THE EVOLUTION OF COASTAL SETTLEMENTS:

A VIEW FROM THE BALLONA LAGOON

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ABSTRACT

Prehistoric settlement in the Ballona wetlands, near present-day Marina del Rey, is the focus of this paper. Using survey and excavation data, natural and cultural developments of the Ballona are described. Descriptive information on the Centinela site (LAN-60), a recently excavated prehistoric shell midden dating to about 2100 B.P., is then presented. After a reconstruction of the paleoenvironment, an apparent contraction of the regional settlement system is explored using chaos theory and hunter-gatherer responses to risk. A change similar to a shift from a foraging strategy to a collecting strategy is hypothesized. Highly mobile groups that initially camped on the bluffs to exploit lagoonal resources, over time abandoned this system and settled within the highly productive estuary. The unpredictable nature of the environment, however, precluded the establishment of large, permanent villages. The establishment of a stratified social order associated with mobile settlements in which social position is correlated with topographic placement in the wetlands is postulated.

INTRODUCTION

Over the past decade, a number of significant archaeological projects have been conducted in the Ballona wetlands (Figure 1), near the present-day city of Marina del Rey (Altschul et al. 1991; Altschul, Homburg et al. 1992; Grenda et al. 1993; Van Horn 1984, 1987; Van Horn and Murray 1985). These projects have greatly increased our knowledge not only about this particular area, but also have raised questions about coastal settlement patterns and concomitant social structures during the post-A.D. 1000 period. Traditionally, archaeologists have argued that lagoons of southern California were favored locales for habitation. Settlement patterns focused on large, permanently occupied villages that housed a relatively complex, stratified society. These interpretations are derived largely from ethnographic accounts of the Gabrielino and Chumash Indians (Bean and Smith 1978; Grant 1978; Heizer 1955; Johnston 1962).

After over a decade of intense archaeological scrutiny, there is still no evidence of permanent habitation, much less a major village site, in the Ballona region. Altschul and Ciolek-Torrello (1990) were the first to point out the apparent discrepancy between the ethnographic model and the mounting archaeological evidence. They suggested two alternative hypotheses. First, a village existed, but either had not been found or had not been adequately documented among the recorded sites. Always a possibility, the search for new data should not be discontinued, but a second possibility is that permanency may never have characterized the occupation of the Ballona. They note that the latter alternative would require

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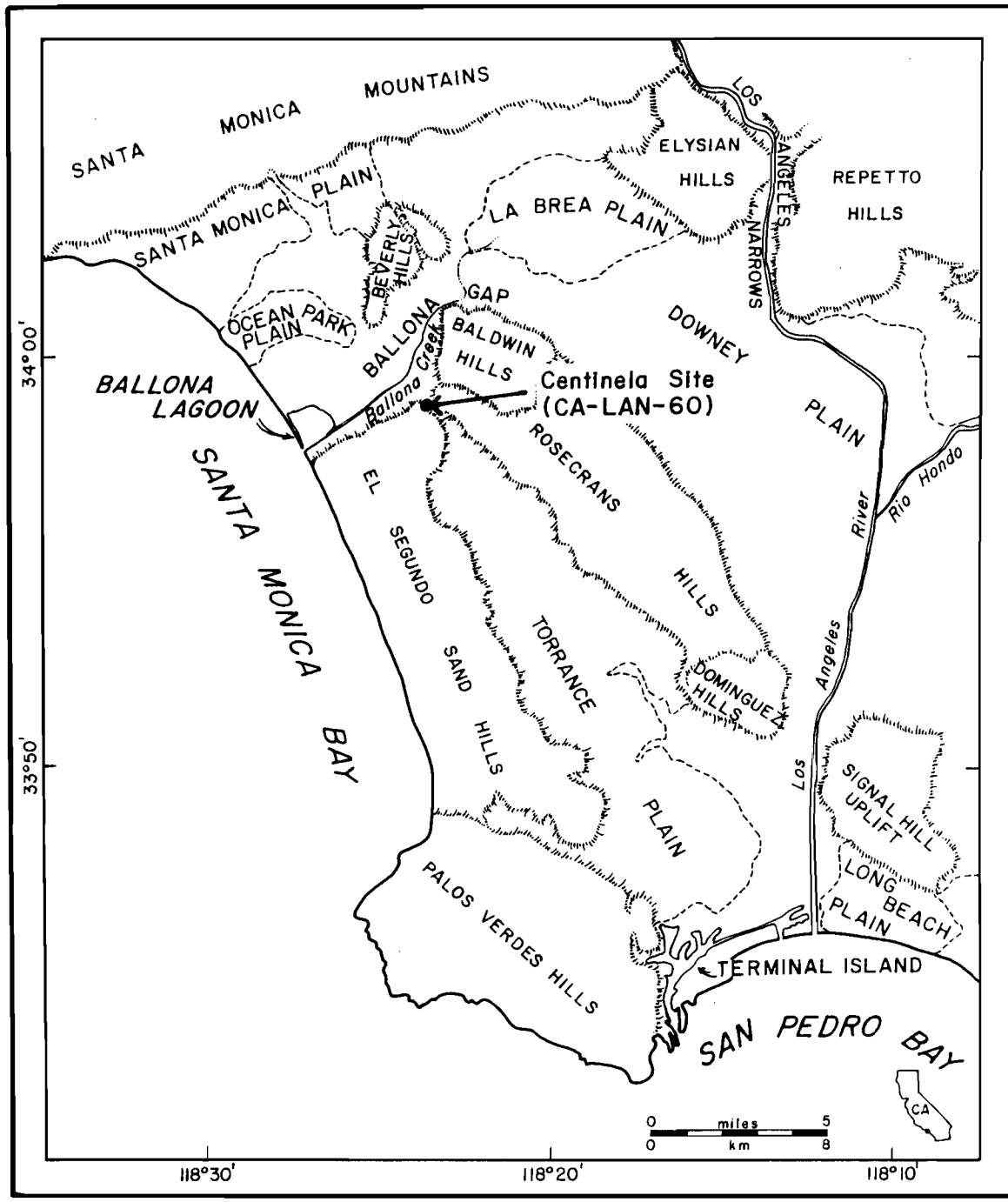

