UNIVERSITY OF CALIFORNIA

Santa Barbara

# Middle and Late Holocene Hunter-Gatherer Adaptations to Coastal Ecosystems Along the Southern San Simeon Reef, California

A Dissertation submitted in partial satisfaction of the

Requirements for the degree of Doctor of Philosophy

in Anthropology

by

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By

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## ACKNOWLEDGEMENTS

This dissertation would not have been possible without the generosity of my friends and colleagues. First, I would like to express my profound gratitude to my doctoral committee: Mike Glassow (chair), Mike Jochim, Katharina Schreiber, and Jon Erlandson. Each member has provided me with a tremendous amount of inspiration, guidance, and friendship that has influenced this research and my perspective on the study of hunter-gatherer societies. Thank you for your insightful and important comments and help editing this dissertation and for answering perhaps the strangest questions you have ever been asked. Jon, thank you for the detailed review of IT, your thought-provoking comments, and for the humor you approached assisting me with revisions.

I am especially grateful to Mike Glassow. From the day that I arrived on campus he has provided the guidance, encouragement, and friendship throughout this project. Mike has provided thoughtful and patient advice on all aspects of my research, from a chaotic admissions mishap through the preparation of a thesis and dissertation. He also introduced and included me in his research on Santa Cruz Island, a place of academic research and discovery as well as a unique environment that evokes great peace and inspiration. I feel fortunate to benefit from the breadth of his knowledge on prehistory and the natural environment, and am completely honored to be a part of the cohort that he has influenced.

Terry Jones and Bill Hildebrandt have encouraged key aspects of this research and are instrumental in inspiring my research on the people and ecology of the central California Coast. Terry's encouragement and the wealth of information, time, and patience during the Fort days motivated me to study this region. His enthusiasm and creativity in approaching coastal societies is represented in the wealth of information referenced in this dissertation. Bill's generosity with sharing perspectives and knowledge of California, from Surprise Valley to Santa Barbara, has introduced new and inventive ways of looking at the archaeological record. Thank you both of the good advice, stories, and humor.

This project was funded by the University of California Natural Reserve System Mildred E. Mathias Graduate Student Research Grant, three Albert Spaulding/Service Fellowships, and the Society of California Archaeology James A. Bennyhoff Memorial Fund Award.

In the wider world, I am indebted to a large network of friends and colleagues that have assisted with field and lab work and thoughtful banter over screens, lab tables, bars, and campfires. I greatly appreciate the amazing friendship and effort of all these people over the years and apologize if I cannot thank you individually for your efforts. This research would have been impossible without the collective effort of this group.

A number of specialists were involved in the analyses of materials recovered from the site deposits. Tim Slowik assisted with debitage analysis and Ethan Bertrando cross-checked many of the lithic identifications. Paul Collins assisted me with reptile and challenging vertebrate elements. Phil Kaijankoski and Kate Ballantyne provided key insights on site soil structure and geomorphology. Obsidian studies were completed by Richard Hughes and Tom Origer. Robert Gibson patiently completed bead and ornament/ pendent identifications and analysis. Dusty McKenzie and Peter Paige assisted with initial fish identifications and Ken Gobalet provided a heroic effort on cross-checking thousands of fish remains. Tim Gross assisted with geomorphology context and shared my enthusiasm for fire-altered rock. Judy Porcasi and Phil Walker kindly reviewed identifiable mammalian specimens. Kim and Tim Carpenter identified several allusive mammal elements that would have otherwise been lumped into general categories. Eric Wohlgemuth meticulously sorted soil and charcoal stained samples to recover floral remains. Paul Valentich-Scott kindly identified an allusive bivalve species. Tammara Ekness Norton digitized sidewall profiles for CA-SLO-1295 and –2563. Ed Schefter expertly corrected the Total Station field data. George Sistek digitized site wall profiles, photographed artifact figures, and assisted with their final formatting. Everyone's patience, attention to detail, and accuracy is greatly appreciated.

Field studies were conducted on two landholdings that most researchers would otherwise not have accesses to, UC Kenneth S. Norris Rancho Marino Reserve (UC Reserve) and a private landholding, the Griswold Ranch. The fieldwork for part of this dissertation research was conducted on the new UC Reserve, established in 2001 through a cooperative agreement with the landowner. Craig Griswold kindly allowed me access to his ranch for surveys and excavations, greatly expanding our knowledge of this area of open coastline and pericoastal valleys. I would like to extend my deep appreciation to UC Reserve Manager Don Canestro, who enthusiastically supported my research, assisted with field logistics, and shared his knowledge on marine and terrestrial communities. I thank Anne and Craig for their generosity and commitment to research by preserving these amazing lands.

Field studies and laboratory analysis could not have been completed in this lifetime without the efforts of an amazing group of field and lab crews. Everyone that has helped me has added a perspective to this research that is unique and their help is irreplaceable. In particular, Ashley Bradbury, Mercedes Cary, Elise Christensen, Robin Demidio, Katie Manion, Karla

Moreno, Christina Navarro, Mark Neal, and Tim Slowik devoted a significant portion of their final UCSB quarters assisting me in sorting and cataloging midden materials while providing considerable friendship that altered my experience of an otherwise daunting task. Christina's enthusiasm and devotion to my research deserves special recognition.

Thank you my dedicated friends Ethan Bertrando, Kelli Brasket, Kristina (Pistola) Gill, Erin King, Dusty McKenzie, and Jenn Perry who gave up fishing, hula hooping, good waves, jumping out of planes, playing music, working on your own research, and time with your families to help me with this project. I cannot thank you enough for your efforts, antics, and laughter. I would be lost without you.

Several supportive friends provided essential editorial assistance with this dissertation. Ethan Bertrando, Paula Carr, Tim Gross, Krista Kiaha, Pat Mikkelsen, Jenn Perry, and Kelda Wilson provided amazing comments and guidance. I also appreciate Brian Codding and Addie Whitaker's kindness in sharing data and graphics. There is no possible way I could ever thank my good friends and colleagues Kelda and Krista who provided daily laughter and encouragement. Thank you all tremendously.

For sharing their valuable insights and providing encouragement during this research, I extend my appreciation to Luther and Betsy Bertrando, Clinton Blount, Brian Codding, Robert Duckworth, Irene and Bob Duckworth, Matt Edwards, Lynn Gamble, Robert Gibson, Tim Gross, Amy Gusick, John Johnson, Justeen Hyde, Mel Lambright, Val Levulett, Pat Mikkelsen, Peter Paige, Jenn Perry, Barry Price, Torrey Rick, Gil Unzueta, Jeff Walker, Phil Walker, Addie Whitaker, and Eric Wohlgemuth. Your contributions have enriched my life and this dissertation

I am sure that I owe my particular way of looking at the world to my parents, Jon and Cheryl Joslin, and my grandparents, Cassie and Lester Cuff, choosing to raise me in the rural foothills and Sierra Nevada Mountains. Adventures on our small ranch and in the wilderness instilled a constant passion for discovery and admiration for the natural environment.

Thank you Jorge –my best friend and love–for the balance, inspiration, and happiness you create in my life everyday. Your steady friendship, support, and respect was beside me through this dissertation as they are throughout life and travels from Columbia to Cambodia. Thank you, again, for your patience with my commitments that kept me away from home.

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**ABSTRACT**

This research examines prehistoric coastal adaptations over a 5,000-year interval during the Middle to Late Holocene along the southern San Simeon Reef, San Luis Obispo County, California. I integrate survey, site excavation, biological, and paleoenvironmental data to determine how cultural and environmental factors affected subsistence and settlement patterns. Interpretations focus on rocky littoral ecosystems and the adaptive strategies of maritime hunting, fishing, and gathering.

During the Middle Holocene, mobile groups exploited high ranked, diverse, and dense resources such as red abalone. Temporally discrete red abalone middens are an example of specialized adaptations. By the Late Holocene, southern San Simeon Reef populations responded to climate-driven resource stress by intensifying existing subsistence strategies through technological innovation and resource intensification. This is evidenced by an overall expansion of diet breadth, increased emphasis on fishing, a shift to lower-ranked land mammals, and increased dependency on resources with higher search and handling costs. A transition to intensified fishing suggests a change in social organization, with collective groups engaged in procurement, processing, storage, and fishing gear manufacture and maintenance activities.

Although subsistence intensification occurred over time, population density remained low and dispersed across the region. Based on shellfish assemblages, intertidal communities remained relatively stable, with only red abalone showing a decrease in size over time. A dietary focus on black turban snails, and the low frequency and small size of California mussel shells may be attributed to ecology rather than resource intensification.

Middle/Late Transition and Late Period settlement was a fluid system, with populations occupying productive resource locations. Medieval Climatic Anomalies drought conditions appear to have transformed social organization, requiring trade or marriage networks to buffer climatic instability. As conditions deteriorated, rocky intertidal shellfish, similar to study site assemblages, appear in interior sites. Although it is uncertain how shellfish reached the interior, this pattern originated during severe droughts that undermined socio-economic systems. Southern San Simeon Reef settlement and subsistence systems clearly reflect the diversity of mobile subsistence adaptations in a coastal environment that requires greater emphasis on researching resource variability.

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# CHAPTER I: INTRODUCTION

Along the Pacific Coast of North America, California contains an especially diverse and rich archeological record, with prehistoric maritime hunter-fisher-gatherers displaying a wide range of technological traditions and economic and sociopolitical complexity (Ames 1991,1994; Arnold 1996; Erlandson 1994; Jones 1991; King 1990a; Kelly 1995; Lightfoot 1993; Yesner 1980). Along the Pacific coast, the "kelp highway" historically supported or sheltered a similar suite of animal and plant resources that were harvested and hunted; however, not all coastal ecosystems are equally productive or accessible for maritime people, even with efficient watercraft (Erlandson et al. 2007). Although there are commonalties shared among prehistoric populations living along the Pacific Coast, the diversity of local settings and cultures illustrates the opportunities and constraints that coastal environments present to human societies and the potential for variation in adaptive strategies (Erlandson 1997; Erlandson and Glassow 1997b). Understanding how specific prehistoric groups adapted to coastal habitats requires focused attention on localized patterns of marine use and changes in human-environment interactions over time.

The research presented here explores social, economic, and ecological developments among the Playano and their predecessors in a discrete region along the central California Coast in northern San Luis Obispo County (Figure 1.1). This region is centered on broad marine terraces overlooking the San Simeon Reef—a term developed by fishery biologists to describe the rocky shelves, reefs, and associated kelp forests of this section of coastline—a distinctive environment that fostered unique coastal adaptations. Studies were conducted on two landholdings along the southern San Simeon Reef, the University of California Rancho Marino Reserve (UC Reserve) and a private landholding, the Griswold Ranch. At the time of Spanish contact, speakers of the Playano language occupied these lands at the boundary between two ethnographic hunter-fisher-gatherer groups that used both marine and terrestrial resources: the Salinan to the north and east and the Northern Chumash to the south (Milliken and Johnson 2005).

My research explores how local hunter-fisher-gatherers utilized marine resources and how their subsistence-settlement strategies were affected by environmental characteristics and their variation over time, and by resource intensification related to population growth. Although the San Luis Obispo Coast has a continuous archaeological record spanning 10,000 years, there is a paucity of information for the Middle to Late Holocene, particularly the period between 1000 calBP to Spanish contact. Limited research, however, has been conducted in some local regions, including the southern San Simeon Reef. Data collected from site excavations and surveys

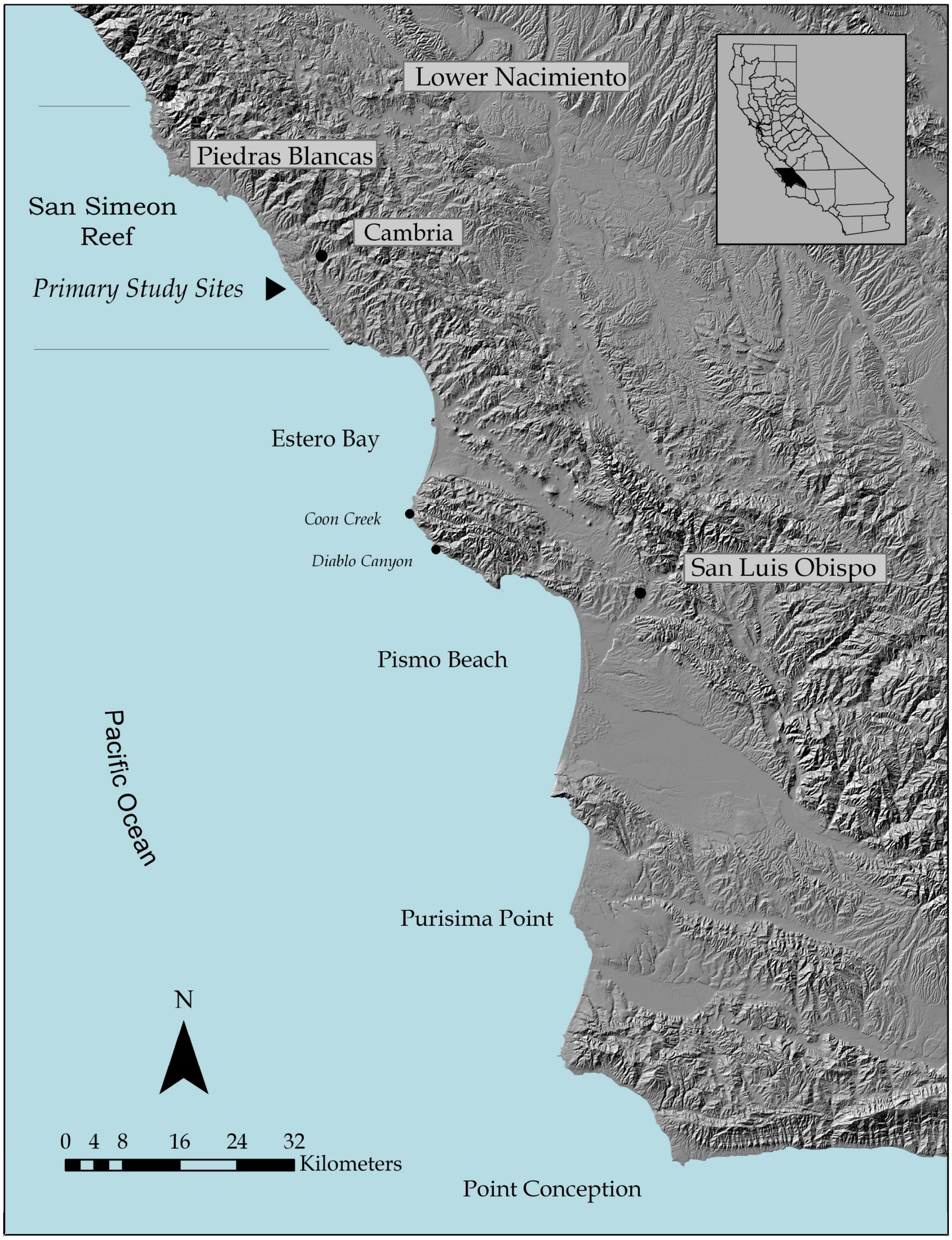


Figure 1.1. San Simeon Reef and the Central California Coast.

are integrated here with biological and paleoenvironmental information to evaluate subsistence and settlement patterns during the Middle (6600—3300 calBP) to Late Holocene (Post 3300 calBP) and to determine how cultural and environmental factors may have affected ecological and cultural systems. Research in the region is integral to developing insights on coastal adaptations in an area where there is currently limited data and where there are significant issues of concern to archaeologists (Erlandson 1997:5; Glassow 1997b).

Using archaeological data from four sites along the southern San Simeon Reef, my research presented here fills data gaps by exploring the specific adaptations characterized by human interactions with rocky shores and headlands, open coastal prairies, and dense Monterey Pine forests. The four excavated sites are CA-SLO-1295 (the Griswold Site), SLO-1622 (the Norris Site), SLO-1677 (the Spring Site), and SLO-2563 (the Ravine Site) (Figures 1.2 and 1.3). Three of these sites, CA-SLO-1295, SLO-1622, and SLO-1677 date to the Middle Holocene, within the Early Period (5000-3000 calBP). The fourth site is a Late Holocene site, occupied during the Middle/Late Transition Period (1000−700 calBP). Two additional sites located on the UC Reserve that will be used as comparison and to infer long-term analysis of habitat use are Late Period (700 calBP- Historic) sites CA-SLO-71 (the White Rock Site) and SLO-115 (Prehistorics) (Joslin 2006).



Figure 1.2. CA-SLO-1622 and SLO-1677 Site Setting Looking East, 2002. (Reproduced with permission. Copyright © 2002-2010 Kenneth & Gabrielle Adelman California Coastal Records Project,www.Californiacoastline.org).


Figure 1.3. CA-SLO-1295 and CA-SLO-2563 Site Setting Looking East, 2004. (Reproduced with permission. Copyright © 2002-2010 Kenneth & Gabrielle Adelman California Coastal Records Project,www.Californiacoastline.org).

Coastal environments and resources had a strong influence on mobile foragers, providing dense and diverse habitats that were the subsistence focus for at least part of the seasonal cycle. During times of unforeseen environmental fluctuation when drought conditions would have depleted the terrestrial resource base, coastal resources—particularly due to the ease with which shellfish could be collected and the predictability of their location and collecting success— were significant economic advantages (Erlandson 1988; Glassow and Wilcoxon 1988; Yesner 1980, 1987). Along the San Simeon Reef, use of both interior and coastal resources is documented in the accounts of the first Spanish explorers (Brown 2001) as well as early ethnographic accounts (Harrington 1985; Kroeber 1925; Mason 1912, 1918; Merriam 1955). Salinan knowledge of coastal resources and place names along the San Simeon Reef was collected by Harrington during field visits between 1930 and 1932 (Figure 1.4).

## THEORETICAL ORIENTATION AND RESEARCH QUESTIONS

Understanding prehistoric hunter-fisher-gatherer adaptations is one of the most ambitious goals of archaeologists and anthropologists studying coastal California. During the last twenty-five years collecting information on spatial organization and subsistence patterns has often relied on an ecological theoretical framework, including models and theories guided by the paradigms of cultural, historical, and human behavioral ecology (e.g., Braje 2007; Erlandson 1994; Erlandson et al. 2005; Glassow et al. 2008; Glassow 1997a; Hildebrandt 1981; Jones 2003; Jones et al. 2004; Kennett 2005; Rick 2007; Whitaker 2008a). In particular, optimal foraging theory and prey choice models have been developed by archaeologist working in coastal settings, generating expectations for the use of local shellfish, fish, and sea mammal species (Braje et al. 2007; Hildebrandt and Jones 1992; Jones and Hildebrandt 1995). Although application of these models vary due to differences in local

Figure 1.4. Salinan Informants Maria Encinales (left), Maria de los Angeles Ocarpia Encinales (center) at Piedras Blancas Rock. (1930-1932, National Anthropological Archives, Smithsonian Institution [81-14089].)

resource availability and technological capabilities, the general ranking from highest to lowest includes pinnipeds and large or highly concentrated shellfish (i.e., abalone and California mussel) followed by nearshore fish, and smaller or less aggregated shellfish (Braje and Erlandson 2009:271). The current research relies on the same foundation to better understand long-term cultural development among the occupants of the southern San Simeon Reef over the Middle and Late Holocene and to add to previous studies on California hunter-gatherers in general.

