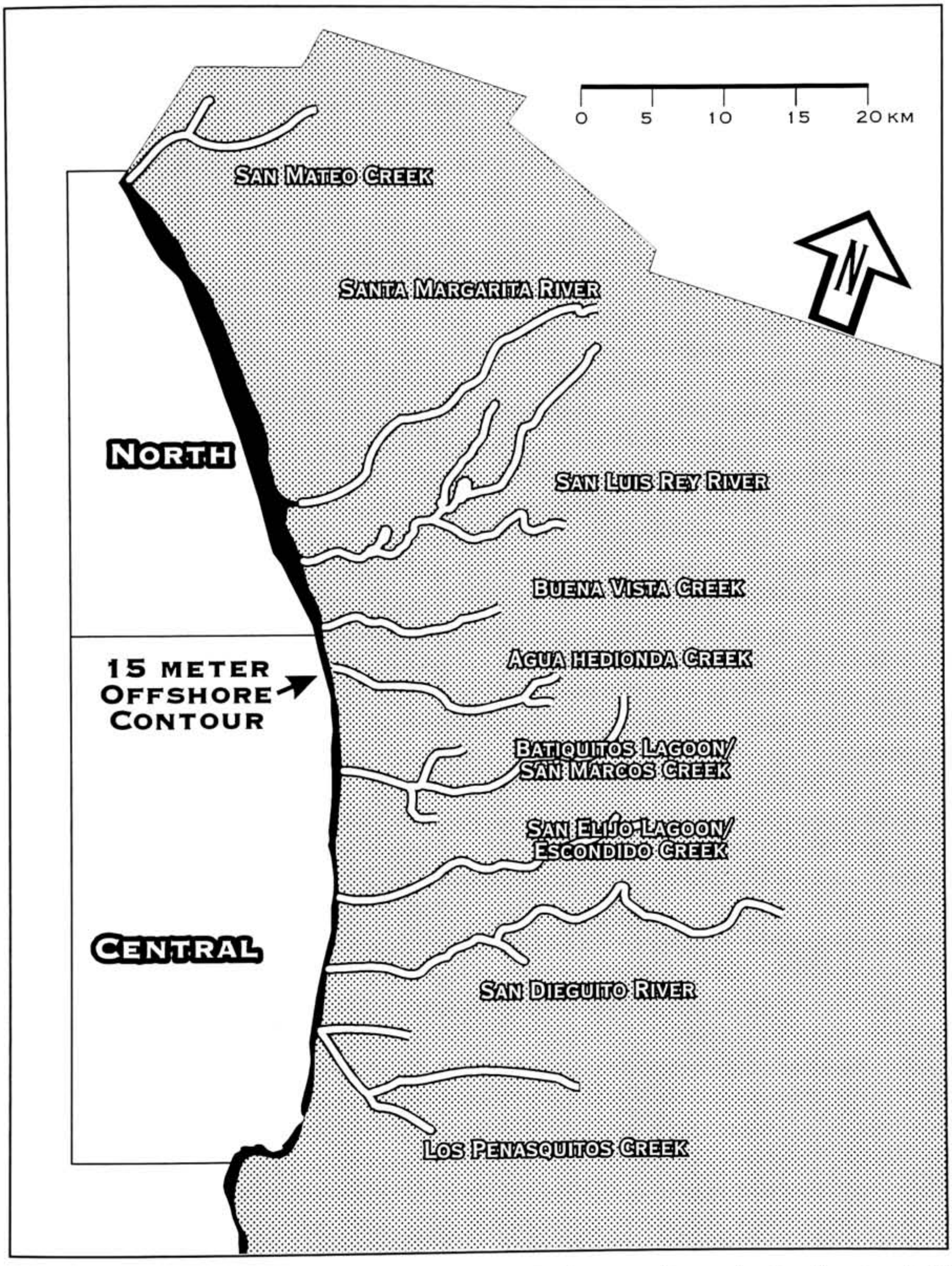

Fig. 6. Northern and central San Diego county coastline showing approximate paleoshoreline at ca. 7,000 B.P. (15-m. isoheight).

the central coastline are the exception rather than the norm for San Diego County.

As noted by Glassow et al. (1988) for the Santa Barbara Channel area, one cannot assume a one-to-one link between resource change and culture change. Shifts in paleoecology did not dictate human adaptations—social factors were an equivalent or more important influence. I would argue that San Diego County is not a major exception to a global, long-term trend toward intensification of littoral resources and increased settlement permanence along the coast. Although a fully maritime economy did not emerge in this area, extended annual occupation of the littoral zone continued throughout much of the Holocene as hunter-gatherers adapted to an ever-changing environment. The task that lies ahead is to unravel the social factors that characterized this trajectory and led to Late Holocene coastal intensification.

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