Figure 1. Map of the project region.

reanalyzing the relationship between coastal settlement and social organization.

This paper explores some of the theoretical propositions involved in Altschul and Ciolek-Torrello's second hypothesis. In particular, we want to explain why certain southern California coastal groups organized in villages and others did not. Here, we limit ourselves to the situation in which relatively complex hunters-and-gatherers evolved a non-village settlement pattern, focusing particularly on data from the Ballona wetlands. A companion study, utilizing data from a lagoon in which a village-based system evolved (e.g., Malibu or Newport Bay), would offer the necessary contrasting elements to test derived hypotheses, but unfortunately is beyond the scope of this paper.

A second goal of the paper is to present descriptive results from a recent excavation in the Ballona region. The Centinela site (LAN-60) is located on a colluvial slope at the base of the Ballona Escarpment, approximately 5 km northwest of the Pacific Ocean. This site is of critical importance to the development of a regional culture history, for it represents the only lagoon-edge site occupied prior to A.D. 1000. Subsistence-related data from the site fill in major gaps in our understanding of the evolution of coastal adaptations in this area. The presentation of these data not only makes them available to a wider audience, but sets the stage for interpreting the development of late prehistoric society in the Ballona.

The paper is divided into three parts. First, we provide background information on the cultural and natural development of the Ballona wetlands. Second, descriptive data from the Centinela site are provided. Finally, we explore theoretical propositions required to explain settlement trends in Ballona prehistory.

BALLONA LAGOON NATURAL AND CULTURAL HISTORY

In order to explain culture change in southern California it is important to understand the dynamic nature of the environment. Altschul and others (Altschul, Ciolek-Torrello et al. 1992; Altschul, Homburg et al. 1992) provide a reconstruction of the natural development and a model of the cultural dynamics of the Ballona region, which is summarized here. With the retreat of glacial ice in the late Pleistocene, the rising sea level inundated the coastal plain north of the El Segundo Sand Hills and west of the Baldwin Hills creating a large open water embayment (Figure 2a). It is the resources of this embayment that attracted the first residents to the Ballona between 7,000 and 5,000 years ago, a time termed the Early period. Sites of the Early period consist of low density middens comprised mostly of shell and fish that appear to have been used opportunistically.