Through the archaeological analysis of four sites located along the southern San Simeon Reef occupied between about 5000 and 400 years ago, I examine a variety of economic, cultural, and ecological developments. These sites were selected because they are relatively dense, well-preserved shell middens that have not been the subject of prior studies. The sites were also chosen because of their location on the Reserve and the Griswold Ranch, which allowed access for research. Due to the limited information about sites along the San Simeon Reef, my study was designed to acquire basic information to address important research questions and form the foundation for further research.

The research objectives fall under three primary categories that are directly related to understanding human-environment relationships: use and change of marine environments, the relationship of sites within settlement systems, and variations in marine fauna utilization. Within these categories, archaeological and environmental data are used to address a variety of research questions. The questions are directly related to understanding how local hunter-fisher-gatherers procured marine resources and how their coastal subsistence-settlement strategies were affected by diachronic environmental fluctuations. A more detailed discussion on the research objectives, research expectations, and the specific data required to address these questions is presented in Chapter V. The basic research questions and themes are introduced here:

- **<u>USE OF MARINE ENVIRONMENTS</u>**: Do episodes of more frequent coastal occupations appear in the archaeological record during the Middle and Late Holocene? If so, is this increase a result of population changes caused by environmental factors, such as fluctuations in marine and terrestrial productivity?
- **<u>SITES IN THE SETTLEMENT SYSTEM</u>**: Are diachronic shifts in the location of particular types of sites a result of changes in the distribution and abundance of marine resources brought about by environmental change, the changing importance of terrestrial resources, or resource intensification?
- **<u>VARIATIONS IN MARINE FAUNA UTILIZATION</u>:** Are changes in the importance of different marine resources over time a result of environmental changes, marine resource intensification brought about by the depletion of resources or population growth, or adoption/ development of new technology? If it occurred, did intensification affect the marine environment by shifting the ecological balance between competing marine taxa?

Through the integration of ethnographic literature, a synthesis of artifact, faunal, and settlement data from previous studies, and biological information, this research provides insights into the organization and types of activities that the Playano conducted while occupying the coast during their seasonal cycle. When compared with research elsewhere on the San Simeon Reef and central California Coast, and from temporal intervals not represented here, these data provide a framework for understanding long-term adaptations and changes in these cultural systems. The detailed analysis of subsistence remains, particularly marine invertebrates, provides a perspective of both dietary choices and how humans interacted with, and potentially altered, local habitats through time. Through these reconstructions of littoral foragers' subsistence and settlement, this research adds to our knowledge of the diversity and variability of coastal people along the Pacific coast of North America.

The overall organization of this dissertation is as follows. First, the environmental contexts are discussed. Following this are the ethnographic research and archaeological contexts (Chapters II-IV) to provide the backdrop for the archaeological and ecological analyses presented in the later chapters. Chapter V discusses the theoretical framework and models guiding my research. A detailed account of the methods employed during my research is presented in Chapter VI. Four site chapters (Chapters VII-X) provide the excavation results from CA-SLO-1295, SLO-1622, SLO-1677, and SLO-2563 in chronological order. Chapter XI synthesizes the results of my site excavations and surveys, then compares the results to surrounding cultural developments, and littoral biological research. In Chapter XII this information is placed within the context of the research questions, addressing changes in subsistence systems and spatial organization during the Middle and Late Holocene. Finally, concluding remarks and a discussion of future research potential are summarized in Chapter XIII.

# CHAPTER II: ENVIRONMENTAL CONTEXT

Hunter-gatherer-fisher populations are intimately connected to their natural environment, the distribution and variability of resources encouraging distinct human subsistence patterns. It is therefore crucial for archaeologists working along the California Coast to understand the environmental context of the culture observed in the archaeological record (Erlandson 1997). Dietary practices that shape subsistence and settlement strategies are closely related to the distribution, abundance, and seasonality of available resources in the surrounding landscape. Deciphering these relationships requires the use of a combination of ecological data from geological, climatic, and biological sources. Although the basic composition of the environment along the central California Coast was probably consistent for much of the Holocene, a number of significant environmental changes occurred over the last 9,000 years of human occupation, often triggering changes in subsistence strategies and social organization. The following provides a brief overview of the variation in terrestrial and marine resources that may have most influenced human foraging strategies.

The San Simeon Reef is defined by the topographically level marine terraces that extend north from Cayucos to the steep and rugged Big Sur that rises above San Carpoforo Creek. Jones and Ferneau (2002a) applied this term to characterize the relatively discrete environmental and cultural district that defines the northern coast of San Luis Obispo County. Within this region, there is an abundance and diversity of resources that were available to prehistoric populations within a relatively short distance, including fish, shellfish, and sea mammals in the rich and accessible rocky intertidal areas and sand beaches, as well as kelp forests offshore reefs, and pelagic waters. The eroded headlands composed of exposed rock outcrops and associated underwater reefs support a wide range of kelp and other seaweed species and an abundant and diverse range of fish (Figure 2.1). A productive and diverse array of plants flank the hill slopes, attracting abundant mammal populations as well as providing an array of products for human use.

The topographic context for this research is the broad south-southwest-facing coastal terrace that extends from the Pacific Ocean east to low-lying foothills. Two study sites are situated along a 250 meter-wide level portion of terrace between Point Estero and Santa Rosa Creek, south-west of the contemporary town of Cambria, and two are located on a narrow terrace south of the UC Reserve (Figure 2.2). The landform is composed of dissected bedrock benches and uplifted Pleistocene-age beach deposits cross-cut by incised drainage channels and alluvial fans. Along the southern portion of the San Simeon Reef, coastal hill slopes reach 692 feet before gently descending


Figure 2.1. Southern San Simeon Reef Rocky Intertidal Zone.

into the low-lying interior Green Valley. Farther to the east, a series of relatively low (600-1500m) northwest-southeast trending mountains, the Santa Lucias, separate the coastal terraces from the inland valleys. At the southern portion of the San Simeon Reef, Santa Rosa Creek drains the watershed to the north, while Villa Creek empties the smaller watershed to


Figure 2.2. Primary Study Sites Along the Open Coastline.

the south. North of Point Estero coastal terraces face the west, while around the point at the southern extent of the San Simeon Reef coastal, terraces are south-facing. The upper Santa Rosa Creek watershed is steep, with elevations reaching 795 m at Cypress Mountain.

## GEOLOGY

The study area is characterized by unconsolidated fill that overlies indurated sandstones, conglomerates, and argillites of the Cretaceous-age Franciscan Formation uplifted during the Late Pleistocene (Muhs et al. 2002; Weide and Susia 1968). The 'Cambria Slab' formation is a mélange of volcanics, metavolcanics, sandstone, shales, serpentines, and cherts that occur on the western flank of the Santa Lucia Range (Stokes and Garcia 2009). Surface manifestations of the formation are small numerous rock outcrops, steep slopes, and thin soils. These outcrops include materials for the manufacture of artifacts shaped by pecking and abrading, such as a discrete serpentine in exposure 3 km northeast of the study sites on a knoll above Perry Creek (Hall 1974). With respect to lithic material availability, the Franciscan Formation also provides excellent-quality green, red, orange, brown, and pink hued chert that often occurs in multiple mottled colors. This high-silica tool stone material is locally available from boulders and cobbles in drainages and along the ocean terrace. Specific to the southern San Simeon Reef, prominent and abundant sources of workable Franciscan chert are situated along the eastern slope of the coastal foothills, exposed along the Cambria Faultline contact zone above Green Valley.

A second lithic material includes the high-quality black and black-and-white-banded cherts available in the Monterey Formation along the flanks of the San Lucia Range and west of the San Andreas Fault zone (Piscoto and Garrison 1981:97). The closest facies of the formation that includes chert is mapped 16.1 km inland from the research sites, trending northwest-southeast along the Santa Lucia Range foothills (Hall 1974). Chipping (1987) also identifies small coastal outcrops of Monterey chert in the vicinity of San Simeon Point, approximately 16 km north of the research sites, and alluvially derived chert occurs as beach cobbles up to 20 cm in diameter along the shoreline in the vicinity of Point Piedras Blancas. Although the origin of the local Monterey chert is not entirely clear, cobbles may also be present in the marine terraces south of Point Piedras Blancas and therefore available from eroding Pleistocene-age deposits.

## CLIMATE

The central California Coast is characterized by a Mediterranean climate, with cool, wet winters and warm, dry summers. Due to the moderating marine influence, seasonal temperature variability is minimal, with modest monthly mean temperatures fluctuating during a normal annual cycle. Summer (15° − 18° C) and winter (11° − 13° C) daily temperatures vary around 10° C (Schoenherr 1995). Most of the annual precipitation occurs during the winter months between December and March. The annual precipitation averages 46 cm (18 in), although above-average years have reached 89 cm (35 in). During summer months, coastal fog frequently blankets the coastline and provides modest moisture to plants.

## THE TERRESTRIAL ENVIRONMENT

Modern vegetation communities along the southern San Simeon Reef are composed of Monterey pine forests, oak woodlands, coastal scrub, chaparral, and coastal prairies. Coastal prairies are one of the most distinctive vegetation types of the level coastal terrace from Cayucos north to San Carpoforo Creek. Although invasive species (e.g., Harding grass, *Phalaris aquatica*, and California oatgrass, *Avena fatua*) brought in by livestock dominate what is now grassland, restoration management on the UC Reserve is providing insights into the diversity of flowering plants and annual grasses. Within the coastal prairies, native California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), pine bluegrass (*Poa scabrella*), and several species of needlegrass (*Nasella* spp.) would have provided edible seeds. Sky lupines (*Lupinus nanus*) and other forbs and herbaceous plants such as California poppy (*Eschscholzia californica*), several species of farewell-to-spring (*Clarkia* spp.), red maids (*Calandrinia ciliata*), red owl's clover

(*Orthocarpus purpurascens*), and blue dicks (*Dichelostemma multiflorum*) are interspersed with grasses along the terrace.

One of the most distinct and significant plant resources available to local occupants is the Monterey pine (*Pinus radiata*) forest that includes an understory of coast live oak (*Quercus agrifolia*) and forbs. The Cambria stand of Monterey pines is the most southern mainland California population; the two northern stands are located on the Monterey Peninsula and at Año Nuevo, north of Santa Cruz. To the south, two small island populations survive off the coast of Baja California. Along the central California Coast, the maximum known extent of the Monterey pine is differentially distributed from the San Simeon area to approximately 3.8 km south of Cambria along the coastline and coastal foothills (Raymond and Jensen 1930).

Ethnographically, Monterey pines were valued for both materials (firewood, resin, fibers, and needles) and food (pine nuts). Pedro Fages described the Ohlone of the Monterey area using a variety of pine nuts including Monterey pine: "The method of gathering them is to build a fire at the foot of the tree, which in a few hours falls, making the fruit available without difficulty" (Fages 1937:68-69). Of particular interest, the closed cones of the species may have resulted in a natural means of storage, as they remain on the tree and can be harvested throughout the year.

Present-day live oak stands are situated among the pines, in interior valleys, and along drainages across the ocean terrace. Oak forests are both more expansive and contain twice as many species in the interior valleys to the east, with only three species on the coast (Pavlik et al. 1991). This important resource would have provided food, raw materials for manufacturing utilitarian items, as well as firewood. Although heavily impacted by historical overgrazing by livestock, it is presumed that the current distribution of oaks is at least what existed in ancient times.

Other important habitats for useful flora include localized coastal sage scrub along the terrace edge, riparian vegetation at drainages, and chaparral at higher elevations on thin bedrock soils (Figure 2.3). Seed bearing species along the coastal bluff are California sagebrush (*Artemisia californica*), yarrow (*Achillea millefolium*), coyote brush (*Baccharis pilularis*), bush lupine (*Lupinus arboreus*), and dune lupine (*Lupinus chamissonis)* . Although devastated by historic cattle grazing, riparian vegetation along drainages and surrounding seeps and springs provides species once available to prehistoric inhabitants: willows (*Salix* spp.), alders (*Alnus* spp.), blue-eyed grass (*Sisyrinchium bellum*), wild blackberry (*Rubus ursinus*), juncus (*Juncus occidentalis*), tules (*Scirpus californicus*), and sedge (*Carex tumulicola*). Edible seeds along the steeper ridges and slopes include California sagebrush, black sage (*Salvia mellifera*), coyote brush, and buckwheat (*Eriogonum fasciculatum*).


Figure 2.3. Chaparral Habitat on Ridges Above the Marine Terrace.

The diverse flora and fresh water provided habitats for terrestrial fauna. Key subsistence resources common in forested, brushy, and grassland regions along the San Simeon Reef include mule deer (*Odocoileus hemionus*), blacktail jackrabbit (*Lepus californicus*), and bush rabbit (*Sylvilagus* spp.). The region probably also supported herds of tule elk (*Cervus elaphus nannodes*) and pronghorn (*Antilocapra americana*). Numerous members of the reptile family including the western rattlesnake (*Crotalus viridis*), gopher snake (*Pituophis caternifer*), garter snake (*Thamnophis hammondii*), western fence lizard (*Sceloporus occidentalis*), and coast horned lizard (*Phrynosoma coronatum*) occur in a variety of local environments. Western pond turtle (*Clemmys marmorata*) is common along drainages. A diversity of residential and migratory avifauna also would have been available, including several hawk species, a variety of songbirds, California quail (*Callipepla californica*), several owls, and migratory waterfowl (e.g., ducks, coots, and loons).

Freshwater streams originating from the Santa Lucia Range are primarily seasonal; however, large watersheds at relatively regular intervals contain year-round water sources. Indicative of the importance of fresh water in determining human settlement, all major stream outlets along the north coast show a pattern of well-developed prehistoric occupation. Seeps and springs are also located along the marine terrace at the heads of canyons. Although occupants from the study sites could rely on adjacent perennial streams and springs, the expansive Santa Rosa Creek (located 2.4 km north) and its tributaries would have provided a relatively stable water supply. East of the coastal terrace in sheltered pericoastal valleys, vernal pools and wetlands would have provided fresh water and rich plant and animal resources on a seasonal basis. One of the largest and most productive wetlands is located in Green Valley, 3.2 km east of the research sites.

### THE MARINE ENVIRONMENT

The marine environments of the San Simeon Reef are exceptionally productive, with an abundance of rocky intertidal, nearshore sandy bottoms, kelp beds, and pelagic waters. The distribution and abundance of specific marine resource patches varies according to geologic composition, slope and orientation of substrates, temperature (when exposed by shifting tides), salinity, and intensity of wave action (Ricketts et al. 1985:450). Expansive sand beaches are found at the southern limits of Big Sur at San Carpoforo Creek, at Point Piedras Blancas, in central San Simeon Reef at San Simeon Creek, and south of Estero Point in Cayucos. The exposed surf-swept rocky shores and headlands, however, are the most abundant coastal habitat in this region. Upwelling and the southward-flowing nutrient-rich waters of the California Current support dense and diverse communities of marine mammals, fish shorebirds, and shellfish. Concentrations of nutrients are brought to the surface, supporting communities of phytoplankton, zooplankton, and fish and shellfish larvae. This nutrient-rich cold water supports an extensive and extremely productive ecosystem and rich offshore giant kelp (*Macrocystis pyrifera*) and bull kelp (*Nerecystis luetkeana*) forests.

Prehistoric inhabitants had access to abundant rocky intertidal habitats and isolated pockets of sandy beaches. Research on north coast shell middens demonstrates that invertebrates from the rocky intertidal are the dominant species in middens across the Holocene, suggesting relative continuity in these environments for the 9,000 year occupation along the coastline (Joslin 2006; J. Rudolph 1985; T. Rudolph 1983a). The same species present in middens through time can still be found in the intertidal today (Appendix A: Table A1). Shellfish in the middle to high rocky intertidal zone include barnacle (*Balanus* spp.), black turban snail (*Tegula funebralis*), black abalone (*Haliotis cracherodii),* California mussel (*Mytilus californianus*), chiton (*Cryptochiton stelleri* and *Mopalia muscosa)* and a variety of limpets (*Acmaea* spp., *Collisella* spp., *Lottia* spp.). Subtidal species include red abalone (*Haliotis rufescens*) and red turban (*Lithopoma (*formerly *Astraea) gibberosa*). Shallow rock outcrops and tide pools support sea urchin (*Strongylocentrotus purpuratus*), ochre starfish (*Pisaster ochraceus*), hermit crab (*Pagurus hirsutiusculus*), red-spotted rock crab (*Cancer antennarius*), and sand crab (*Emerita analoga*). The small purple olive snail (*Olivella biplicata*) occupies the low-tide water line as well as sandy-bottomed areas. Shellfish harvested from sandy beaches include cockles (*Clinocardium nuttalli*) and the Pacific littleneck clam (*Protothaca staminea*).

Fishery habitats include open-ocean, kelp beds, sandy bottom, and rocky intertidal. Prehistoric populations took advantage of fish in these diverse environments throughout the Holocene, but well over half of the remains at sites consistently represent fish procured from the waters above the rocky reefs and nearshore kelp forests (Gobalet and Jones 1995). Along the north coast, fish that are particularly abundant in all archaeological sites are a diverse array of rockfish (*Sebastes* spp.), pricklebacks (*Stichaeidae* spp.), kelp greenlings (*Hexagrammus* spp.), rock or black prickleback (*Xiphister* spp.), cabezon (*Scorpaenichthys marmoratus)*, and sculpins (*Cottidae* spp.) from waters near the rocky intertidal zone. Surfperch (*Embiotica* spp.) inhabit sandy bottom locations and were acquired from the shoreline. The rich and extensive kelp bed environments support giant kelpfish *(Heterostichus rostatus*), señorita *(Oxyjulis californica)*, and offshore Pacific hake (*Merluccius productus)*, all of which were are identified in study sites. Inshore/offshore migratory species such as Pacific herring (family Clupeidae), Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax)*, and silversides (family Atherinidae) are most abundant from September to December; however, they are locally present throughout the year. Freshwater sources at large local watersheds such as Arroyo de la Cruz, San Carpoforo Creek, Pico Creek, Little Pico Creek, San Simeon Creek, and Santa Rosa Creek support rainbow trout and steelhead (*Oncorhynchus mykiss irideus*).

Marine mammals would have been targeted when available and accessible, providing perhaps the largest meat, protein, and fat packages. Sea mammals along the central California Coast include a diversity of dolphin species and pinnipeds. Migratory pinnipeds frequenting the open coast include the northern elephant seal (*Mirounga angustirostris*), a species hypothesized to be more common in early prehistory and recently rebounding; California sea lion (*Zalophus californianus*); northern fur seal

(*Callorhinus ursinus*); and Steller sea lion (*Eumetopias jubata*) (Hildebrandt and Jones 1992, 2002; Jones and Hildebrandt 1995). Two non-migratory species include the harbor seal (*Phoca vitulina*) and the sea otter (*Enhydra lutris*), which genreally reside in the extensive kelp beds that line the rockier stretches of coastline. Resident dolphin populations include common (*Delphinus delphis*), Pacific white-sided (*Lagenorhynus obliquidens*), bottlenose (*Tursiops truncata*), and Risso's dolphin (*Grampus griseus*). When occupying favorite terrestrial haul-outs and breeding locations, seals and sea lions are abundant, visible and largely immobile; when at sea they would be difficult to hunt and retrieve when encountered.

## ENVIRONMENTAL FLUCTUATIONS THOUGH THE HOLOCENE

Archaeologists studying coastal California have recognized the importance of climate change and its potential for shaping prehistoric adaptations (Arnold 2001; Glassow et al. 1988; Kennett 2005; Jones and Kennett 1999; Jones et al. 1999). This interest, as Kennett et al. (2006:351) noted, stems from observation that coastal and terrestrial environments are highly sensitive to climate change and that such climate instability can partially be responsible for triggering cultural development.