The Middle period, 3,000 - 1,000 B.P., follows a time of abandonment or low use of the Ballona. Intense use of the region begins around 2,500 B.P. (Freeman 1991). By approximately 2,000 B.P., the bay was blocked off from the open sea by a sand barrier creating a sheltered wetland environment (Figure 2b). Middle period occupation is centered on the bluff tops overlooking the open lagoon. Only the Centinela site, which was located on a creek-edge, upstream from the lagoon, was located within the wetlands. To date, most excavations have focused on Middle period sites, all of which have been interpreted as short-term camps utilized periodically throughout the year (Van Horn 1984, 1987; Van Horn and Murray 1985).

By 1,000 B.P., as sedimentation increased, a network of islands, marshes, and waterways developed in the estuary (Figure 2c). The bluff tops were largely abandoned, with sites in the Late period (1,000 - 700 B.P.) located at the edge of the lagoon (Altschul, Homburg et al. 1992). Absolute dates suggest that the Ballona was

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largely abandoned by A.D. 1250 (Freeman 1991). The estuarine environment continued into the historic period, however (Figure 2d), and there are indications that the area was utilized, if not settled, by the Gabrielino (Altschul, Homburg et al. 1992; Johnston 1962; Kroeber 1925).

THE CENTINELA SITE

Over 50 years ago, the Centinela site was identified and mapped as an intact archaeological deposit (Farmer 1936). Unfortunately, testing in the early 1980s concluded that the site represented a secondary cultural deposit of materials that had been bulldozed downslope from LAN-59 (Van Horn 1984). It was not until archaeological monitoring of the grading process prior to construction that the true nature of the site was discovered. By that time salvage excavations over a period of four days were all that could be accomplished (Grenda et al. 1993).

The site is kidney-shaped and approximately 140 m by 100 m. Our excavations consisted of two 2-m by 3-m test pits placed in the richest part of the midden (Figure 3). Radiocarbon dates of shell samples collected from the top and bottom of the midden indicate the site was occupied for a relatively short period around 2100 B.P. (Table 1). Its occupation, then, corresponds to the intense use of the Ballona that occurred during the Middle period between 2,500 and 1,100 B.P. (David Van Horn, personal communication, 1993).

Inhabitants of the site subsisted on plants and animals of the marsh, particularly shellfish, waterfowl, fish, small mammals, and various seeds and berries. Little evidence of pelagic exploitation was found, and the Centinela site fits the Ballona regional pattern of little or no evidence for marine mammal exploitation. The majority of material recovered from the excavation units consisted of shellfish remains, primarily *Chione* spp. with small quantities of *Pecten* sp., *Tivella* sp., *Polynices* sp., and *Ostrea* sp.. Little vertical differentiation in the relative abundance of shellfish species was noted.

The inhabitants of the site processed plant and animal resources with chipped and ground stone tools. Chipped stone reduction strategies primarily focused on the manufacture of expedient flake tools. A range of lithic raw materials was represented at the site, including fine-grained materials such as chert and chalcedony, and coarser-grained, locally available basalt and quartzite river cobbles. The lithic assemblage is dominated by debitage and a few cores. Towner (1992, 1993) suggests that the paucity of bipolar flakes and the lack of shell beads at the Centinela site indicates that beads were not made in the Ballona during the Middle period, whereas the presence of both at the nearby Late period Admiralty site (LAN-47) suggests that shell bead production was an important industry by A.D. 1000.

No evidence for permanent occupation was found. Yet, the floral and faunal assemblages indicate that the site was used during all seasons. It is possible that a comprehensive examination of the remaining portions of the site will document a permanent occupation but at present the Centinela site is interpreted as a repeatedly used temporary camp not unlike the sites on the bluff tops (Van Horn 1987).

COMPARING THE CENTINELA SITE TO OTHERS IN THE BALLONA

In addition to our work at the Centinela site, archaeological investigations have been carried out at a number of locations in the Ballona region. These locations include four sites on the bluffs (LAN-59, -61, -63, and -64) and one site on the lagoon edge (LAN-47).