Spatial and temporal variation in precipitation and sea and land temperatures influences the distribution and abundance of natural resources. This variation occurs on three general scales of duration and intensity. Briefly summarized below, records of fluctuation in sea-surface temperature and marine productivity help differentiate the effects of natural environment change from those potentially caused by humans.

First, and most predictable, is annual sea temperature, which vary from the coldest between April and June, to the warmest in September and October (mean of 13.14 °C) (Jones and Kennett 1999). Expanding on earlier research, Jones et al. (2008a) and Kennett (2003) have found that modern sea-surface temperatures range between 9.32 and 14.4 °C and reflect four seasonal periods (Table 2.1). Based on oxygen isotopic measurements from archaeological samples, average sea-surface temperature appears to vary though time. These results suggest that between 2000 and 700 calBP sea surface water temperatures were ~1 °C cooler than present and fairly stable; between 700 and 500 calBP there was greater seasonal variation, with extremes above and below historic levels; and between 500 and 300 calBP, when temperature was 2—3 °C cooler than today (Jones and Kennett 1999). These seasonal fluctuations result in variation in the distribution and

Table 2.1. Central California Modern Sea-Surface Temperature Profile.

| Season: Month | Temperature | Water Trend |
|---|---|---|
| Spring: March-June | ≤11.10°C | Coldest |
| Early summer: June-July | 11.11−12.30°C | Temperatures increasing |
| Late summer/early Fall: August-October | >12.30 °C | Warmest |
| Winter: November-February | 11.11−12.30°C | Decreasing |

Note: Table adapted from data in Jones et al. (2008a:2291).

abundance of marine species. Although minor in scale, this variation affects a complex combination of physical, chemical, and biological factors, including seasonal fluctuation in plankton biomass and fluctuation in kelp canopy species composition (Foster and Schiel 1985).

New marine climate sequences demonstrate the climatic instability exhibited in distinctive cold- and warm-water sea surface temperature cycles in the Santa Barbara Channel (Kennett 2005; Kennett and Kennett 2000). Kennett (2005:65) identifies nine millennial-scale sea surface temperature cycles during the Holocene. These include cold-water intervals between 9600 and 8200 calBP; 6300 and 5900 calBP; 3800 and 2900 calBP; and 1500 and 500 calBP. Warm-water intervals developed between 11,000 and 9600 calBP; 8200 and 6300 calBP; 5900 and 3800 calBP; 2900 and 1500 calBP.

Less foreseeable and with greater impact on populations is the variability in marine and terrestrial temperature related to El Niño-Southern Oscillation (ENSO) events. The events, which have occurred every seven to 19 years, are accompanied by swings in inter-annual fluctuation in tropical sea level pressure between the eastern and western hemispheres (Kennett 2005; Masters 2006). The ENSO events have widespread effects on California coastal habitats by elevating sea surface temperature over a period of one to three years due to the intrusion of warmer waters and suppression of the thermocline (Philnader 1990). The result is reduced upwelling, coinciding with a decrease in resident marine populations. Increases in sea temperature alter or destroy productive kelp beds, disrupting a wide range of species dependent upon this specific environmental niche (Colten 1992; Dayton and Tegner 1990). Based on Big Sur and Monterey historic rainfall and sea temperature records, Jones (2003:20) identified a positive correlation between precipitation and sea temperature and a strong relationship between ENSO events and rainfall amounts. The relationship between rainfall, sea-surface temperatures, and upwelling has significant implications for mobile hunter-gatherer-fishers who depend on both terrestrial and marine habitats. El Niño events, as a result of high rainfall, would change the productivity of terrestrial resources and could potentially offset the decline in marine environments (Jones 2003:20).

On a larger scale, several lines of evidence indicate that marine and terrestrial environments have changed over the course of the region's 9,000-year span of human occupation. Fluctuation in the region's climate and concomitant effects of Holocene sea level rise had significant effects on prehistoric populations. However, an understanding of the intensity and timing of these changes continues to evolve. Available data on climate change derived from pollen, oxygen isotopes, and radiolaria (marine protozoa) derived from sediment cores, provide a picture of regional climatic trends (e.g., Antevs 1955; Pisias 1978; Stine 1994; West 1968). Recent paleoenvironmental data from the central coast and Big Sur Coast provide significant new insights (Jones and Kennett 1999; Kennett 2003).

The terminal Pleistocene and Early Holocene are marked by rapid environmental change. Regional information indicates that the cool and wet climate of the late Pleistocene continued through the Pleistocene-Holocene transition (11,000-10,000 calBP), with a relatively abrupt change to warmer, drier conditions by approximately 8000 calBP (Erlandson 1994:31; Glassow et al. 1988). During the Early Holocene, rising sea levels flooded many coastal lowlands and canyons, forming estuarine embayments along portions of the California coastline (Erlandson 1994; Inman 1983:8-9). These large estuaries were centers of early human settlement, including Morro Bay and Halcyon Bay on the central coast, where coastal fisher-foragers procured a wide range of estuarine, marine, and terrestrial resources.

Sea level rise slowed dramatically during the Middle Holocene (7700 to 3500 calBP), but many coastal habitats remained in a state of constant flux. Sea level reconstructions for the California coast suggest rapid inundation of the coastline until 7000 calBP, with levels stabilizing between 6000 and 5000 years ago (Inman 1983; Kennett 2005). As a result, sediments began to fill many coastal bays and lagoons, reducing their size. Many were periodically cut off from the oceanic circulation or disappeared entirely (Erlandson 1997;

Masters 2006). Along the open coastline, coastal terraces continued to be lost to shoreline transgression caused by often rapid coastal erosion.

Terrestrial climatic conditions across western North American fluctuated during the Holocene. Antevs (1955) argues that the Middle Holocene (7000 – 4500 calBP) was warm and dry, an interval called the Altithermal or climatic optimum. Preceding and following the Altithermal is the Anathermal (10,000 – 7000 calBP) and Medithermal (4500 years ago to present), interval consisting of generally cool and wet conditions. Kennett (2005:70), however, poses that dry Altithermal conditions may have had less of an impact on coastal California environments, suggesting possible cyclical fluctuations in rainfall.

Climatic variability of the Late Holocene has been exceptionally high, and also appears to be one of the coldest, most unstable marine climatic intervals of the last 10,000 years (Kennett 2005; Kennett and Kennett 2000). The climatic instability of the last 3000 years indicates episodes of marine cooling that may coincide with cool and dry terrestrial conditions. Two pervasive intervals of drought punctuated the last 1500 years of prehistory. The first occurred between about 1100 and 900 calBP and the second between 800 and 650 calBP (Stine 1994). These periods of reduced rainfall, referred to collectively as the Medieval Climatic Anomaly, resulted in a decreased marine resource productivity across California (Raab and Larson 1997) and disrupted human populations along the central California coastline (Jones et al. 1999). Following the Medieval Climatic Anomaly, after about 600 years ago, the contemporary Mediterranean climate weather pattern emerged.

Coastal erosion, resulting in the systematic loss of sites, is an important consequence of Holocene sea-level rise. Recent research within the northern section of the San Simeon Reef and the Big Sur Coast indicates the average rate of coastal erosion is 18 ± 6 cm per year, or 180 m per 1000 years (Hapke and Green 2004). However, erosion of the paleo-sea cliff may not equate to 1,800 m of coast over the past 10,000 years, as wave-induced erosion did not start until the sea reached its former shoreline between 7000 and 6000 years ago (LaJoie and Mathieson 1985:143). According to Meyer (2007:9), while erosion may have destroyed as much as 1,260 meters of the coastal terrace over the past 7000 years, it appears that the paleo-coast was located less than 1,000 m west of its present position based on recent data (i.e., Hapke and Green 2004). This places the rocky intertidal zone at least 500 m farther west than it is today, demonstrating the large-scale effects of erosion on the sites located along, or once located along, the coastal terrace.

### SUMMARY

Understanding temporal and seasonal fluctuations in the distribution and relative abundance of terrestrial and marine resources is crucial to the analysis of prehistoric settlement organization and subsistence practices.

During the last 9000 years people responded to numerous climatic changes and landscape evolution on a variety of scales. Whereas long-term and low-intensity climatic changes would have allowed for gradual adaptive responses, short-term and sporadic fluctuations in rainfall and sea temperature brought on by El Niño events and the Medieval Climatic Anomaly would have been more disruptive by quickly affecting the composition and abundance of the local resource base. Although the complex mosaic of land and marine habitats along the San Simeon Reef may have ameliorated the impact of these climatic events, extended droughts and declines in marine habitats would have invoked shifts in land and resource use.

## CHAPTER III: ETHNOGRAPHIC BACKGROUND

Observations of Native California documented by early ethnographers are a valuable source of information about prehistoric hunting and gathering behavior that can lead to explanations of the patterns we observe in archaeological data (e.g., Jones and Rivers 1993; Jones et al. 2000). Information gathered by Harrington (1942, 1985), Kroeber (1925), Merriam (1955), and Mason (1912, 1918), when used in combination with accounts from early Spanish expeditions (Boneau Companys 1983; Brown 2001) and mission registry research (Gibson 1983; Milliken and Johnson 2005), provides important clues about subsistence, settlement, and population density, as well as the timing of terrestrial and marine resource procurement.

At the time of Spanish contact, speakers of the putative Playano language occupied the lands within the study area at the boundary of two known ethnographic groups, the Salinan to the north and the Obispeño or Northern Chumash to the south (Figure 3.1; Milliken and Johnson 2005). The language is referred to as a secondary dialect, "…which those [who] speak [it] are called 'beach people,' Playanos, on account of having come from the bays and oceans" (Mason 1918:105). Diaries of the first Spanish explorers indicate that native people along the San Simeon Reef lived a mobile lifestyle and

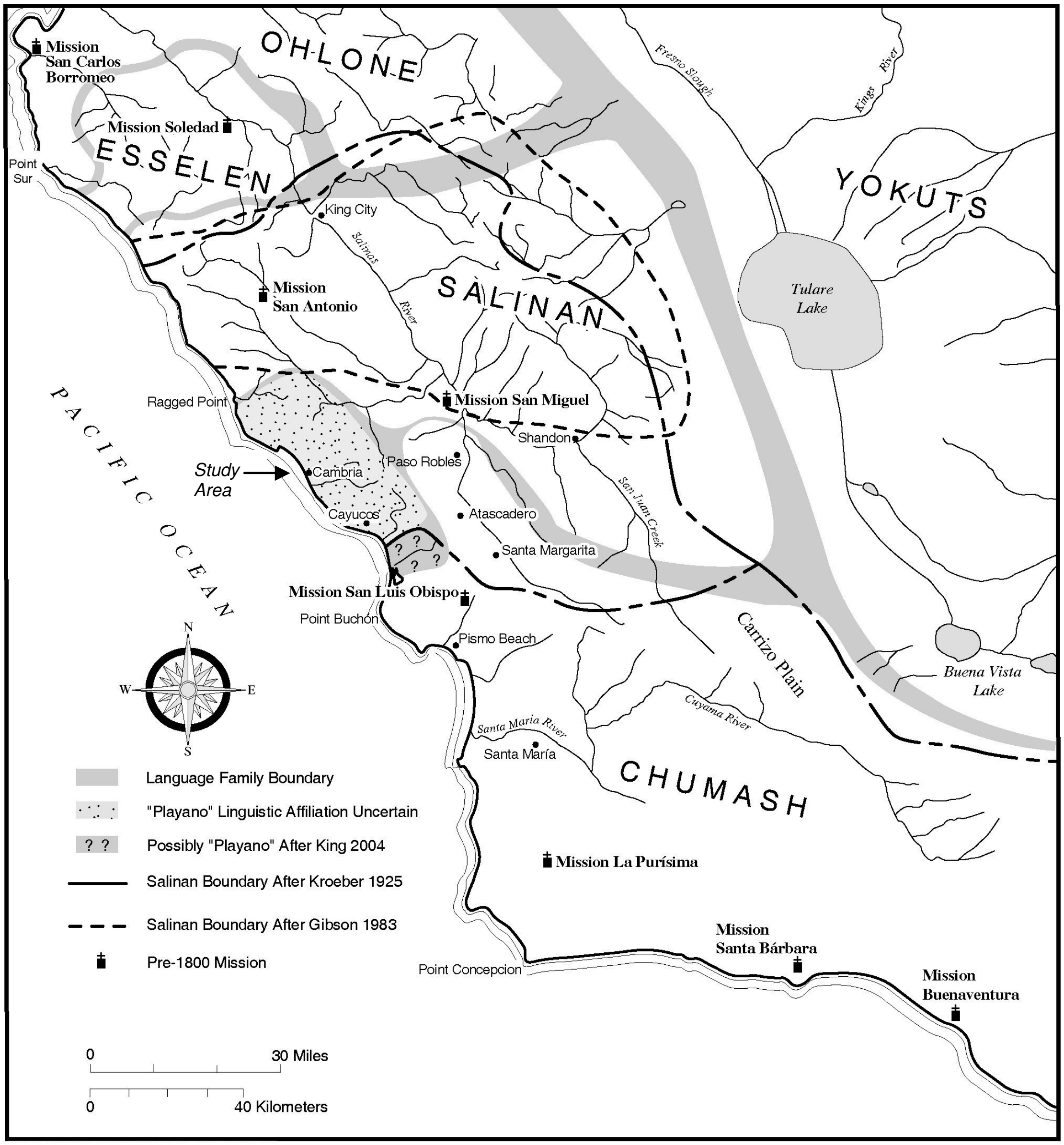


Figure 3.1. Ethnographic Language Areas Along the Central California Coast (adapted from Milliken and Johnson 2005: Figure 13).

appeared to have a more dispersed settlement pattern compared to the Chumash of Santa Barbara Channel. These early explorers and Franciscan missionaries were impressed by the southern Chumash and devoted considerable effort to documenting their elaborate material and social culture. The San Simeon Reef, perhaps due to more rugged topography or smaller, less sedentary population, was not a focus of these explorers' attention, and after 1772 Spanish travelers bypassed the area, preferring inland routes. The people of this region were moved to the missions between 1771 and 1806, predominantly northward to Mission San Antonio (Milliken 2002).

### THE PLAYANO LANGUAGE CONUNDRUM

The priests at Mission San Antonio noticed a distinction between the predominantly Salinan language at the mission and a distinct language spoken by the people arriving from the coast, a language that few spoke. Based on the 1812 Spanish *Interrogatorio*, Mason (1912) argued that the coastal language was a divergent dialect of Salinan, which Kroeber (1925:546) endorsed, and he included the entire coast west of Mission San Antonio and San Miguel as Playano territory (Figure 3.1). He stated, "Along the steep harborless coast one dialect or division of the language, the extinct 'Playano' or 'beach' idiom, was spoken; in the mountains and valleys the second or 'principal' [language was spoken]" (Kroeber 1925:546). Kroeber's Northern Chumash and Salinan boundaries were the vicinity of contemporary

Cayucos, and following this model the current research area would have been populated by Salinan-speakers, and the people at Morro Rock would have been Northern Chumash-speakers. Although Harrington recorded conflicting testimonies from his Salinan and Northern Chumash respondents regarding the original language spoken along the San Luis Obispo Coast north of Morro Bay, both statements and placenames suggest a language break somewhere between San Simeon Creek and Cambria (Milliken and Johnson 2005:133).

The linguistic origin of the ethnographic Playano language of the coast is ambiguous. In his early research, Gibson (1983) assigned the region to Northern Chumash territory. Recent investigations have expanded on this early work, which entailed re-evaluating linguistic clues derived from Spanish-period reports and assimilating information from mission San Antonio, San Miguel, and San Luis Obispo registers to reconstruct rancheria locations (Milliken and Johnson 2005). Based on detailed examination, evidence suggests that Salinan was the coastal language to the north of the study area, in Big Sur (Lopez Point and Willow Creek regions), while Northern Chumash was spoken in the San Luis Obispo and Morro Bay regions. The Playano language spoken in the Estero Point and Piedras Blancas regions; however, continues to be in question. Playano speakers were either a divergent form of Salinan, a variant of Northern Chumash, or an independent language (Milliken and Johnson 2005:144).

### San Simeon Reef Rancheria Locations and Population Density

Within the study area population size and land-use varied considerably through time, and it is difficult to estimate how many people lived in the region prior to contact and before the devastating effects of introduced diseases**.** However, important details on residential locations, or rancherías, and population estimates from the baptismal records (Milliken and Johnson 2005). The term rancherías is used by missionaries to describe two different levels of settlement and social identity among Native California communities. The first level includes specific villages or political groups occupying multiple fixed villages, and the second is a community of people who occupied more than one permanent village or moved seasonally among a number of temporary encampments.

Rancherías along the San Simeon Reef were assigned to two regions, Piedras Blancas and Estero Point (Table 3.1, Figure 3.2; Milliken and Johnson 2005:92-98). The northern of these two regions, Piedras Blancas, spans from Arroyo de los Chinos Creek in the north to San Simeon and Santa Rosa creeks in the south. The Estero Point region includes the current study area, from Santa Rosa Creek in the vicinity of Cambria southward to the Old Creek watershed southeast of Cayucos.


Figure 3.2. Rancheria Locations Along the North Coast of San Luis Obispo.

Table 3.1. Ranchería and Placenames along the San Simeon Reef.

| Region | Proposed Location |
|---|---|
| Piedras Blancas Rancherías | |
| *Chitama* | Coastal: San Carpoforo Creek |
| *Chaal* | Coastal: Piedras Blancas Point or Arroyo de la Cruz |
| *Esmerileua* | Coastal: San Simeon |
| *Tay* | Coastal: Pico or San Simeon Creek |
| *Cazz* | Inland: Nacimiento River |
| *Chapeuex* | Inland: Near Bryson |
| Estero Point Rancherías | |
| *Tsetacol* | Coastal: Cambria area or region |
| *Setjala* | Coastal: Cayucos Creek (?) |
| Estero Point Placenames | |
| *Stjahuayo* | Coastal: Cambria area |
| *Zassalet* | Coastal: Cambria area |
| *El Pinal* | Coastal: Cambria area |

Note: Information based on Milliken and Johnson (2005:92-98).

The Piedras Blancas region includes four coastal rancherías and two inland villages (Milliken and Johnson 2005:92-95). Coastal rancherías include *Chitama*, located at or just south of San Carpoforo Creek, which the author identified as the southern edge of the multi-village district *Lamaca*. *Chaal*, the earliest ranchería in the region to send numerous people to a mission, is suggested to have been a village or a multi-village district on the open flat at Piedras Blancas Point or in the valley of Arroyo de la Cruz. The coastal location *Esmerileua* is speculated to be a village at or just inland of the present-day town of San Simeon. *Tay*, the fourth ranchería assigned to the Piedras Blancas area, is most likely a village located on Pico Creek or San Simeon Creek, at the southern end of the Piedras Blancas region.

Although identifying eight specific placenames that pertain to the Estero Point region, Milliken and Johnson (2005) found it impossible to specify ranchería locations.  These placenames include: *Steloglamo*, *Zassalet, Stjahuayo, El Pinal, Zizayho Zixja*, *Escon, Tsetacol*, and *Setjala*. The authors propose that *Stjahuayo, Zassalet*, and *El Pinal* all refer to the Cambria area. *Tsetacol* may be the village at 'The Pine Grove' near Cambria, or alternatively, it may encompass a larger area comprised of all small groups in and near Santa Rosa Creek and eastward over the Santa Lucía Range crest in the Las Tablas Creek watershed (Milliken and Johnson 2005:98).

Based on mission records and environmental considerations, Milliken and Johnson (2005:76-77) reconstructed a pre-mission population size for the study area and adjacent areas (Table 3.2).  The regions are approximately 16 miles in diameter, the size of most multi-village tribelet territories that Milliken (1987, 1990) identified in the Mission San Carlos and Mission San Juan Bautista areas.  The authors calculated the baptized population at San

Table 3.2. Estimated Populations for Regions Within and Adjacent to the Study Area.

| Region | Relationship to the Study Area | Expected Pre-Mission Population[a] |
|---|---|---|
| Estero Point | Within | 280 |
| Morro Bay | South | 280 |
| Nacimiento | Immediately East | 310 |
| Paso Robles | Immediately East | 280 |
| Piedras Blancas | Within | 300 |
| Willow Creek | Immediately North | 280 |

Note: [a]Milliken and Johnson 2005:77, Table 10.

Antonio, San Miguel, and San Luis Obispo missions and accounted for the pre-mission population reduction by disease based on a multiple (1.5%) proposed by Cook (1976) and Brown (1967). After arriving at a hypothesized pre-mission population of 5,840 people, the authors divided the total number of individuals among the 27 regions, and intuitively weighted each region as having a higher or lower population on the basis of rainfall, permanent running streams, and productive environments.

Milliken and Johnson (2005) identified 117 baptized adults from the Piedras Blancas region and 132 baptized adults from the Estero Point region. The authors suggest this represents a pre-mission regional population of about 300 people. This indicates a regional population distribution of only 1.5 persons per square mile, which is low relative to most estimates for the South Coast Ranges, and very low compared with the heavily populated Santa Barbara Channel. Ethnographic population density for the San Francisco Bay Shore is 5.5 persons per square mile (Milliken 1991: 34-36), and between 8.0 and 10.0 persons per square mile along the Santa Barbara Channel between Malibu and Point Arguello (Brown 1967:79; Cook 1976).

### SUBSISTENCE

Ethnohistorical populations along the northern San Luis Obispo Coast practiced a hunting-gathering-fishing economy similar to most areas of precontact coastal California, where groups occupied a wide range of microenvironments and employed a diverse array of material culture to acquire resources. The maritime orientation of Playanos appears to be less pronounced than groups south of Point Conception probably due to the higher wave energy. The Chumash plank canoe evidently was not used by the Northern Chumash. Instead, nearshore forays entailed use of dugouts and balsa rafts (Greenwood 1978).

Early Spanish explorers documented a considerable array of foods available to the local population. Seasonal plant foods include three kinds of acorns; islay [or cherry] used for both fruit and seed; madrone berries; pine nuts; seeds of the chia sage; grass seeds (Fages 1937: 59-60); manzanita, toyon, and laurel berries; and wild potatoes (Harrington 1985:R1.84, Frames 0155, 0156, 0162, 0231). Fages (1937:60) also lists a range of animals hunted with bow and arrow and traps, such as deer, antelope, wild sheep, hares, conies [probably rabbits], and squirrels. Fish would have been available from riverine environments, and fish and shellfish from estuarine and ocean environments. Fages, in describing the lifestyle of the coastal people "…at the mission of San Luis Obispo and of a radius of about twelve leagues around it," (e.g., the population south of San Simeon Creek) provided the following account:

> Among the sea fish there are many sea bream, crabs, whitefish, *curbina* [white seabass], sardines of three kinds, *cochinillo* [possibly croaker], and tunny; in the streams and rivers there are trout, spinebacks, *machuros* [an Indian name], and turtles. The fishing canoes [tule balsas] are finely described in the public accounts published in October of the year 1770. The tridents they used are of bone; the barb is well shaped and well adapted to its use. The fishhooks are made of pieces of shell fashioned with great skill and art….For catching sardines, they used large baskets, into which they throw bait which these fish like, which is ground-up leaves of cactus, so that they come in great numbers; the Indians then make their cast and catch great numbers of the sardines [Wagner 1929:15-16].

The division of labor for collecting and gathering these resources is generally expected to have followed general worldwide patterns of gender-specific tasks, in which women gathered, processed, and manufactured basketry and nets, and flake and bone tools, while men predominantly fished, hunted and manufactured associated procurement tools (Kroeber and Barrett 1960). The relative participation of men and women in various tasks associated with subsistence undoubtedly varied over the short term (e.g., in response to seasonal resource fluctuations) as well as over the long prehistory prior to contact. All social group members, including children, probably collected shellfish and small intertidal fish, to varying degrees of dietary importance (Bird and Bird 2000). Fishing is also an activity that, although primarily ascribed to men, also may have been accomplished by women, children, and elderly members of the groups. Nearshore netting and polepoking presumably would be the focus of less mobile groups more tethered to land and a residential base (Jochim 1988), while male groups would have fished in the open sea locations.

## SETTLEMENT PATTERNS

Spanish explorers' descriptions of their encounters with Native people along the coast, including the number of individuals, occupied or abandoned villages and locations, and the activities in which people were engaged, provide key details about pre-contact settlement systems (Jones 2003:30-33; Jones et al. 2008a:2287-2289; Milliken and Johnson 2005). In particular, important clues are found in the diaries of members of Gaspar de Portolá's expedition, including Juan Crespi, Miguel Costansó, and Pedro Fages, who were the first Europeans known to make contact with Native people in the study area. The expedition traveled north through the study area in September 1769, returned south in December of 1769, and then repeated their journey back again in May of 1770 (Boneau Companys 1983; Brown 2001).

The first relevant reference to the study area is in Costansó's diary of the 1769 Portolá expedition. As the expedition traveled along the coast, diarists documented a campsite in the hills overlooking Santa Rosa Creek, near present day Cambria, called *Los Ositos*: "some mountain Indians coming down to visit us brought a cub…and offered it to us. They must have amounted to sixty men" (Costansó in Boneu Companys 1983:208). As they continued north, the Portolá party traversed Arroyo de la Laguna and Arroyo de la Cruz and then turned up the coast to the mouth of San Carpoforo Creek without mention of local people. Once they reached San Carpoforo Creek "six heathens from a nearby village visited us" and traded "…gifts of pinole in baskets, and some fresh fish…" for beads (Crespí in Hoover and Costello 1985). As the expedition entered the Santa Lucia Range, they encountered a group of 60-80 people camping on the north fork of San Carpoforo Creek approximately three miles from the coast "without house or hearth" (Costansó in Boneu Companys 1983:212). As they crossed the crest of the range, the expedition encountered inhabitants collecting pine nuts (Costansó in Boneu Companys 1983: 212). Upon their return trip in December, most of the previously occupied fall upland locations observed by the Spanish were abandoned.

When the Portolá expedition arrived back at the coast in December, they continued to encounter native people both at the previous village locations as well as at new ones. At San Carpoforo Creek, the people seen on the fall trip north were still in the area. From the mouth of the creek, the explorers followed a new route south that followed the coast of the Piedras Blancas. They found a village at the mouth of either Arroyo de la Cruz, three miles north of Piedras Blancas Point, or at Arroyo de los Chinos. The people here had received notice from the "mountain people" of the expedition's journey (Costansó in Boneu Companys 1983:275). The expedition visited a second "small-sized village" at Arroyo del Laurel near Point San Simeon or farther south at Little Pico Creek (Costansó in Boneu Companys 1983:276; Milliken 2002:10); this village had not been encountered previously. Continuing south, Portolá returned to *Los Ositos* and at the location where 60 "mountain Indians" had previously been, "over two hundred heathens of both sexes came by, many of them bringing baskets of gruel and some fish" (Costansó in Boneu Companys 1983:276-277). Milliken and Johnson (2005:10, 96-97) suggest that this account may indicate the presence of a large permanent settlement in the Cambria vicinity, referred to in mission registers as either *Stjahuayo* or *Tsetacol*.

On the second Portolá journey north in May 1770, two accounts regarding the local groups are particularly enlightening. The first is that the San Carpoforo location was abandoned, a stopover where the expedition had camped with local people the previous September and December. Crespí (in Gibson 1983:202) states, "We saw no one around, probably because they were out gathering seeds." The party continued north over the crest of the Santa Lucia Range into the Jolon vicinity. While in the San Antonio Valley, Crespí wrote "the *Playanos* gentiles of the previous journey having learned of our arrival had come from their ranchería of the *Playanos* of the sierra to join us at the beautiful canyon site of *Robles de las Llagas de Nuestro Padre* (Crespí in

Gibson 1983:204-205)." Milliken (2002:10) suggests the "*playanos de la sierra*", that is, "beach people of the mountains," are the group encountered in September and December of 1769 in San Carpoforo Creek, proposing that the people who used coastal habitation sites also used the upland interior landscape.

A detailed analysis of ethnohistoric information collected by the 1767-1770 Portolá expeditions on the distribution of Native populations shows clear patterns, notably a year-round presence on the coast by at least small groups (Jones et al. 2008ac:2289). First, the authors found that Native people were living on the coast during fall, winter, and spring. Second, populations appeared to aggregate in the interior during late summer/fall, when people were observed collecting pine nuts. However, at that same time coastal groups were still fishing and collecting shellfish. In the interior, although villages were observed during all seasons, records of Native people are much less common in the spring and winter. Finally, and as the accounts suggest, abandoned villages were noted on both the coast and in the interior, indicating both groups were mobile, at least at times.

### SOCIAL AND POLITICAL ORGANIZATION

Accounts of the way people within a region interacted offer information on distinct population aggregations and recognized political groups. The complexities of defining the affiliation of the Playano people have made it difficult to determine their social and political organization. Kroeber (1955) defined two primary socio-political organizations in central California: maximal patrilineages and tribelets. In rich environments, such as the Santa Barbara Channel, Kroeber (1955:308) proposed a third type: multiple lineages incorporated into permanent villages. Conversely, Kroeber (1955:311) stated that the type of land ownership and social organization of Salinan speakers was either of the lineage or tribelet type, although no definitive determination could be made. Harrington (1942) provides additional clues to the central coast social and political framework. Summarizing the cultural traits of Costanoan, Salinan, and Chumash speakers, he suggested that these groups were organized into patrilocal lineages, with multiple lineages aggregated into the largest political group, tribelets (1942:32). Harrington (1942:32) suggested that many villages contained a single lineage, although multiple-lineages also existed.

Recent information suggests that although the Playano may have had affiliations with Chumash or Salinan, they were not a united political group at the time of Spanish contact (Milliken and Johnson 2005:4). Similar to the Chumash groups in the vicinity of San Luis Obispo, the Playano lived as independent village communities, each with an empowered leader, a person whose primary role seems to have been to redistribute wealth, settle internal disputes, and lead the group in forays (Fages 1937: 47-48). Milliken (2002:13) noted that, “Since the mission registers do not associate any of the Piedras Blancas region rancherias with a regional “district” name, it is suggested that each village (or traveling, cohesive community) was an independent political entity.” This contradicts Fages (1937:73) observations people living near Mission San Antonio, who were organized as multi-village groups, united under a single captain delegated to distribute wealth over a larger area.

Milliken and Johnson (2005:144) found evidence that all small rancherias in the study area participated in marriage alliances with neighboring groups, particularly those to the north. Individual villages along the coastline (Figure 3.2) were found to have numerous marriage ties with the *Lamaca* district that stretched from Ragged Point north along the coast to Kirk Creek, and inland into the upper Nacimiento River watershed. South of the study area, fewer marriages are apparent in the mission registers pertaining to the study area groups of *Stjahuayo*, *Tsetacol*, and the other rancherias in the Cambria and Estero Point vicinities, and even fewer intermarriages occurred within the inland groups in the Lower Nacimiento watershed (Milliken 2002:13). This decrease in marriages suggests less social alliances with groups to the south.

## ETHNOGRAPHIC SUMMARY

The ethnohistoric and ethnographic literature reveals that hunter-gatherer-fisher populations inhabited both coastal and pericoastal locations along the San Simeon Reef at the time of Spanish contact. The Playano language spoken by the Native people may have been a dialect of neighboring Salinan or Chumash languages or a language isolate. The population density was low, around one person per square mile. Even with low population, it is apparent that groups and individuals aggregated to form rancherias or villages or a cluster of residential groups that continually interacted and identified with one another. Although the locations of such entities are more difficult to define within the Point Estero region, the Cambria vicinity is known to have had at least one village, *Tsetacol*, and three placenames.

Ethnohistoric accounts from the Portolá expeditions provide insights into the Playano mobility and settlement patterns. The abandonment of locations suggests seasonal use of coastal and upland areas during favorable conditions for plant collection in the spring. The paucity of houses and structures may suggest that during part of the seasonal round at least some social groups were away from main settlements and apparently were relatively mobile. Settlements probably varied in size according to the course of the yearly subsistence cycle; some were permanent and others were used seasonally.

# CHAPTER IV: CENTRAL CALIFORNIA COAST PREHISTORIC SEQUENCE

The central California Coast was once considered one of the least understood archaeological regions in California. However, over the past twenty years researchers have built on the early regional studies (Rogers 1929) and significant local contributions (e.g., Abrams 1968; Greenwood 1972; Pierce 1979; Pohorecky 1964) to develop a cultural sequence that specifically pertains to the San Simeon Reef. In the past two decades there have been significant advances in understanding the archaeological record within the San Luis Obispo archaeological region and within discrete localities, particularly along the open coastline (Jones et al. 2007). A similar suite of cultural changes evident in the archaeological record, and often related to local and regional environmental changes, has framed the local chronology into six periods (Table 4.1; Jones et al. 1994; Jones et al. 2007; Jones and Waugh 1995; King 1990a). To understand cultural patterns pertinent to the

Table 4.1. Chronological Sequence of the California Central Coast.

| PERIOD | TEMPORAL SPAN | | HOLOCENE[A] |
|---|---|---|---|
| Late | 700 B.P. – Historic | A.D. 1250 – 1769 | Late |
| Middle/Late Transition | 1000 – 700 calBP | A.D. 1000 –1250 | Late |
| Middle | 3000 – 1000 calBP | 600 B.C. – A.D.1000 | Late |
| Early | 5500 – 3000 calBP | 3500 – 600 B.C. | Middle |
| Millingstone | 10,000 – 5500 calBP | 8000 – 3500 B.C. | Early |
| Paleoindian | Pre–10,000 calBP | Pre–8000 B.C. | Early |

Note: Dates refer to calibrated age; [a]Erlandson and Colten (1991).

study sites, the chronological sequence is briefly discussed here with regard to significant natural events and changes in behavioral strategies and technology reflected in subsistence and settlement Table 4.2. Excavated San Simeon Reef sites from which chronological information has been obtained are depicted in Figure 4.1 and summarized in Table 4.3.

### PALEOINDIAN - MILLINGSTONE PERIOD (10,000 TO 5500 CALBP)

Once considered an anomaly characterized only by projectile points in private collections (Bertrando 2004), the central coast now has a well defined continuity of human coastal and nearshore adaptations over the past 10,000 years, with hints of occupation as early as 12,000 to 13,000 years ago (Jones et al. 2007; Jones et al. 2008b, 2008c). To date, at least six coastal and pericoastal sites have radiocarbon dates Millingstone Period, some which extend into the Paleoindian Period (Fitzgerald 2000, 2004; Fitzgerald and Jones 1999; Greenwood 1972; Jones et al. 2008b, 2008c, 2009; D. Jones et al. 2004; Mikkelsen et al. 2000; Pierce 1979; 2004; Rudolph 1983a, 1983b).

As suggested by the abundance of millingstones and high density of shellfish remains, the collection and processing of seeds and shellfish were important economic pursuits during the early Holocene. Except for interior locations, early Holocene sites along the central California Coast have components that contain shellfish assemblages that are dominated by

Table 4.2. Summary of the Central California Coast Archeological Sequence.

**MILLINGSTONE PERIOD (10,000 TO 5500 CALBP)**

- Few projectile points
- High densities of handstones and millingslabs
- Core Hammers and tools, cobble tools
- Focus on estuarine shellfish and plant foods
- Settlement predominantly along hilltops, lakes, and estuaries
- *Olivella* beads: Thick Rectangular, Spire-lopped

**EARLY PERIOD (5500 TO 3000 CALBP)**

- Large side-notched, Contracting- and Rossi square-stemmed projectile points
- Mortars and pestles, notched net weights
- Storage of resources
- Terrestrial hunting of big game increase
- Principal residential bases in estuary settings *Olivella* beads: Oblique Spire-lopped, End-ground, Cap, Thick Rectangular

**MIDDLE PERIOD (3000 TO 1000 CALBP)**

- Contracting-stemmed projectile points
- Circular shell fishhook
- Intensified use of marine resources
- Peak in obsidian exchange with eastern Sierra Nevada
- Emergent status ranking
- Increased occupation of outer-coast sites
- *Olivella* beads: Spire-lopped, Small Oblique Spire-lopped, Medium End ground, Small Barrel, Medium Barrel, Tiny Saucers, Saucers, Symmetrical Irregular Saucer, Asymmetrical Irregular Saucer
- Other Beads and Ornaments: *Haliotis* disk ornaments, perforated disks, ring with incised edges, and plain and flat-ended rings

**MIDDLE/LATE TRANSITION PERIOD (1000 TO 700 CALBP)**

- Contracting-stemmed, Cambria double side-notched, and small arrow projectile points
- Circular shell fishhook
- Major adaptive changes linked to Medieval droughts
- Increased use of estuaries
- Disruption of settlement systems
- A wide a variety of *Olivella* shell bead types

**LATE PERIOD (700 CALBP TO HISTORIC)**

- Desert side-notched, and Canaliño/Coastal Cottonwoods
- Bowl and hopper mortars
- Bedrock mortars
- Mobile settlement system
- A wide a variety of *Olivella* shell bead types including Callus and lipped
- A wide variety of bead and ornament types from many shell types; steatite disks, talc-schist disks, glass beads

Table 4.3. Archaeological Sites Excavated along the San Simeon Reef.

| CA-SLO- | Location | Temporal Component | Reference |
|---|---|---|---|
| 369 | Lodge Hill | Millingstone/Early Period | Parker (2004) |
| 177 | Lodge Hill | Millingstone | Pierce (1979); T. Rudolph (1983a, 1983b); J. Rudolph (1985) |
| 273/H& 274 | Arroyo de los Chinos | Early Period | Hildebrandt et al. (2002) |
| 265 | Piedras Blancas | Millingstone to Early Period | Hildebrandt et al. (2007) |
| 697 | Lodge Hill | Early Period | Gibson (1979a) |
| 369 | Lodge Hill | Early Period | Gibson (1979a) |
| 264 | Piedras Blancas | Early/Middle Period | Bouey and Basgall (1991) |
| 383 | San Simeon Crk | Early/Middle Period | Hines (1986) |
| 267 | Piedras Blancas | Terminal Early - Middle/Late | Bouey and Basgall (1991); Jones and Ferneau (2002a) |
| 175 | Little Pico Crk | Early to Middle/Late Transition | Abrams (1968); Jones and Waugh (1995) |
| 1259 | Little Pico Crk | Early to Middle/Late Transition | Jones and Waugh (1995) |
| 179 | Pico Crk | Early to Middle/Late Transition | Leonard (1968); Waugh (1992); Jones and Ferneau (2002a) |
| 268 | Piedras Blancas | Middle Period | Bouey and Basgall (1991) |
| 266 | Piedras Blancas | Middle Period | Bouey and Basgall (1991) |
| 77 | Piedras Blancas | Middle Period | Clifford et al. (2006) |
| 187 | San Simeon Crk | Middle, Middle/Late Transition | Hines (1986); Gibson (1979b) |
| 273/H& 274 | Arroyo de los Chinos | Middle Late Transition | Hildebrandt et al. ( 2002) |
| 186 | San Simeon Crk | Middle-Late Period | Hines (1986) |
| 267 | Piedras Blancas | Late Period | Bouey and Basgall (1991); Jones and Ferneau (2002a) |
| 71 | San Simeon Reef | Late Period | Joslin (2006) |
| 115 | San Simeon Reef | Late Period | Joslin (2006) |
| 826 | Piedras Blancas | Late Period | Hildebrandt et al. (2007) |
| 178 | Lodge Hill | Proto-Historic | Gibson (1979a); J. Rudolph (1985) |
| 221 | San Simeon Crk | Proto-Historic | Gibson (1992a) |
| 1373 | San Simeon Crk | Proto-Historic | Gibson (1992a) |
| 258 | Piedras Blancas | NA | Rosenthal and Jones (2001) |
| 1226 | Piedras Blancas | NA | Bouey and Basgall (1991) |
| 1227 | Piedras Blancas | NA | Bouey and Basgall (1991) |
| 1276 | Piedras Blancas | NA | Hildebrandt et al. (2007) |
| 2156 | Piedras Blancas | NA | Rosenthal and Jones (2001) |
| 2157 | Piedras Blancas | NA | Rosenthal and Jones (2001) |
| 2435 | Piedras Blancas | NA | Hildebrandt et al. (2007) |