A comparison of the faunal assemblages collected from the sites indicates marked differences between bluff-top and lagoon-edge assemblages (Table 2). In general, bluff-top sites contain far greater densities of sharks and rays and much less shellfish than their lagoon-edge coun-

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Table 1

Radiocarbon Dates from the Centinela Site			
	Provenience		
	Test Pit 1 Top of Stratum II	Test Pit 1 Bottom of Stratum II	Test Pit 1 Top and Bottom of Stratum II
Depth (cm)	56-66	166-176	--
Sample Type	*Chione* shell	*Chione* shell	*Chione* shell
Sample Content Average	Top of shell midden	Bottom of shell midden	Weighted
Laboratory No.	Tx-7667	Tx-7666	Tx-7666/7667
^{13}C	+0.20	+0.37	--
Uncalibrated Radiocarbon Age B.P.*	1720 +/- 60	1670 +/- 60	--
Uncalibrated Age Adjusted for ^{13}C B.P.*	2140 +/- 60	2060 +/- 60	2100 +/- 42

*These uncalibrated radiocarbon ages are based on the 5568-year half-life of ^{14}C, as suggested in the *American Antiquity* (1992) Style Guide.

terparts. The smaller amounts of shellfish on the bluffs probably reflect the processing of these animals near the point of collection, that is, the lagoon edge. The same logic, however, cannot be used to explain the near absence of sharks and rays at lagoon-edge sites. The greater proportion of shellfish and the decrease in sharks and rays at the Late period Admiralty site may be explained by changes in the Ballona from an open lagoon to a closed estuary. But such an explanation only partially fits the Centinela site. The intermediate proportion of shellfish at Centinela, high in relation to most bluff-top sites and low compared to the Admiralty site, is consistent with the interpretation of shellfish becoming a more important resource as the lagoon filled with sediment. The low proportion of sharks and rays at the Centinela site compared to contemporaneous bluff-top sites, however, is not easily explained.

As a group, Middle period sites, whether located on the bluffs or lagoon-edge, exhibit great intersite variability. Whereas occupants of the Loyola-Marymount (LAN-61) and Hughes sites exploited large amounts of sharks and rays, roughly contemporaneous residents of the Del Rey (LAN-63) and Centinela sites relied heavily on shellfish. Such variation supports Van Horn's (1987) contention that Middle period sites represent short-term occupations by small groups who visited the Ballona periodically throughout the year, subsisting on whatever resources happened to be available. These resources were highly diverse consisting of fish, shellfish, and terrestrial animals found in the lagoon and adjoining areas and grasses and other plants indigenous to the bluff-tops (Miksicek 1993).

Late period sites are restricted to only one setting -- the lagoon edge -- yet contain greater densities of faunal remains, and a wider diversity of artifact and feature types than their Middle period predecessors. It appears that as the subsistence system became more specialized, social complexity increased. Burial data suggest that differences in social position were becoming

Table 2. A comparison of the faunal asseblages from sites in the Ballona region.

	# of Shark and Ray	Mean Identifiable Shark/Ray Elements per cubic meter	# of Bony Fish	Mean Bony Fish Elements per cub meter	# of Terrestrial Elements	Mean Identifiable Terrestrial Element per cubic meter	# of Sea Mammal Elements	Mean Identifiable Sea Mammal Elemen per cubic meter	# of Avian Elements	Mean Identifiabl Avian Elements per cubic meter	# of Shell Valves	Mean Shell Valves per cubic meter
Bluff Sites												
Hughes Si CA-LAN-59	2230	58.0	628	16.5	n/a	n/a	n/a	n/a	675	17.8	683	28.5
Loyola-M CA-LAN-61	4780	14.8	1254	3.9	1818	7.7	224	0.6	1281	3.6	789	0.7
Del Rey S CA-LAN-63	3137	13.3	4188	17.7	2951	5.1	30	0.1	249	1.1	23792	117.4
Bluff Site CA-LAN-64	108	2.3	34	0.7	76	1.1	4	0.1	49	0.7	187	19.9
Lagoon Sites												
Centinela CA-LAN-60	54	3.2	116	6.9	239	14.2	0	0	18	1.1	976	116.2
Admiralty CA-LAN-47	102	1.6	732	11.4	2150	33.5	21	0.3	480	7.5	14290	595.4

Note: Different faunal analyses at the various Ballona sites often analyzed different percentages of the total collections. Below we provide the number of cubic meters of matrix examined for each analysis for each of the Ballona sites. In some cases, these volumes are estimated, based on the description of the sampling technique provided in the report.

Terrestrial and Sea Mammal Faunal Analysis: Hughes site - not reported; Loyola Marymount - 234.6 cubic meters (terr), 356 (sea mammal), Del Rey - 574; Bluff - 69; Admiralty - 64.2: Centinela 16.8

Avian Faunal Analysis: Hughes - 36; Loyola-Marymount - 356; Del Rey - 236; Bluff - 69; Admiralty 64.2; Centinela 16.8

evident by A.D. 1100 (Altschul, Homburg et al. 1992). No evidence exists, however, to indicate that increased social complexity was accompanied by permanent settlements. These paradoxes lead us to ask two basic questions. Why, when a variety of resources existed, did people choose to focus on only a few, and how did this new focus affect the way they related to each other and to outsiders? We believe the answers to these questions can be found in the ways hunter-gatherers respond to risk and the unpredictable nature of estuarine environments.