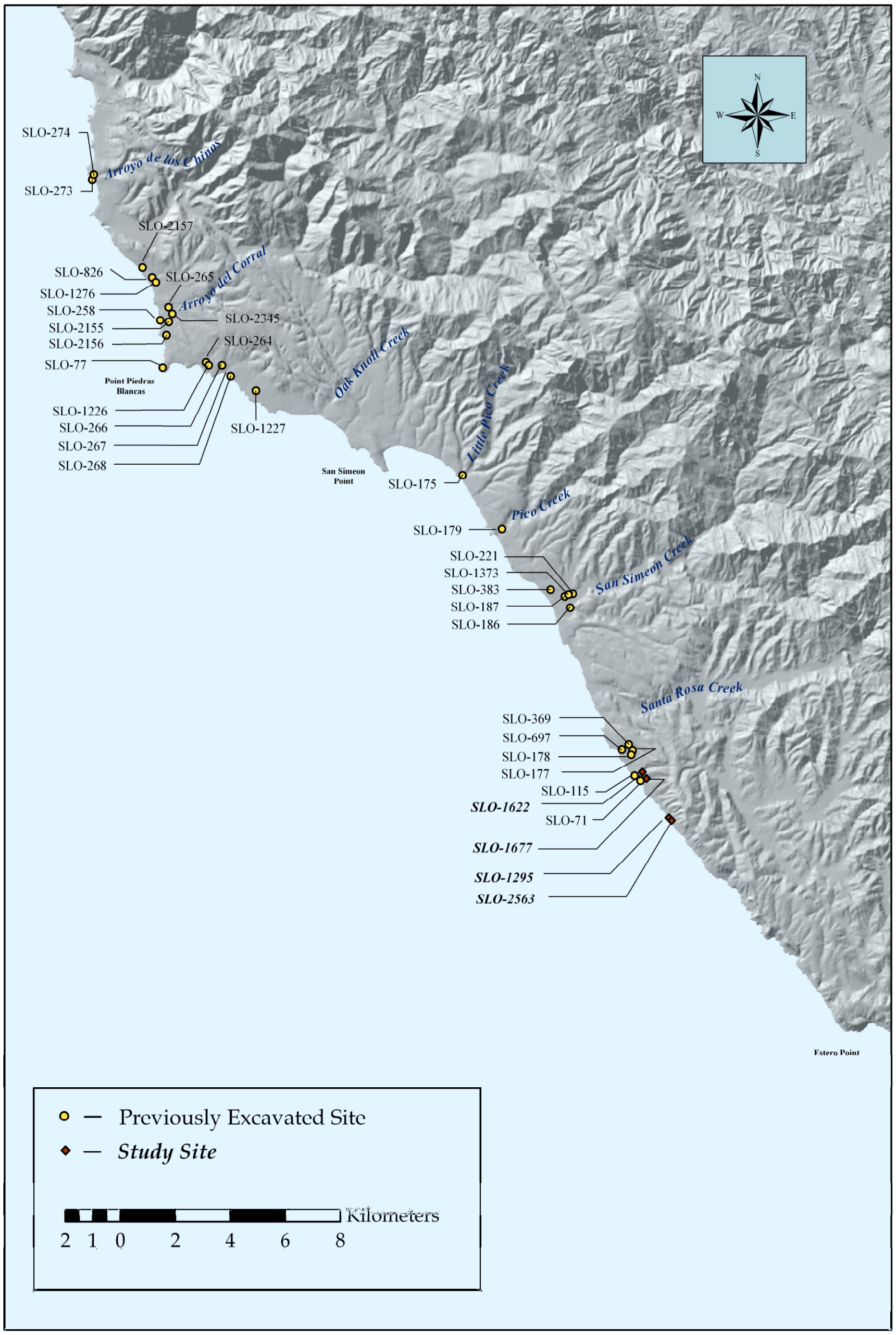


Figure 4.1. Excavated Sites Along the San Simeon Reef.

estuarine and rocky intertidal species and they contain a limited range of marine fish compared to later periods. Erlandson (1988, 1994) and Jones (1991) have argued that this early reliance on invertebrates is justified, as shellfish require little search time and can be harvested by all age and gender classes in the social group. An analysis of the structure, composition and location of Millingstone deposits led Erlandson (1994) and Hildebrandt and McGuire (2002) to conclude that a semisedentary settlement system was in place. Significant information from the Cross Creek-Diablo Canyon complex has expanded our understanding of local central coast habitats. Jones et al. (2008c:195) suggest that by 10,000 years ago related, inter-dependant populations had distinctive settlement preferences, with inland people who made forays to the coast but specialized in hunting small game and collecting vegetal resources, and coastal inhabitants who exploited a wider variety of marine and terrestrial resources.

### EARLY PERIOD (5500 TO 3000 CALBP)

The diachronic continuity of artifact assemblages and local adaptations led Greenwood (1972) and later Jones (1993) to apply Rogers's (1929) term "Hunting" Culture to Early, Middle, and Middle/Late Transition deposits along the central coast. The rise of new technology, particularly large quantities of stemmed and notched projectile points, and adaptive changes entailing greater emphasis on marine mammals and fish stimulated researchers to offer a range of explanations of cultural changes during this time. Rogers (1929) proposed that new innovations in the Santa Barbara area were the result of the arrival of the "Hunting People" who relied on acorns and terrestrial and marine mammals. In response, Harrison (1964) and Harrison and Harrison (1965) proposed an intrusion to the area from western Alaska, eastern California (Warren 1968), or the Channel Islands (Lathrop and Troike 1984). Glassow (1997) and Erlandson (1997) have argued that there is limited archaeological evidence for a population replacement, and associate the technological changes to population expansion and adaptive shifts of local groups. Favorable climatic conditions may have stimulated population growth, leading to subsistence intensification and giving rise to the adoption of mortars and pestles at the onset of the Early Period. This explanation seems possible, as researchers have suggested that the earliest mortars and pestles were not necessarily used for acorns (Glassow 1996). Perhaps mortars and pestles were used to process small terrestrial animals, shellfish, pulpy plant parts, as well as minerals such as ochre.

Although artifact assemblages from the Millingstone Period continued into the Early Period, major changes in subsistence technology are evident along the San Luis Obispo Coast. Fishing-related artifacts, which persist into later periods, become more common than during the Millingstone Period

(Jones and Waugh 1997; Jones 2003). Mammals and fish increased in dietary importance relative to shellfish, while a more intensive use of plant resources is reflected by the introduction of mortar and pestle technology. Jones and Ferneau (2002a:242) suggested that sites along the San Simeon Reef reflect a diverse adaptation characterized by a settlement system entailing residence on the coast from fall through winter, a move to the interior in the spring, and a return to the coast in summer.

Evidence of Early Period occupation on the central California Coast is extensive. The emergence of this more substantial archaeological pattern, combined with a growing body of evidence for middle Holocene depopulation in the interior desert regions, has provided some support for Warren's (1968) hypothesis. Although there is no direct evidence for the migration of a specific cultural group(s) from the interior to the central coast, Mikkelsen et al. (2000) proposed that a major re-structuring of regional populations took place around 6500-4000 BP. The authors suggest the middle Holocene drought conditions had little effect on local resource productivity (e.g., coastal estuaries; Hildebrandt 1997), compared to the more arid interior. Basgall (1987) advocated that the presence of mortars and pestles is consistent with an increase in local human populations, and the more intensive use of acorns may have been necessary to support the higher density of people after around 3000 calBP. During the Early Period, Jones and Waugh (1997) proposed that people began storing resources (particularly acorns) for extended periods of time, allowing them to establish principal residential bases villages in a variety of estuary settings along the California Coast. However, site distribution and radiocarbon date frequencies suggest that people during this interval may have been one of fairly mobile populations (Erlandson 1997; Glassow 1997a). Local populations may have become more circumscribed during this interval, reducing mobility amplifying the increased importance of inter-group exchange. Evidence for this trend is the increased importing of obsidian into the local areas (Jones and Waugh 1997).

## MIDDLE PERIOD (3000 TO 1000 CALBP)

Diagnostic assemblage markers of the Middle Period consist of a wider range and density of artifact types (Table 4.2). Perhaps most significant is the innovation of the circular shell fishhook during this interval and an increase in the use of net sinkers (Jones et al. 2007), signaling an increased importance of marine fish. Bone tools and ornaments are relatively abundant and include needles, pins, awls, strigils, whistles, spatulas, gorge hooks, and antler tines. Based primarily on large samples of excavated material from two sites situated on the San Simeon Reef (CA-SLO-175 and SLO-267), Jones (2003) assigned these Middle Period artifacts to the Little Pico II Phase.

Mortuary practices inferred from artifacts associated with burials of this period indicate that the society was primary egalitarian, but with some evidence of political status, unequal distribution of resources, or gender inequality. Based on a small sample of Middle Period burials (five sites) the portrait of social organization appears no more complex than during previous periods (Jones and Ferneau 2002b:227). For most burials, individuals were interred with no artifacts, a few had modest assemblages, and one or two per cemetery had an exorbitant quantity of goods. Older males had the highest proportion of associated artifacts, possibly representing individuals who acquired some political or social status. At the Diablo Canyon site (CA-SLO-2) bone whistles were equally associated with men, women, and children (Greenwood 1972). An exception to this trend is at the Fowler Site (CA-SLO-406), where several infants had large quantities of grave items, which Jones and Ferneau (2002b:227) attribute to possible ascribed political status.

Along the north-central coast, many of the subsistence-settlement trends set in motion during the Early Period continue into the Middle Period, including an increased use of mortars and pestles, a great significant focus on small schooling fish and sea otters and a decreased dependence on shellfish (Jones and Ferneau 2002a). Subsistence pursuits in general appear to reflect a broad-spectrum diet with distinct signs of local resource intensification over time. In contrast to the Santa Barbara Coast, where Glassow (1996) identified the rise of principal residential bases villages due to an increased reliance on marine fish, Jones and Waugh (1995, 1997) suggested that few adaptive changes occurred during the Middle Period along the San Simeon Reef. Residential bases appear to be loci of population aggregation, evidenced by the low frequency but spatially extensive deposits. Jones (1995) proposed that the unusually high frequency of sea otter bones in Middle Period sites may be the result of a major rise in the trade of sea otter pelts. Interregional exchange appears to have increased during this interval, with Casa Diablo obsidian hydration readings reaching peak proportions during this interval (Bouey and Basgall 1991; Jones 1995, 1996).

### MIDDLE/LATE TRANSITION PERIOD (1000 TO 700 CALBP)

Central California Coast populations experienced dramatic changes around the onset of the Middle/Late Transition, sometime after 1000 calBP, evidenced in the increase use of arrow points, the disappearance of most stemmed points, and changes in bead types (Codding and Jones 2007; Jones et al. 2007:139). To the south, the Santa Barbara Channel Chumash large, permanent coastal villages continued to develop, part time craft specialization increased, and inter-regional trade networks intensified (Arnold 1993, 1996, 2001a; Rick 2007). In contrast, along the San Luis Obispo Coast site frequencies decline during the Middle/Late Transition (Jones 1995, 2003; Jones and Ferneau 2002a). Archaeological sites dating to this interval are quite rare, limited to two known deposits along the San Simeon Reef: Arroyo de los Chinos (CA-SLO-273/274H) and Little Pico Creek (CA-SLO-175); consequently, our understanding of this interval is still unfolding. Recent research at the Coon Creek site (CA-SLO-9), a single-component site located on the open coastline south of Estero Bay, however, demonstrates that some sites were occupied during this interval and provides significant new information (Codding and Jones 2007; Codding et al. 2009).

There is some evidence that sites occupied during the Middle Period continue to be used during the Middle/Late Transition, especially along the open coastline. Available subsistence information from northern San Luis Obispo reveals that shellfish utilization declines significantly during this interval, while vertebrate fish (especially small inshore/offshore migrants) increased (Hildebrandt et al. 2002; Jones and Kennett 1999). Faunal remains show a focus on terrestrial mammals over marine mammals, primarily composed of rabbits and artiodactyls, with assemblages suggesting a greater reliance on cottontail and jack rabbits than on deer, perhaps reflecting a decline in deer populations by this time. To the north along the Big Sur coastline, Jones (1995) found that marine mammals and fish declined in dietary importance and residential sites moved increasingly to interior settings where a relatively narrow range of terrestrial fauna was exploited. Based on the dramatic decrease of both obsidian and sea-otter remains (inferring production of pelts) in the archaeological record, exchange networks appear to have collapsed (Jones 1995).

The Middle/Late Transition has been the focus of intense, contentious debate concerning emergent socio-political complexity and its connection to environmental variability (Arnold 2001a; Arnold and Munns 1994; Arnold et al. 1997; Erlandson and Rick 2002; Gamble 2002; Jones 2002; Jones and Ferneau 2002b; Jones and Kennett 1999; Jones et al. 1999; Kennett 2005; Kennett and Kennett 2000; Raab and Larson 1997). The Middle/Late Transition coincides with the Medieval Climatic Anomaly, an interval that many researchers associate with prolonged drought and low terrestrial productivity that disrupted exchange networks, reduced human population densities, and stimulated reorganization of the entire socioeconomic system (Jones 1995; Jones et al. 1999).

Although drought conditions may have had a severe impact on the interior resource base, new information from sites along the coast indicates that Middle/Late Transition coastal resources may not have been significantly impacted. In a recent synthesis of Morro Bay sites and sites surrounding the estuary, Mikklesen et al. (2000) proposed that the productive estuary may have served as refugium during this period of environmental disruption. Located just south of Morro Bay, the Coon Creek site was a year-round residential base, where people procured rocky intertidal fish, shellfish, marine birds, marine mammals, and small terrestrial mammals with stemmed points, small leaf-shaped arrow points, notched line sinkers and circular shell fishhooks (Codding and Jones 2007).

### LATE PERIOD (700 CALBP TO HISTORIC)

Compared to the Hunting Culture sites, Late Period assemblages are easily distinguished by new patterns of technology, subsistence, and settlement. Jones (1992) suggested that local populations along the coast recovered from the effects of the environmental changes during the Middle/Late Transition; however, they never returned to the maritime adaptations observed during the Middle Period. This contradicts earlier interpretations by Greenwood (1972, 1978), who argued for a more socially complex population reliant on littoral resources. The discovery of Late Period middens in Big Sur (Hildebrandt and Jones 1998; Wohlgemuth et al 2002), San Simeon Reef (Joslin 2006), and Morro Bay (Joslin and Bertrando 2000) have improved our understanding of this interval.

New insights derived from recent research on coastal and interior sites (e.g., Carpenter et al. 2004; Mikkelsen et al. 2000; Stevens et al. 2004), and more focused research on the Late Period settlement (Joslin and Bertrando 2000; Joslin 2003) have demonstrated the Late Period is marked by a profusion of single-component sites in the interior and on the coast. One of the most apparent site characteristics is the lack of occupational continuity from the Middle/Late Transition to Late Period times (Jones and Ferneau 2002b:219). Occupations are marked by small middens, often associated with or close to bedrock mortars in the interior (Jones et al. 2007:140). Although sites of considerable size are known along the back-bay of Morro Bay, e.g., CA-SLO-214 (Hoover and Sawyer 1977), along the coastline Late Period middens are often small (between 30 to 40 meters in diameter) with multiple discrete loci and appear to be characteristic of a relatively mobile population (Joslin 2006). Collections from two sites (CA-SLO-71 and SLO-115) suggest that marine fish were the principal subsistence resource intensively targeted by occupants, demonstrated in high fish bone frequencies, evidence for the use of watercraft, and evidence of processing fish for on-site use, storage, trade, or transportation (Joslin 2006).

In summary, the current knowledge of the archaeology along the San Simeon Reef spans over a 10,000-year period of time. This overview of the prehistory reveals that cultural systems became increasingly complex within the realms of culture that are archaeologically visible, although not along the more accelerated trajectory we see in the Santa Barbara Channel. Subsistence practices entailed expansion in the number of plant and animal species used and presumably elaboration of subsistence technology. The economic system, facilitated by the use of shell-bead money was in place, but, we do not see evidence of the significant growth of craft manufacture and specialization of the Chumash villages to the south. Along the central coast, a few bead drills and small amounts of *Olivella* bead manufacturing debris in most Late Period deposits suggests that low-level bead production was widespread (Jones et al. 2007:140). Social organization appears to remain largely egalitarian throughout most of prehistory but eventually involved some level of status ranking and hereditary leadership.

## PREVIOUS RESEARCH IN CAMBRIA

The Cambria Region of San Luis Obispo County has a remarkable archaeological record spanning at least 10,000 years, and contains one of the area's most significant site complexes, the prominent Lodge Hill complex. This distinctive knoll and surrounding area has attracted the attention of archaeologists for the last forty years, with the early salvage efforts of the 1960s, giving way to under-funded cultural resources management investigations in the 1970s, followed by more problem-oriented research of the 1980s. Like much of California, however, despite this rich archaeological record, systematic interpretations are hindered by the number of independent excavations, the variety of investigative methods employed, and different levels of detailed analysis and documentation. Making interpretations more challenging, the archaeological sites have been impacted by residential development, looting, and burrowing animals, resulting in a great deal of stratigraphic mixing.

The expanded conservation efforts prompted by the passage of the California Environmental Quality Act (CEQA), triggered numerous projects in Cambria that still stand today as important local contributions (e.g., Parker 2001, 2004; Pierce 1979; Gibson 1979b; J. Rudolph 1983, 1995; T. Rudolph 1983a, 1983b). Since the 1990s, largely due to the more extensive and systematic research by well-funded federal CRM projects north of Cambria, there has been considerable improvement in our knowledge of regional prehistory along the open coastline (e.g., Bouey and Basgall 1991; Ferneau 1998; Jones and Waugh 1995,1997; Jones and Ferneau 2002a, 2002b; Hildebrandt et al. 2002, 2007; Waugh 1992). These large-scale, research-based undertakings have answered many lingering questions about cultural adaptations and have provided a basis for comparisons with the Cambria area. These projects have resulted in impressive assemblages of faunal remains, artifacts, and archaeological features that are drawn upon throughout this research.

Excavations at Lodge Hill have identified Trans-Holocene deposits at the expansive site CA-SLO-177/178, situated on the south-facing hillslope immediately adjacent the Reserve (Gibson 1979b; Pierce 1979; J. Rudolph 1985; T. Rudolph 1983a, 1983b). First excavated by Pierce (1979), the lowest levels revealed a wide range of ground and battered stone artifacts in a rich midden dating to the Millingstone Period, although the early radiocarbon date was initially refuted. Subsequent research in the southern site area (J. Rudolph 1985; T. Rudolph 1983a, 1983b) confirmed the presence of the basal deposit with diverse artifacts and shellfish remains dated to 9110-8780 calBP. This additional work also identified both Early and Middle Period components and provided new information on shellfish procurement, particularly an increase in turban snails and a decrease in California mussels as the most abundant species over time.

Excavations at CA-SLO-177 identified an upper Late Period deposit rich in rocky intertidal shellfish remains and a high density of fire-altered rock. However, no radiocarbon dates are available from this occupation (Gibson 1979b). Pierce (1979) uncovered a small triangular arrow point (Cottonwood series), a Cambria double side-notched and small leaf-shaped projectile points, slate and steatite pendants, a clam disk bead, and a range of *Olivella* beads in the "upper 12 inches of the site" (Gibson 1979b). Late Period evidence at the site is further suggested by a second Cambria double side-notched point recovered during a surface survey (Hoover 1974). T. Rudolph (1983a, 1983b), excavating along the south slope of the site, did not encounter the later deposit. Located just south of the Rudolph study area, a single radiocarbon date between 510 and 260 calBP and an *Olivella* full-lipped bead date the Late Period locus situated on the flank of a coastal hill slope (Gibson 1979b). Subsistence remains include the remains of rocky intertidal shellfish species, marine fish such as rockfish, sea mammals such as sea otter and dolphin, and land mammals, primarily blacktailed deer, coyote, and rabbits.

Situated on the north-facing slope of Lodge Hill, a second trans-Holocene deposit, CA-SLO-369, has revealed components dating from the Millingstone though the Middle/Late Transition (Breschini and Haversat 1988; Gibson 1979a; Parker 2004). The first excavations by Gibson identified an Early Period deposit with contracting-stemmed and lanceolate points and pitted stones interspersed in a rich midden containing high frequencies of birds and sea mammals and few fish remains. Limpets, turban snails, and chiton dominated the invertebrate assemblage (Gibson 1979a: Table 13). In 1988 Breschini and Haversat monitored construction activities, analyzed existing collections from a previous monitoring project, and documented unpublished Early Period dates (Breschini and Haversat 1988). Additional testing by Parker (2004) established three site occupations between 9800 and 910 calBP, showing that the earliest site population focused primarily on harvesting California mussel and hunting deer. The Middle and Middle/Late Transition deposits reveal a broader diet and artifact assemblages that suggest a permanent residential site (Parker 2004:41).

At CA-SLO-697, located on a marine terrace at the base of Lodge Hill, Gibson (1979a) identified an Early Period deposit contemporaneous with CA-SLO-369. The site appears to reflect a seasonal or multi-season site only 45 cm in depth. Excavations recovered a range of artifacts, including large side-notched and contracting-stemmed points, and subsistence remains dominated by limpets, turban snails, and chiton with the intriguing absence of California mussel. In Unit 3, however, a red abalone midden was encountered with "25-30 whole shells between 10-12 cm long and few large shells 15 cm and up" (Gibson 1979a:11). During a second project at the site, Breschini and Haversat (1988) excavated a single unit at CA-SLO-697 to implement a mitigation plan in a shallow portion of the deposit. Two additional dates were collected, confirming the deposit as Early Period.

### Summary

The preceding review identifies numerous subsistence, settlement, and socioeconomic changes in prehistoric San Simeon Reef. Some of these temporal changes are clearly defined, however, it is clear that a number of significant questions remain unanswered. In many situations our lack of knowledge is due to the absence of a well-defined archaeological record. Only 32 systematically excavated sites are known for this region, and only 25 of them have been radiocarbon dated with defined components. We also have limited knowledge on the variety of sites and how these sites relate to each other. The current research spans a critical period in the region, a time when coastal people are increasing in numbers and adjusting to dramatic changes in their natural environment and social systems. With these considerations in mind, this research is focused on understanding the unique variability of human occupations along this rich and diverse coastline.

## CHAPTER V: THEORETICAL PERSPECTIVES AND MODELS GUIDING THE RESEARCH

Historical, cultural, and human behavioral ecology provides the theoretical framework for studying cultural processes in this research (Ames 1991; Beaton 1973; Crumley 1994; Erlandson and Rick 2010; Grayson 2001; Hayden 1998; Jochim 1976; Redman et al. 2004; Winterhalder and Smith 1992; Williams 1966). Ecological themes in archaeology emerged in the 1960s and 1970s in response to a dissatisfaction with normative paradigms and an interest in formal explanations of culture change. The decision to adopt an ecological perspective is mainly based on establishing a foundation of understanding of environmental factors affecting cultural behavior before proceeding to higher level research concerning social organization and complexity, a strategy consistent with prior local research (Hildebrandt et al. 2007; Jones 2003; Jones and Ferneau 2002a, 2002b). This research strategy will allow comparisons to be made with respect to changes in prehistoric resource use. In short, it is important to recognize the nature of shifts in behavioral patterns along the southern San Simeon Reef as a spatial-temporal process, and to determine the archaeological manifestations of responses to environmental and cultural conditions. Given the minimal knowledge available about resource use in the study region, a significant component of the research presented here is designed to acquire basic information that will form a foundation for future, more sophisticated research endeavors.

The interdisciplinary approaches of ecology in the context of archaeology are used to contextualize faunal and floral remains and artifacts both diachronically (to examine cultural entities that existed in different epochs), and synchronically (to examine one cultural entity and its components). Viewed from a long-term perspective, faunal remains and formed tools not only provide data on subsistence, but are also indicative of human health, demography, technology, social status, environmental change, and human impacts on local habitats and species (Reitz 2004; Reitz and Wing 1999). A multi-theoretical approach can also facilitate addressing social landscapes, thus compensating for the shortcomings of strict economic theories (Fitzhugh 2003; Holly 2005; Habu and Fitzhugh 2002). By analyzing dietary and technological changes though this framework, the patterns observed over the course of the Middle to Late Holocene can be systematically evaluated in order to understand the dynamic relationship between the environment and prehistoric human foraging.

Historical ecology provides a framework for investigating long-term relationships between hunter-fisher-gatherers and their environment. This approach encompasses a broad field of research focused on understanding how people have interacted with and altered their habitat through time

(Crumley 1994). As the field is still emerging, there is debate as to whether the approach is a unified theoretical position or merely a research tool (Balée 1998; Gragson 2005; Whitehead 1998). Ecologically based research, however, is not new to California. Broughton's (1994b, 1995, 1997, 1999, 2002) study of faunal remains from the Emeryville Shell Mound along the San Francisco Bay and Jones et al.'s (2008c) findings on the extinction of a flightless duck at along the California Coast are particularly insightful as examples of reconstructing human impacts on the environment (see Rick and Erlandson 2008). These studies highlight that all people, regardless of how dense their populations or culturally complex they were, had some impact on the environments they occupied (Grayson 2001:46). This argument will be addressed over the course of this research along the southern San Simeon Reef.

## MODELS OF RESOURCE PROCUREMENT

Within the realm of evolutionary ecology, particularly with regard to models encompassed within optimal foraging theory, important economic theories such as diet breadth, patch choice, and central place have been used to understand the process of subsistence change and intensification (e.g., Basgall 1987; Beaton 1991; Bettinger et al 1997; Bouey 1987; Erlandson 1991; Glassow 1992, 1996; Hildebrandt and Jones 1992; Jones 2003; Wolgemuth 1996; Zeanah 2002). The models are effective for predicting qualitative patterns in human subsistence in a variety of complex environmental settings. The basic argument is that a particular strategy is selected dependent on a complex set of factors including environmental and social opportunities and limitations, technology, search and handling costs, and individual perceptions and agency (Kaplan and Hill 1992:167; Winterhalder and Smith 1992:8). Archaeologists commonly reconstruct and evaluate subsistence strategies using such economic models (Bird and O'Connell 2006).

### OPTIMAL FORAGING THEORY

Simple optimal foraging models are based on the assumption that individuals have a detailed knowledge about their environment, as well as the relative costs and benefits of different behavioral strategies, and as a result they will make economically rational choices (Bettinger 1991:104 –105; Kaplan and Hill 1992:168). Essentially, human foragers can maximize reproductive success through the efficient acquisition of food, meeting dietary requirements, and providing time for other fitness-enhancing pursuits. Bettinger (1991:84) suggests that the costs and benefits of exploiting specific resources are considered by individuals with respect to significance ranking, which is determined on the net energetic yield per specific resource based on a unit of time expended. The principle is essentially economic: lower ranking resources are those with relatively high search and handling costs relative to nutritional or other returns. Calories or protein are the primary measures in the costs and benefits of food resources (Stephens and Krebs 1986), but long-term currencies are survivorship, fertility, wealth, and prestige.

Applicable optimal foraging models considered here are diet breadth, patch choice, and central place. In the diet breadth model, foragers select a combination of foods based on an encounter rate that maximizes net energy intake per unit of foraging time (Kaplan and Hill 1992). The model predicts whether a particular species will be included in the diet, but not their relative dietary contributions (Smith 1983:628). The assumption is that higher ranked resources, when encountered, will always be procured. In contrast, lower ranked species will often be overlooked and added to the diet only when there is no expectation for encountering higher return-rate resources. The relative ranking of resources is dependent on two mutually exclusive and exhaustive factors—search and handling costs—which are determined by species characteristics and the effects of human predation.

The patch choice model is an extension of the diet breadth model. It emphasizes the spatial distribution of resources and focuses on groups of resources in a defined area or "patch" (Broughton 1994a; Kaplan and Hill 1992). When resources are distributed and encountered in a spatially heterogeneous pattern, the distribution can be referred to as "patchy." In these patchy environments, foragers are faced with two related optimization problems: which patches to forage in and how long to remain in each patch (Stephens and Krebs 1986). As with the diet breadth model, the patch choice model postulates a trade-off between declines in yield per unit of time spent foraging at a location and an increase in the travel time between patches (Kaplan and Hill 1992:178; Smith 1983:631). Patch choice is based on the assumption that individuals will move to the next patch if resources within the current patch are considerably reduced, and higher energy yields per unit of expended time can be obtained at an alternative patch. As a result, resources considered low-ranking, although abundant in a high-ranking patch, may be more prevalent in the diet.

Patch choice is an intriguing model for studying mobile hunter-fisher-gatherers who follow seasonal rounds. During intervals of resource abundance, diet breadth would focus on particular patches based on the relatively high productivity of abundant and diverse resources (e.g., game or inshore/offshore fish migrations). Once return rates in a selected patch decline to a critical level, a new patch with a fresh suite of resources is targeted. Possible strategies for maximizing nutritional yields within patches may include one of two objectives (or a combination of objectives): increase the procurement of high-ranking species or expand the diet breadth to include more species within that patch. If essential resources were continuously and evenly distributed, movement to a new residential location would take place only when travel time begins to impact return rates.

Central place foraging models are distinct within optimal foraging models in that they solve problems concerning the manner in which resources are obtained in one location for use in another (Bettinger et al. 1997; Orians and Pearson 1979). The models posit that, holding technology and field conditions constant, optimal foraging behavior changes as a function of increasing round-trip travel time from central place to foraging location and back (Bettinger 1991:96). Therefore, important dimensions of central place models are how much of a particular resource is being transported and whether field processing would result in greater overall efficiency by reducing the weight during transportation. Bettinger et al. (1997:897) propose that field processing is generally more costly when compared to the alternative in which the same resources is procured within the foraging radius and processed and consumed at residential bases. As residential mobility decrease, residential bases will therefore be increasingly tied to locations were key resources are abundant. A shift in the importance of a resource from non-essential to essential should be reflected in the replacement of temporary camps and field processing stations by residential bases in the same vicinity (Bettinger 1976; Bettinger et al. 1997:897)

## SUBSISTENCE INTENSIFICATION

Common topics in the study of marine resource subsistence and settlement across California are the process of subsistence intensification and how people interacted and altered the environment they inhabited over time (e.g., Broughton 1994; Bouey 1987; Glassow 1993a, 1996; Jones 2003; Raab 1992; White 2003). Subsistence intensification refers to the process by which increasing quantities of food resources are extracted from a specific sized territory at a greater cost of energy expended per unit of food value than was previously required (Price and Brown 1985; Lourandos 1985). The course of intensification is intimately linked to diet breadth, adding a temporal dimension that entails the expansion of food resources or increased harvesting of resources already important to the diet (Ames 1994:217). The use of resources at an optimal level is accomplished when overexploitation of important dietary species is avoided through targeting other resources or resource patches or shifting reliance on taxa that cannot be easily overexploited, such as fish. Evidence of sub-optimal subsistence strategies and resulting economic intensification can take a variety of forms (Table 5.1).

Efficient subsistence pursuits can have internal and external pressures that constrain optimization, preventing diets from expanding over time and resulting in the intensified exploitation of resources. Internal pressures

Table 5.1. Indications of Resource Intensification in Coastal Environments.

| | |
|---|---|
| RESOURCES ACQUISITION | • Intensification of existing subsistence strategies<br>• Increased use of marginal/low-ranking environmental locations<br>• Increase in diet breadth<br>• Increase in low-ranking species/reduction in high-ranking species<br>• Increased dependence on predictable resources<br>• Decline in average size of prey |
| SOCIAL FACTORS | • Greater reliance on food processing<br>• Greater dependence on food storage<br>• Increased dependence on producing manufactured items for trade to acquire food resources<br>• Local specialization in food resources for economic exchange<br>• Establishment of socioeconomic alliances between territory-holding groups<br>• Settlement system diversification |

include cultural circumstances such as higher population density and smaller catchments or increased territorial consolidation (Basgall 1987:45). External pressures may include short- and/or long-term climate fluctuations that may promote shifts in distribution and the abundance of certain resources. Cultural ties, such as interior-coastal marriage networks, may ameliorate food shortages over difficult periods by facilitating exchange (e.g., Johnson 2000).

As useful heuristic measures, the models presented here are simplistic compared to the complexity of decisions and factors that prehistoric hunter-gatherers actually encountered on the landscape (Holly 2005). By making specific predictions regarding "optimal" behavior, the divergence between optimal and observed behaviors may have other causes that may not be based on predictions (Bettinger et al. 1997). Jones (2003:5) for example, warned that both optimization and intensification models do not incorporate diachronic environmental variability or local environmental variation into their explanations for cultural change. Additionally, resources may hold value for hunter-gatherers beyond diet in that they provide raw materials for tools, examples being shell, and bone, sinew, and hides. Personal choice or food preference and a wide range of sets of social and cultural structures may also frame decisions that we label as irrational or idiosyncratic when encountered in the archaeological record.

### SETTLEMENT SYSTEMS

Binford's (1980) forager-collector hunter-gatherer settlement model proposed that seasonal or short-term hunter-gatherer mobility is patterned in a predictable manner with respect to spatial and temporal variation in resource availability. The approach exemplifies the cultural ecological explanatory method, posing environment as the prime mover in variation among hunter-gatherer settlement strategies. The model has been one of the most common middle-range theories that archaeologists across the world (Habu and Fitzhugh 2002) and in California have employed in studying settlement systems (Byrd 1998; Christenson 1992; D. Jones 1992; Jones 2003; Laylander 1997; Lightfoot 1992).

Essentially, the model stipulates that hunter-gatherer settlement strategies, in response to different security problems presented by the environment, will be differentially reflected in the archaeological record. Binford (1980:17), however, acknowledged that population density is an important aspect of determining the nature of a system. The model defines residential mobility as a pattern in which complete social groups move from one residential base to another, while logistical mobility is the movement of organized task groups conducting excursions from a residential base. Binford (1980) identified two basic subsistence-settlement systems: collectors, who focus primarily on residential bases, and foragers, who move from one residential base to another during an annual cycle. Based on this continuum, collectors are characterized by high logistical mobility and low residential mobility, while foragers have high residential mobility and low logistical mobility. Forager systems are responses to environments where the distribution of important resources is spatially and/or seasonally relatively homogenous. Along the San Simeon Reef (Joslin 2006) and to the north in Big Sur (Jones 2003) the range of site types is not consistent with a specific collector or forager form of settlement but appears to represent a continuum. Both archeological data and ethnographic accounts suggest that populations moved regularly across the landscape within defined territories, a pattern that does not conform to a specific dichotomy (Jones et al. 2008a).

The distinction between Binford's forager and collector site types has implications for understanding the annual cycles of subsistence activities and changes in diet, particularly subsistence intensification, that result in settlement pattern changes. In my research area, hunter-fisher-gatherers used both interior and coastal locations and undoubtedly conformed to different kinds of settlement systems both within each of these environments and differentially over time as a result of social and long or short-term climatic changes (e.g., El Niño events and the Medieval Climatic Anomaly). During an annual round of mobility, if critical resources are concentrated and only available within limited patches (e.g., fresh water, high quality tool stone) locations are expected to have repeated use. Presumably, a forager group could not remain in the location forever because availability of food resources ultimately would require or favor movement to another location.

Researchers reevaluating the forager-collector model have recognized that other ecological, economic, technological, social, and ideological factors may have played important roles in determining subsistence-settlement systems (Habu and Fitzhugh 2002). Namely, many studies have posited that hunter-gatherers shifted along the forager—collector continuum rather frequently, and as a result, settlement patterns may have varied even at the local level (Zeanah 2002). Previous archaeological, biological, and ethnographic data suggest two strategies of seasonal mobility for the central coast (Jones et al. 2008a:2290). The first is bi-seasonal system in which groups traveled between coastal and inland residential bases, occupying the coast in the winter and the interior during the remainder of the year (Hildebrandt and Mikkelsen 1993. The second is a collector system in which groups were located primarily in semi-permanent inland residential bases and moved to the coast to acquire coastal resources in the summer (Breschini and Haversat 1994). Recent findings in the Big Sur region have identified the co-existence of two distinctive settlement strategies, which can best be described as "semi-sedentary," which depended on resource ability (Jones et al 2008a:2292). Such results are warnings of the oversimplification of site type classifications and have implications for evaluating subsistence and settlement organization (Chatters 1987; Laylander 1997). Unanticipated variations of expected patterns in ecological and optimal models, however, are telling in their own right, challenging us to look at local deviations outside the notion of unilinear variation.

### RESEARCH QUESTIONS AND EXPECTATIONS

In light of the theoretical tenets just discussed and the current knowledge of Middle and Late Holocene coastal adaptations in the San Simeon Reef region, three major research issues and a variety of research questions and preliminary expectations may be posited. The topics discussed below are directly related to understanding how local hunter-fisher-gatherers utilized marine resources and how their marine resource subsistence-settlement strategies were affected by diachronic environmental fluctuations.

- **USE OF MARINE ENVIRONMENTS:** Do episodes of more frequent coastal occupations appear in the archaeological record during the Middle and Late Holocene? If so, is this increase a result of population changes caused by environmental factors, such as fluctuations in marine and terrestrial productivity?

**MIDDLE HOLOCENE**

Based on current paleoenvironmental data it is anticipated that at the onset of the Middle Holocene around 5000 calBP, population density along the coastline was greater than in the interior as predicted by optimal foraging strategy. Marine resource productivity would have been high, as cooler than current seawater surface temperatures, and presumably greater upwelling, existed around 5750 and 5150 calBP (Kennett et al. 2007). As cooler sea-surface temperatures are often associated with dryer terrestrial conditions, populations would have turned to marine resources to balance the decline in interior resources.