COPING WITH VARIABILITY

Hunting and gathering societies typically employ a wide range of buffering mechanisms to minimize the effects of environmental scarcity and variability. Halstead and O'Shea (1989) have grouped these buffering mechanisms into four categories: mobility, diversification, storage, and exchange. Throughout prehistory, coastal inhabitants have employed different combinations of these strategies to reduce the risk involved with living in an unpredictable environment.

When populations are low, flexible territorial boundaries and extensive kin networks provide hunter-gatherer groups faced with scarce resources with the opportunity simply to move to another location where resources are abundant. Diversification can take the form of two distinct but related strategies. Groups can broaden the resource base that is exploited within an area by defining new resources and/or technologies, or increase the exploited area to include more resources. As population levels increase, the strain on resources rises. Populations become circumscribed and their ability to move is reduced. To a certain extent, one can argue that the development of villages in some lagoons and not others reflects differing degrees of circumscription.

In those areas where the movement of people became restricted, another form of mobility - the movement of goods - may have offered decided advantages. Access to trade networks provides a buffer to environmental variability by allowing goods from productive regions to enter the area in exchange either for goods or social wants (e.g., information). Facilities to store resources can enhance the trading network's value. In absence of storage facilities or the ability to store value (i.e., some form of money), trading must be maintained on a regular basis.

With the exception of acorns, no resource capable of sustaining groups for any length of time was suitable for long-term storage. Storage facilities along the coast were relatively crude compared to similar facilities constructed by contemporary agriculturalists of the American Southwest. This inability to physically store goods may have encouraged the development of stored value in the form of shell money. The importance of shell money to solidify and reify alliance and marriage patterns is well documented among ethnographic groups in southern California (Gifford 1947). Exchange at this time probably had a great deal to do with buffering economic vicissitudes as well as with insuring stable social relationships.

During the Late period in the Ballona, we have evidence for increasing population, decreasing mobility, resource specialization, and exchange in economic goods with outside groups. These conditions occurred within a particular environmental setting. We suggest that the interdigitating between the social and environmental parameters led to a peculiar settlement system.

SETTLEMENT AND CHAOS THEORY

Altschul, Homburg et al. (1992) argue that unlike other coastal lagoons it is possible that the Ballona was never permanently occupied. They suggest one possible explanation for the absence of a permanent village site in the Ballona is that the environment may have been perceived as too risky. Based on a streamflow reconstruction for the Santa Ana River covering the period A.D. 1530 to 1966, they predict that the Ballona Lagoon would have been flushed out, on average,

every 84 years. But the average is of little meaning. Major floods occurred within several years of each other as well as being separated by over a hundred years. Streamflow was extremely variable, following a classic "chaotic" pattern. It is in the chaos that long term adaptive strategies evolved.

The study of nonlinear systems such as weather, turbulence, or modern traffic flow has been revolutionized by the new science of chaos (Gleick 1987). One of the major points of chaos theory is that nonlinear systems are extremely sensitive to initial conditions; so sensitive in fact, that predictability of such systems is impossible. "A system exhibiting chaotic dynamics evolves in a deterministic way, but measurements made on the system do not allow the prediction of the state of the system even moderately far into the future" (Rasband 1990:2). Whereas most social scientists agree that long-term phenomena concerning world processes are unpredictable, many argue that short-term processes approximate a normal distribution (Park 1992). It is from these distributions that scientists claim individuals can make decisions concerning risk (see Dean 1988).

Weather systems and related streamflows are currently viewed as chaotic systems at any point beyond the immediate short-term (Lorenz 1963; Pestiaux et al. 1987). An annual mean can be calculated and may contain "quasi-cycles" but the period and amplitude of these cycles are chaotic. The result of this information creates a situation where knowing the range of floods does not allow one to predict any future flood level, beyond the fact that it will likely fall within an expected range. Past years provide no basis for predicting future years. As a result, inhabitants of flood zones such as the Ballona could not have assigned risks to different potential areas for settlement. Certainly they would have known that higher ground was less likely to flood, but a risk schedule for lower land could not have been constructed. These facts have profound impacts on settlement patterns.