Mobility strategies entailing more frequent coastal occupation may have focused on the more productive marine environment. Regardless of relative site density, compared to subsequent periods there would be few differences between interior and coastal sites with respect to size and intensity of occupation, due to low population density and high mobility within larger territories. Higher mobility would be reflected in greater proportions of interior Franciscan chert and imported obsidian in coastal sites.

Optimal foraging theory states that hunter-gatherers would have maximized the exploitation of high-ranked, diverse, and dense resource patches in the region. Along the San Simeon Reef, larger coastal sites occupied throughout prehistory, such as Lodge Hill, should have been central places where primary residential activities took place based on the unusually diverse and dense high-ranking resources in their vicinity. As well, the unique landform may have been ideal as a defensible location.

### LATE HOLOCENE

Based on a variety of paleoenvironmental indicators, it appears that a series of major droughts affected much of California during the Middle/Late Transition (1050-600 calBP; Stine 1994). In particular, the effects of the Medieval Climatic Anomaly drought intervals, beginning around 1000 calBP, had a severe effect on hunter-gatherer populations.

One result of this climatic instability should be the use of the coastline in higher frequencies to target more dependable marine resources, particularly near perennial fresh water sources. Coastal areas would be marked by a high proportion of residential sites that suggests a more mobile strategy. Evidence at these sites may also suggest higher frequencies of coastal use for shorter duration, if interior areas in the Lower Nacimiento have the same proportion of sites dating to this interval. Prehistoric groups may have turned to a more mobile settlement pattern as a means of risk-management, acquiring resources from all available locations. Late Holocene sites are expected to be more dispersed than those of the Middle Holocene, in order for coastal resources to support slightly higher population densities.

- **SITES IN THE SETTLEMENT SYSTEM:** Are diachronic shifts in the location of particular types of sites a result of changes in the distribution and abundance of marine resources brought about by environmental change, the changing importance of terrestrial resources, or resource intensification?

**MIDDLE AND LATE HOLOCENE**

The continuity of settlement strategies, subsistence pursuits, and material culture along the San Simeon Reef between 5500 and 700 calBP are assigned to a "Hunting Culture" phenomenon (Jones and Ferneau 2002a). The distribution and variety of sites along the San Simeon Reef, however, is based on a small sample of excavation and survey information identifying a small fraction of the diversity that once existed. This is particularly true for the current study area.

During intervals of short-term and sporadic fluctuations in rainfall and sea-surface temperature brought on by El Niño events and the Medieval Climatic Anomaly, there appears to be a decline in permanent residences and a concomitant increase in both short-term occupations and abrupt subsistence shifts. As a result, it is proposed that fewer and less substantial sites would be located in the interior relative to the coast due to a decline in fresh water and terrestrial plant resources. Populations would have responded to resource instability by adopting a mixed forager and collector subsistence strategy adjusted to the complex mosaic in terrestrial and marine resource distribution. Although populations remained low, resource intensification is expected at the settlement level as manifested in a gradual transition in behavior such as the use of more marginal environments and a diversification of settlement systems to target lower-ranking resource patches. Indications of increased trade or social factors such as extending marriage networks will show if social ties buffered these climatic changes.

**MIDDLE HOLOCENE**

It is expected that locations targeted for residential bases would have been those facilitating a great emphasis on procurement and processing of high-ranking resources (e.g., red abalone and pinnipeds) located in dense resources areas (e.g., kelp forests and nearshore waters). Due to low population density, the territory occupied by social units was probably larger during this time, and the richest coastal habitats would have been available without competition.

### LATE HOLOCENE

Specific to the Late Holocene, with an increased focus on fish, it is expected that greater numbers of residential sites would be located adjacent to productive fishing locations. Although populations remained relatively low, they are higher than earlier intervals, and an increase in territorial circumscription may have limited mobility.

- **VARIATIONS IN MARINE FAUNA UTILIZATION:** Are changes in the importance of different marine resources over time a result of environmental changes, marine resource intensification brought about by the depletion of resources or population growth, or adoption/ development of new technology? If it occurred, did intensification affect the marine environment by shifting the ecological balance between competing marine taxa?

### MIDDLE HOLOCENE

Previous research along the San Simeon Reef during this interval suggests that occupants focused on shellfish collecting and terrestrial mammal hunting, with limited use of marine fisheries. However, little is known about the subsistence focus or intensity of marine and terrestrial resources and the relationship to their change overtime within the current study area.

It is expected that during the Middle Holocene, highly mobile groups of low population density employed strategies to maximize the exploitation of high-ranked, diverse and dense resources in the region such as marine and terrestrial mammals, larger shellfish species such as red abalone, and easy-to-acquire nearshore fish. During periods of low population, site occupants would have has a narrower diet breadth that included high ranked resources from all easily accessible habitats. Based on available Middle Holocene water temperature data demonstrating cooler seawater temperatures, shellfish procurement strategies would have focused on red abalone. Protein-rich resources would have been obtained with minimal technology and minor labor investment and would not have require substantial investment in technology.

### LATE HOLOCENE

By the Late Holocene, it is expected that populations responded to climate-driven resource stress by intensifying existing subsistence strategies through technological innovation and resource intensification, with increased emphasis on fishing and dried fish storage. The advent of arrow points, large bowl mortars, bedrock mortars, and increased use of small watercraft are indicative of intensification during the Late Holocene. As fishing from watercraft and use of nets intensified, the diversity and density of kelp forest fish and small migratory species should have increased significantly over shore-caught species. Due to drought intervals, terrestrial habitats would have been less productive or reliable (e.g., resulting in a decline in fresh water and terrestrial plants and some terrestrial mammals) relative to marine environments with predictable and abundant fish species.

### MIDDLE AND LATE HOLOCENE

Although intensification occurred, population density remained low and dispersed across the region; therefore, the composition of marine taxa, particularly shellfish and fish populations, remained stable over time. The increase reliance of small shellfish (i.e., black turban snails) and fish (i.e., pricklebacks) may not be evidence of resources stress of over-harvesting. Harvesting of these small resources may be an optimal strategy due to ease of procurement, high yields, low technological investment, and the division of labor among members of the society (Rick and Erlandson 2000:631). Archaeological observations of shellfish ecology should be a reflection of environmental conditions that support or constrain the growth of particular species such as California mussel.

## ADDRESSING THE RESEARCH QUESTIONS

Based on the limited information about sites along the San Simeon Reef that are known to date during these intervals, this study is designed to acquire the basic information that will be used to address the research questions and form the foundation for further research. Specifically, required information pertains to the topics related to subsistence, settlement, and paleoenvironment. Dietary reconstructions based on midden analysis provide much of the foundation for the remaining topics, so they are discussed first and in greater detail than information pertaining to the other topics.

## DIETARY RECONSTRUCTION

Determining the nutritional role of the various resources available in a prehistoric economy has important implications for interpreting the structure of a given subsistence-settlement system, as well as broader issues such as the evolution of coastal adaptations (Erlandson 1988:107). A common goal of most archaeological research in the last twenty-five years therefore has been the reconstruction of prehistoric subsistence patterns. The stimulus for these efforts was the development of ecological perspectives in anthropology, with major contributions from evolutionary ecology and archaeological studies of prehistoric subsistence and settlement (Bettinger 1980:189). As inter-and intra-regional data has accumulated, the relative importance of marine and terrestrial environments has become intriguing. The relationship between dependence on marine versus terrestrial resources remains varies both spatially and temporally in response to environmental conditions, population change, and technological innovations. However, social factors such as sexual division of labor, family provisioning, show-off strategies (Hawkes

1991), and food preference should also be considered. Jochim (1976) suggested that the role of dietary constituents in a specific economy is assessed best in a cultural ecological context that considers various attributes of a resource (e.g., size of food package, nutrient composition, abundance, aggregation, seasonality, accessibility, reliability, risk) against available alternative resources as well as the dietary requirements, demographics, and technology of a given human population.

The research reported here is comparative in nature. It entails evaluation of the array of potential terrestrial and marine resources in the subsistence economy, and it also considers change between different time periods. Important short- and long-term environmental events are considered in light of their impacts on the quality and abundance of basic subsistence resources. Cultural variables, such as the relative cost involved in the search, procurement, and processing of various resources provide a context for proposing potential hunting strategies. The quantified data derived from all recovered faunal materials are used to define dietary composition. Once established, subsistence and settlement information is evaluated within the framework of optimization and intensification.

The nutritional returns inferred from subsistence remains can be considered with respect to a variety of food values, including calories, fat, protein, minerals, or a combination of these. Information to address this research goal requires a range of fine-grained floral and faunal remains identified to the most specific taxon possible. Although there is much debate about methods for deriving information from subsistence remains (e.g., Claassen 1991; Glassow 2000; Mason et al. 1998) this research employs a variety of methods (including MNI, NISP, and weight) to quantify dietary contributions that are consistent with those used in earlier local and regional investigations. These efforts conclude with converting shell and bone remains to meat weight ratios.

### SITE OCCUPATION CHRONOLOGIES

My research questions require fundamental data obtained from radiocarbon dating and diagnostic artifacts to bracket the time (or times) when sites were (and were not) occupied. Additionally, chronological information will provide the basis for inferences about: (1) contemporaneity of sites along the coast and in the interior; (2) the date of initial site use to infer population decline or expansion; and (3) the time span of occupation at each study site to develop rates of midden accumulation important to inferences of site mobility.

### SITE LOCATION, CONTEXT, SIZE, CONFIGURATION, AND INTERSITE VARIABILITY

A second essential requirement for addressing the research questions is spatial information on sites located in both terrestrial and marine environments. Due to private property access issues, the study area is rather narrowly defined as the coastline, and information on interior sites in the Nacimiento River Watershed will be based on a GIS database and existing archaeological records pertaining to inland occupations (Basgall 2003; Carpenter et al. 2004). Information on site size, frequency, and the depth of middens dating to specific periods will be used to address shifts in the importance of specific site locations and targeted environments.

### TEMPORAL VARIABILITY OF SUBSISTENCE PRACTICES

Assessing shifts over time in the distribution of sites and changes in the kinds of coastal resources inhabitants targeted requires specific information on the diversity, density, and relative importance of food remains present in middens. Relevant information includes plant, vertebrate, and invertebrate taxa represented in the remains and their proportional abundance. Additionally, identification of shellfish, fish, birds, reptiles, and terrestrial and sea mammals to the most specific taxon possible will assist with defining targeted species. These results will also allow inferences about whether the subsistence emphasized food resources, such as shellfish, that were the easiest to acquire with the least investment in technology or more costly resources (in technology and labor) such as marine fish and sea mammals were exploited.

### INTENSITY OF RESOURCE EXPLOITATION

Measuring the intensity of collecting and hunting specific marine and terrestrial resources will be key to addressing research questions. Indications at the site level would include a decrease in the size of shells of species (such as mussels and abalones); an increase in the proportion of smaller shellfish species such as limpets and chiton; a decrease in sea and terrestrial mammals; an increase in the proportions of more difficult-to-acquire fish species, such as inshore-offshore migrators; and an increase in the overall diet breadth. Intensification strategies would also be suggested in technology such as an increase in the abundance of fishing tackle such as bone gorges, net weights, and shell fishhooks; evidence of increased use of watercraft; and evidence of increased dependence on production of manufactured items for trade such as beads and ornaments. At the regional level intensified strategies would include establishment of socioeconomic alliances between territory-holding groups in the interior (i.e., inter-regional trade), a diversification of settlement systems, and increased use of more marginal/low-ranking environmental locations.

**SEASONALITY MEASURES**

Important information on evaluating the narrow brackets of time that sites were occupied, and therefore inferring mobility patterns to understand settlement systems, requires indicators of season(s) of site occupation. Although there are many problems associated with inferring seasonality (e.g., Jones 2003; Monks 1981) these data are fundamental in addressing research questions one and two. Inferences about the season of site occupation will be based on a variety of indicators, including the bones of migratory sea mammals (e.g., Northern fur seal), seasonally abundant fish (e.g., Northern anchovy, Pacific sardine) and migratory bird (e.g., loons) species; the presence of pinniped juvenile bones; and the remains of seasonal blooming plants in discrete associations. The results of regional studies based on oxygen isotope analysis on mussel shells will be used to establish the possible season of harvest (Jones et al. 2008a; Codding and Jones 2007).

#### RANGE AND VARIATION OF TOOL MANUFACTURE AND USE

Obtaining a range of formed tools and associated manufacturing refuse will assist in addressing all three research questions. Specifically, artifacts and manufacturing refuse that relate to different kinds of extractive and maintenance activities will assist with chronology, technological change, placement of sites in a settlement system, tool material change (e.g., chert versus obsidian), and inter-regional trade.

#### ENVIRONMENTAL INDICATIONS OF CHANGES

It is apparent that information on marine and terrestrial biology and the paleoenvironment are essential in addressing all three of the research questions. This information will be primarily gathered by examining existing data, as well as data obtained from geophysical and biological researchers in the region, to develop an understanding of environmental factors that might have affected subsistence and settlement patterns and the scheduling of patterns. First, information on the ecology of key species in intertidal habitats will include data on competition from macrophytes (algae and surfgrass), and predation by sea stars. These data will be collected through existing species lists and information obtained from marine biology groups surveying the Reserve's intertidal zone. Data on geophysical characteristics and changes such as landform stabilization, sea cliff erosion, upwelling, wave action and elevated wave exposure, and bedrock substrate were collected during collaborative studies with geologist Dr. Martin Stokes, School of Earth, Ocean and Environmental Sciences, University of Plymouth, and geologist Dr. Antonio Garcia, Department of Physics, California Polytechnic State University, San Luis Obispo.

Paleoenvironmental characteristics and changes in sea level rise and sea surface temperatures, particularity prior to and during the period spanning 5500 and 4000 calBP (when Middle Holocene sites are first occupied) and around 700–600 calBP (at the onset of the Late Period, when groups reappear along the coast after the Medieval Climatic Anomaly occupational hiatus) are integral to this study. Information that can assist with paleoenvironmental indicators includes taxa of shellfish (e.g., the prevalence of red abalone shells is indicative of cooler water temperatures than present) and fish (e.g., warmer water species such as barracuda).

Currently, the most high-resolution records of the paleoenvironment pertain to seawater paleotemperatures of the Santa Barbara Channel region (Kennett et al. 2007). To the north, recent oxygen isotope research in Big Sur provides new information on sea surface temperatures (Jones et al. 2008a). As there is currently a paucity of sensitive paleoenvironmental reconstructions along the central California Coast, the best information will be comparative, using Santa Barbara Channel, Big Sur, and Monterey Bay data.

### SETTLEMENT ORGANIZATION

Binford's model of hunter-gatherer settlement pattern organization and evolution is used here to investigate seasonality and to model population movement along the north coast of San Luis Obispo County. Site types for the San Simeon Reef are adapted from the forager−collector continuum model (Binford 1980) and are elaborated as a result of a review of existing site data and various models of settlement other researchers in the area have suggested. Within the study area, sites may be classified as primary residential bases, short-term residential sites, brief occupation sites, procurement locations, and ideological sites. Assigning sites to particular types is based on size, midden density, and artifact assemblages, all of which provide a measure of the general diversity of activities. Ascertaining the contemporaneity of these sites is often difficult, particularly on the basis of surface observations, and relies on radiocarbon dates and/or diagnostic features and artifacts.

Residential bases are long-term habitation sites or village locations marked by substantial middens deposits with high artifact assemblage diversity. These sites are situated in environmental settings that provide access to a mixture of coastal and terrestrial resources, contain trade and exchange items, have evidence of a wide range of on-site activities (processing, manufacturing and maintenance) due to their diverse tool assemblages, and contain midden deposits containing a wide range of faunal materials. Glassow (1997a:154) suggested that these sites are a focal point in a settlement system, optimally located for obtaining a variety of food resources, with people regularly returning to the site in the course of a seasonal round over a period of years.

A second site type is the short-term residential or seasonal base. These are usually smaller sites with sparse artifacts relative to faunal remains. Although they may contain middens, they have a more limited range of artifacts than the long-term residential bases. These sites include campsites where relatively limited occupations took place, and they may have been seasonal or multi-seasonal locations regularly visited during the annual round of movement to exploit specific resources.

Brief encampments are discrete sites associated with sparse and rather shallow deposits of artifacts and subsistence remains. They may contain features, such as bedrock mortars, but they lack developed middens aside from sparse shell scatters. These include field camps where a small group of individuals lived for a limited period of time to conduct a discrete activity.

Quarries and bedrock mortar sites characterize procurement locations. These sites are locations for the extraction of raw materials, although bedrock mortars also imply food processing. It is assumed that these are nonresidential sites where activities were focused on the procurement and initial processing of a specific, targeted resource. Alternatively, plant and lithic material may have also been acquired within an embedded strategy of movement between sites. Separate production areas may be related to field camps, but are regarded as different sites.

The fifth site category includes locations associated with ideological activity, evidence of which includes aesthetic viewsheds, rock art, or pit-and-groove rocks. Although chronologically difficult to place, as their use may have changed over time, it is assumed that the locations were associated with ideology. Grant (1965) suggested that most of the rock art sites of the geometric style observed in the Chumash areas were created over the last one thousand years. Such sites are generally situated on promontories. To date, these sites are poorly understood, as they are generally located on private property and are inaccessible.

To date, relatively minimal knowledge exists concerning basic site functions and settlement systems along the southern San Simeon Reef over time. North of the study area, Jones (2003:185) suggested that periodic seasonal aggregation and dispersal into smaller groups may have been an effective method for coping with the biodiveristy of the Big Sur Coast and Santa Lucia Range. Based on the preponderance of residential sites and inferred seasonal movements between them, Jones sees the settlement pattern as rather a hybrid of Binford's (1980) two basic settlement systems. Recent studies have provided additional clues concerning mobility and settlement along the central coast. It is known that coastal inhabitants collected shellfish year round and appear to have occupied residential bases throughout the seasonal cycle, while interior occupants harvested mostly in the spring and early summer. Findings suggest two inter-dependent groups with distinct seasonal settlement patterns: inland people, reliant on acorns and nut crops harvested in the fall, and coastal inhabitants who did not use interior plants as intensively (Jones et al. 2008a:2286). In contrast, the Chumash occupying the Santa Barbara Channel region at the time of European contact are characterized as having a collector type settlement system (Glassow 1996:129). The ethnographic and archaeological data collected to date on the

San Simeon Reef will be used to evaluate the information relative to Binford's settlement model as modified here, while observed settlement patterns in the surrounding regions will be used to glean insights into local adaptations.

### SUMMARY OF THE THEORETICAL BASIS OF THE RESEARCH

Integrating historical, cultural, and human behavioral ecology paradigms to address research objectives and expectations will provide significant insights concerning human subsistence and use of various environments and resources along the southern San Simeon Reef over a 5,000 year time span. Taxonomic identification and the quantification of faunal remains will demonstrate the importance of certain species and habitats within human subsistence strategies. Furthermore, these data will provide valuable insights on the possibility of human impacts on local invertebrate, fish, and mammal populations and biotic communities. When used in conjunction with paleoenvironmental information, the patterns observed over the course of my research can be systematically evaluated to understand the dynamic relationship between the environment and prehistoric human foraging.