REGIONAL SETTLEMENT RECONSTRUCTION

Overall settlement trends in the Ballona are relatively simple. Initially, the area was probably used on a short-term basis throughout the year by small hunting and gathering groups that came to exploit the abundant resources. The open, unsheltered bay lacked potable water, and seasonal fluctuations in resource availability probably led to sporadic use of the area. The early pattern probably approximated a seasonal round with groups moving between inland and coastal areas. During the Middle period, we see evidence of increasing use of the wetlands. This pattern continued to develop into the Late period with the length of occupation probably increasing at sites around the lagoon-edge until a rancheria type of settlement became established by the time of early Spanish exploration.

Site file data indicate that a contraction in the settlement pattern occurred over time. Early groups used the bluffs on a regular basis. Estuarine species were not as important as open water lagoon species such as sharks and rays. However, as sedimentation increased and the amount of stable land and estuarine resources grew, settlements moved off the bluffs. As the estuary became more attractive, sites on the bluffs were abandoned in favor of settlements in the wetlands.

The shift in settlement and subsistence can be likened to a shift from a foraging strategy to a collecting strategy (Bailey 1983; Bettinger 1991; Binford 1980; Winterhalder and Smith 1981). Initially, individuals and small groups foraged in the Ballona from residential bases on the bluffs. As resources were depleted, the group simply moved to the next foraging area and established a new residential base. As the estuary developed and became more productive it invited a more sedentary strategy where larger residential bases could be maintained by collectors who employed a logistical strategy to gather seasonal and/or patchy resources. To date there is no evidence that the system progressed to a fully sedentary society.

The lack of domestic features at the Admiralty site led Altschul, Homburg et al. (1992) to conclude that the site, although perhaps used for longer durations than Middle period sites, was still only used on a seasonal or short-term basis. Further, burials at the site were not placed in a centralized cemetery but dispersed throughout the midden in what appeared to be a random pattern. Burials seemed to have been placed in the midden at many different times, perhaps by different groups.

There was clearly no permanent village in the Ballona at the time of Spanish contact. Although several early anthropologists, notably Kroeber (1925) and Harrington (in Johnston 1962) cite a Gabrielino placename for the Ballona (*Sa'angna*), Johnson (in Altschul, Homburg et al. 1992:47) has argued that this name does not apply to a specific village and probably refers to the general region. By the time the Spanish explorers passed through the area a rancheria type of settlement system was established in many of the estuaries along the coast.

Functionally, a rancheria settlement system can be distinguished from an aggregated village pattern by the manner in which people are distributed over the landscape. The village pattern, which is the model commonly derived from Gabrielino ethnohistory, centralizes decision making in one logistic locale. Although often unstated, power over economic decisions may be one strong impetus toward the development of a stratified society and a centralized village pattern along the southern California coast. In contrast, the rancheria system spread the population over a number of small sites within the estuary. This pattern reduces the risk of losing an entire settlement to a flood and provides for easy dispersion of settlements during environmental disasters. The unpredictable nature of the environment may also have stimulated social solutions to resource variability. Dividing the land in the wetlands among the group may have led to the social stratification and unequal distribution of wealth, also documented by early explorers. In essence, decision making and power may also have been centralized in the rancheria system. Social relationships between groups may have been expressed not so much by position or wealth within a village as by topographic position within the estuary, with the more powerful groups located on the most favored landforms near the best resources.

CONCLUSIONS

Our research in the Ballona has shed light on the dynamics of regional settlement and subsistence patterns. Interpretations of the data indicate that the bluffs above the Ballona wetlands were initially used by highly mobile foragers. As sedimentation transformed the open water lagoon into a tidal marsh, the increase in available resources made the estuary more attractive. This encouraged a more sedentary settlement pattern. Over time, increasingly sedentary populations needed to find solutions to the unpredictable environment. By the time of the Gabrielino a complex sociopolitical system had been constructed, economic activity was high, and populations were growing. Unlike other southern California estuaries, the Ballona system does not appear to have been focused in a large, permanent village, but rather spread between a number of small sites in a rancheria pattern. Why the social system in the Ballona evolved into a rancheria system, whereas other lagoons hosted major villages undoubtedly involves environmental factors peculiar to each system. Unraveling these factors is a crucial area for future research.

NOTES

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