# CHAPTER VI: ARCHAEOLOGICAL METHODS

The primary goals of this research are to reconstruct human settlement, subsistence, and associated activities from data acquired at the four study sites. Reaching these objectives require a multidisciplinary strategy that draws from archaeology, biology, paleoecology, and ecology. Field sampling strategies and laboratory procedures and analyses were directed towards identifying the range of cultural materials that could generate data sets to address research objectives. Field methods included pedestrian surveys and site documentation, surface collection of artifacts, and an excavation program. Laboratory methods encompass the processing of faunal and artifact assemblages from surface collections and subsurface excavations as well as specialized studies of time-sensitive artifacts, obsidian hydration and source analyses, and radiocarbon dating. Additionally, two earlier collections from a salvage project at CA-SLO-1622 and SLO-1677 were analyzed as part of the present study. Although focusing primarily on a high-resolution sampling strategy that relies on the recovery of faunal microconstituents, the excavation methods also focused on generating a large enough excavation volume to identify site components and their constituents. Site collections are curated at the UCSB Repository for Archaeological and Ethnographic Collections under Accession Number 696. Summarized here are the methodological decisions made during the course of my research.

## FIELD STUDIES

Field methods were designed to identify site locations and boundaries, to collect a sample of subsistence remains and artifacts, and to record information about features. Field studies were carried out in collaboration with local Salinan and northern Chumash representatives. The first phase of this undertaking was a mixed strategy pedestrian survey of the 1000 acres within the landholdings of the UC Reserve (Joslin 2006) and the Griswold Ranch (Figure 6.1). All marine terraces, gentle hill slopes, and ridge tops were intensively walked in 10 m transect intervals by crews of six archaeologists. Marine terrace edge exposures allowed for excellent visibility along the western extent of both the Reserve and Griswold Ranch. Steep, rugged slopes required a more cursory strategy of walking deer trails from the top of the ridge down slope to the marine terraces. Although generally thought to be of low archaeological sensitivity, the steep topography and ridge top along the eastern extent of the survey area were inspected for small sites, such as lithic quarries, bedrock mortars, tool retouching locations, or shrines. Surveying the 1000 acres around the study sites allowed for a greater understanding of the topography, geology, plant community composition, opportunity to identify and record the constituents of pericoastal sites situated within areas covered by chaparral, coastal sage, oak woodlands, and


Figure 6.1. Primary Study Sites and Survey Acreage (Cambria 7.5' Quadrangle 1959 (1979)).

pine forests. Immediately following the survey all sites located on the properties were formally recorded, mapped, and GPS points collected at site boundaries and key environmental features.

After site documentation, a testing program was conducted at four sites: CA-SLO-1295, SLO-1622, SLO-1677, and SLO-2563. Considering how little was known about the nature of the sites at the onset of the project, the testing program focused on characterizing midden constituents and chronology. Systematic excavations focused on identifying intact deposits to provide information on the diversity of food categories, artifacts, and features and changes in these remains through the sequence of site occupation. Due to the slight differences in soil type, landform and cultural constituents between the sites, slightly different field strategies were applied.

To characterize the species in the intertidal zone and to locate previously identified sites, I surveyed seven miles of coastline from Point Estero to Cambria. This survey created a foundation for understanding the nature of littoral resources that may have been available to coastal foragers along the local rocky shoreline. Additionally, I collected shell samples for radiocarbon dating from a previously unidentified red abalone midden at CA-SLO-2637 and a midden deposit at CA-SLO-327 near Point Estero.

Field studies were conducted in the fall of 2003 (SLO-1622 and SLO-1677) and winter of 2008 (CA-SLO-1295 and SLO-2563). The varying lengths of time of field work at the two sets of sites was due to constraints on access to the private landholding on which CA-SLO-1295 and SLO-2563 are located. During field studies, the crews intensively surveyed the site surface, surface-collected artifacts, excavated test units and associated column samples, and mapped the sites.  As summarized in Table 6.1, site sampling entailed excavating a total of nine excavation units.

Field studies at the sites were initiated with an intensive surface survey with a six-person field crew walking the length of the site in 3-m transects.  The site boundaries and surface artifacts were pin-flagged, and site datums were established.  Studies began with the establishment of a north-south m grid, and the grid was used to lay out units and to facilitate the mapping of surface artifacts.  Surface collections were limited to temporally diagnostic artifacts and/or formed tools that are indicative of specific subsistence and socioeconomic-related activities.  The location of each artifact, the site boundaries, and the site datums were then mapped with a "total station" system and Trimble station.

Unit locations were established, with the northwest datum corner tagged with the corresponding site excavation unit and grid number.  The only exception is CA-SLO-2563, Unit 1 in which the northeast unit corner was established as a datum due to the eroding terrace edge along the west

Table 6.1. CA-SLO-1295, -1622, -1677, and -2563 Excavation Unit Summary.

| Site (CA-) | Unit Designation | Depth (cmbd) | Size (M) | Screen Mesh Size | Cubic Meters |
|---|---|---|---|---|---|
| SLO-1295 | 1: S 33/ W 1 | 0 - 130 | 1 X 1[a] | 3 mm | 1.05 |
| | 2: S 47/ W 14 | 0 - 80 | 1 X .50 | 6 mm | 0.4 |
| | 3: N 7/ E 7.5 | 0 - 40 | 1 X .50 | 3 mm | 0.2 |
| | 4: S 24.5/ E 32 | 0 - 80 | 1 X .50 | 6 mm | 0.4 |
| | | | | Subtotal | 2.05 |
| SLO-1622 | 1: S 37.5 / W 23 | 0 - 60 | 1 X .50 | 3 mm | 0.3 |
| | 2: N 51.5/ W 14 | 0 - 90 | 1 X .50 | 3 mm | 0.45 |
| | | | | Subtotal | 0.75 |
| SLO-1677 | 1: S 20 / W 5 | 0 - 170 | 1 X .50 | 3 mm | 0.85 |
| | 2: S 7/ E 11.5 | 0 - 130 | 1 X .50 | 3 mm | 0.65 |
| | | | | Subtotal | *1.5* |
| SLO-2563 | 1: S 6.7/ W 0.5 | 0 - 70 | 2 X 1[b] | 3 mm | 0.7 |
| | | | | Subtotal | 0.7 |
| TOTAL UNIT VOLUME | | | | | 5.0 |
| Column Samples | | | | | |
| SLO-1295 | 1 CS (North Wall) | 0 - 130 | .20 X.20 | 1.5 / 0.4 mm | 0.052 |
| | 3 CS (North Wall) | 0 - 40 | .20 X.20 | 1.5 / 0.4 mm | 0.016 |
| | | | | Subtotal | 0.068 |
| SLO-1622 | 1 CS (North Wall) | 0 - 60 | .20 X.20 | 1.5 / 0.4 mm | 0.024 |
| | 2 CS (North Wall) | 0 - 90 | .20 X.20 | 1.5 / 0.4 mm | 0.036 |
| | | | | Subtotal | 0.060 |
| SLO-1677 | 1 CS (East Wall) | 0 - 170 | .20 X.20 | 1.5 / 0.4 mm | 0.068 |
| | 2 CS (West Wall) | 0 - 130 | .20 X.20 | 1.5 / 0.4 mm | 0.052 |
| | | | | Subtotal | 0.120 |
| SLO-2563 | 1 CS (East Wall) | 0 - 70 | .20 X.20 | 1.5 mm | 0.028 |
| | 2 CS (S12.4/ W 0) | 0 - 60 | .25 X .25 | 1.5 mm | 0.038 |
| | | | | Subtotal | 0.066 |
| COLUMN SAMPLE VOLUME | | | | | 0.314 |
| TOTAL CUBIC METERS EXCAVATED | | | | | 5.314 |

Note: cmbd- centimeters below datum; Column samples were processed using the Flote-Tech flotation system; [a] The five final levels (80-130 cm) were excavated as a 0.5 x 1.0-m unit; The unit was established along an eroding sea cliff wall and the west-east axis fluctuated between 0.50 and 1 m along with maximum extent of the western erosion.

sidewall. The units were excavated in 10-cm levels below the unit datum (the northwest corner) using shovels, hand picks, and trowels (Figure 6.2). In an attempt to ensure that the lower cultural deposits were not contaminated by loose materials falling into the unit, the ground surface around each excavation unit was cleared of vegetation and debris. The soil matrix recovered from the excavation units was screened in the field through 1/8 inch (3 mm) and visually inspected to determine soil characteristics, general categories of faunal remains and their relative proportions, and artifact destiny and diversity. Units 2 and 4 at CA-SLO-1295 were the only exceptions; their soil was screened through 1/4 inch (6mm) mesh. Observations were recorded on level records and summarized daily on unit records. All screen residuals were then bagged and labeled for transport to the University of California, Santa Barbara, Collections Processing Lab (UCSB Processing Lab). Fragile artifacts were individually bagged and tagged. Fire-altered rock from each level was collected in buckets, cleaned with brushes, examined, and weighed, and placed adjacent to the unit for later backfilling. Fire-altered rocks that had the potential to be ground stone were brought to the laboratory to be cleaned and inspected under a magnifying lens.

To complement the excavation units, column samples from small excavations (20 x 20-cm) into a wall of each unit were collected to obtain


Figure 6.2. Excavation Unit 1, CA-SLO-1295 with Dusty McKenzie Excavating.

samples of microconstituents. At CA-SLO-2563 a 25 x 25-cm column sample was collected to obtain the last intact vestige of the eroding midden. The samples were excavated with hand tools from the unit wall that appeared to retain the most integrity, avoiding roots and obvious bioturbation. All column samples were excavated in 10-cm levels. Deposits from each level of these 20 x 20-cm columns were double-bagged without any field screening and brought to the UCSB Processing Lab for flotation.

After completing the excavation of each unit, detailed profiles were drawn of the wall from which the column sample was excavated. Both dry and moist soil colors were noted for each stratum using the Munsell soil color chart. Unit locations were precisely mapped using a total station, and GPS points were collected at the northwest unit corner.

Although there is considerable debate about sample size in site interpretation, the relatively small excavation volumes were sufficient for fine-grained analyses and interpretation for quickly determining the depth, density, and distribution of cultural deposits. In light of the exploratory nature of this research, initial results allow for identifying and targeting baseline information for future, more robust studies. Furthermore, this approach is attractive when investigating multiple sites within the time frame and financial constraints of the current research.

**CA-SLO-1622 and SLO–1677**

Field strategies at the two UC Reserve sites focused on collecting samples from the relatively shell-rich middens that had not been excavated before. The small scale testing program entailed the excavation of two 1.0 X 0.5 m units at each site. Based on surface observations, units were placed in areas of the site that appeared to be the least disturbed from ground-burrowing rodents and also to contain the densest site materials. At CA-SLO-1622 the units were placed in the center of each locus in an attempt to characterize the constituents across the site, as Locus 1 appears to be predominantly a lithic deposit while Locus 2 is a relatively rich midden. Although shovels and picks were used to excavate the units, when the indurated red abalone middens were encountered, the levels were excavated with trowels and small picks to prevent damaging the whole shells and carefully expose the unit floor to ascertain if the shells were part of a burial.

In 1995 the installation of utility lines three to four feet deep and 24 inches wide through CA-SLO-1622 and SLO-1677 resulted in a salvage project (Singer 1995). Prior to the installation of a water line, Parker (1995) prepared an impact assessment and proposed mitigation measures for the 80/$m^3$ of proposed trenching at CA-SLO-1622 and 52/$m^3$ of proposed trenching at to SLO-1677. Before these measures could be implemented, two parallel backhoe trenches were excavated though each site, and artifacts were collected from the trench as well as across the site surface. These trenches run parallel to the Reserve access road. In 2001 the collections from this project were obtained by the author and UC Reserve Manager Don Canestro from a shed in an adjacent landholding, and field notes later were obtained by Michael Glassow. Because the 1995 materials were from two sites studied here, they are incorporated into the current research. The artifact collections were listed on a handwritten field catalog with some field notes (Singer 1995). Although the artifacts do not have the specific horizontal and vertical provenience recorded, they can assist with understanding these single-component sites. Further details on the analyses of the collections are provided in the *Laboratory Processing and Analytical Techniques* section.

**CA-SLO-1295 and SLO-2563**

At the two southern study sites (CA-SLO-1295 and SLO-2563), the primary objective was to identify if red abalone middens similar to those identified at the two Reserve site deposits (CA-SLO-1622 and SLO-1677) were present, and to determine whether other site components pre- or post- date these sites. To achieve this goal at CA-SLO-1295, the maximum surface extent of red abalone and red turban snail shells (both of which occur in high abundance in the red abalone middens) were pin-flagged, and a 1.0 X 1.0 m unit was established in the center of this site. In the upper (northern) and lower (southern) portions of the site, where the midden deposits contained no red abalone midden shells two additional 1.0 X 0.5 m units were excavated. A final unit, also a 1.0 X 0.5 m in size, was located in an area of high-density ground stone artifacts scattered on the site surface and along a road cut to characterize the nature of this deposit. The soil matrix within the 1.0 X 1.0 m excavation unit (Unit 1) and the 1.0 X 0.5 m unit in the ground stone locus was screened in the field through 1/8 inch (3 mm) mesh, while soil from the remaining 1.0 X 0.5 m units was screened through 1/4 inch (6 mm) mesh. Due to the homogenous nature of the midden and a decrease of cultural materials beginning at 70 cm below datum, the remaining five levels, i.e., 80-130 cm, were excavated as a 1.0 X 0.5 m unit. Two additional sterile levels (0.50 X 0.50 cm) were excavated to insure the alluvial and colluvial deposition, resulting from the steep hillslopes above the site, did not bury an earlier component.

Excavations at CA-SLO-2563 required a more complex approach. The field strategy was designed to obtain a sample from the small remaining portion of the midden that is rapidly eroding from the coastal terrace as a result of sea cliff retreat caused by exposure to the surf and exacerbated by cattle grazing. The sea cliff profile of site deposits presented a broad exposure that allowed estimation of the depth and nature of deposit prior to excavations. Recovery of the sample was therefore restricted to the western site margin that was in immediate danger of eroding into the ravine below the site. One 2.0 X 1.0 m unit (Unit 1) was excavated along the eroding sea cliff wall, and the west-east axis of the unit fluctuated between 0.50 and 1 m along maximum extent of the terrace edge. A second 25 x 25-cm column sample was collected at the southwestern edge of the site to obtain a sample from the last intact vestige of the eroding midden.

## LABORATORY PROCESSING AND ANALYTICAL TECHNIQUES

To standardize the data and assure its comparability, laboratory methods analytical definitions for artifacts are consistent with the work of previous researchers working in the San Simeon Reef (Hildebrandt et al. 2002, 2007; Jones and Ferneau 2002a; Mikkelsen et al. 2000). Screen residues were wet screened and after drying, all materials were sorted into general categories: gravel/non-cultural stone; debitage; formed tools; shell beads; ground and battered stone; plant fiber and seeds; charcoal; asphaltum; shellfish remains; mammalian, bird, and reptile bone; and marine fish bone. Due to the labor-intensive nature of processing shell midden samples, I taught a series of undergraduate laboratory classes where the students in these classes sorted the midden constituents under my direction. I ultimately checked all sorted materials, and identifications were cross-checking by specialists as necessary.

Column samples were processed with a Flote-Tech machine-assisted flotation system to recover charcoal and organic remains. After removing the soil matrix, the light fraction (organic remains) were captured in fine-grained 0.4 mm nylon mesh, and all remaining materials (the heavy fraction) were washed and screened over 1/16-inch (1.5 mm) and 1/8-inch mesh screen. The light fraction samples were weighed and cataloged without further processing. To recover the remains of schooling fishes, identifiable marine fish vertebrae were recovered from the 1/16-inch sample, and the unsorted residue was weighed and cataloged. All of the 1/8-inch and larger materials were sorted into general categories, with faunal remains identified to the most specific taxonomic category possible.

Special studies of artifact categories were initially completed by the author and then inspected by individuals with more specific expertise. Specialists who assisted with material identification include Ethan Bertrando (flaked stone artifacts); Robert Gibson (beads); Michael Glassow (ground and battered stone artifacts); Kim Carpenter and Phillip Walker (terrestrial and sea mammal bone); Ken Gobalet (fish remains); and Eric Wohlgemuth (floral remains).

**RADIOCARBON DATING**

Radiocarbon dating was used as the primary means of determining the age of deposits. Ten radiocarbon dates, six standard dates from Beta Analytic, Inc. and four AMS dates from CAMS Lawrence Livermore National Laboratory, were obtained from the archaeological sites. Four previously unreported conventional dates for CA-SLO-1622 and SLO-1677 are also presented. All the dated samples were from single red abalone (*Haliotis rufescens)* shells. Careful selection of shell samples for AMS dating was taken to insure the shell contained multiple growth lines (Culleton et al. 2006).

The calibration program CALIB 5.0.1 (Stuiver et al. 2005) was used to provide a calendar-age estimate for each of the dates, using a marine reservoir correction of 325±35 years developed by Jones and Jones (1992) and

Jones and Waugh (1995). Jones and Jones (1992) revised the Stuiver et al. (1986) correction factor based on dates obtained from shell and charcoal pairs and historic shells from the central coast. $^{13}C/^{12}C$ corrections were determined by the radiocarbon labs or were assigned an average of +410 years (Stuiver and Polach 1977). When referring to a dated assemblage, I often refer to the calibrated midpoint, not the intercept, recognizing that these dates are approximations of the age of each assemblage rather than the exact date (Darden Hood, personal communications 2010).

**OBSIDIAN ANALYSIS**

A small sample of seven obsidian flakes recovered from CA-SLO-1622 (n=5) and SLO-1677 (n=2) were geochemically analyzed by Richard Hughes of the Geochemical Research Laboratory (2009) and hydration band analysis conducted by Tom Origer (2009) of Origer's Obsidian Laboratory using standardized methods.

**ARTIFACT ANALYSIS**

A wide variety of artifacts was recovered during excavations, and the following provides a framework for defining classes of artifacts and analyses undertaken. The classification of specific flaked, ground and battered stone artifacts is presented in Appendix C.

**SHELL BEADS**: Key dimensions were measured on all 12 *Olivella* and *Mytilus* beads in the collections prior to typing and documenting the specimens

(Gibson 2009). The classification of the shell beads conforms with the bead typologies and chronologies established for the Santa Barbara Channel Region by King (1981, 1990a) and Gibson (1992b), and is consistent with typologies of Gifford (1947) and Bennyhoff and Hughes (1987).

**SHELL ARTIFACTS**: Other culturally modified shell artifacts include a small ornament preform, a shell fishhook blank, and modified fragments of abalone shell. Shell modifications included edge grinding, application of asphaltum, or drill perforation. All specimens were weighed and measured, notations of attributes were made, and as appropriate they were compared with C. King's (1990a) typology.

**BONE TOOLS:** Modified bone artifacts was measured, weighed, and classified according to function (Gifford 1940). When appropriate, bone tools were also classified following the regional typology established by Milliken (2000) that is based on morphological variation in the tool midsection and tip. Information on artifact morphology included completeness, the portion present if fragmentary, and type of modification.

**FIRE-ALTERED ROCK:** Burned rock included cobbles with dark brown, black or red color and/or angular cracks from thermal alteration were identified as fire-altered. For each excavated level, all rock was examined, weighed and recorded in the field. Artifacts re-used as fire-altered rock were classified as ground stone. Potential ground or battered stone artifacts were transported to the UCSB Collections Processing Lab for further analysis were identified as unmodified fire-altered rock, then added to the field total and returned to the completed unit.

## SUBSISTENCE REMAINS

The primary objectives of the faunal analysis were to determine the species hunted, collected, gathered, or fished and the relative temporal frequencies of their remains by taxonomic category. Patterns in the faunal assemblage were evaluated with respect to diet, taxonomic diversity, intensity of human exploitation, and implication for establishing site function and seasonality.

### MAMMALS, BIRDS, AND REPTILES

Vertebrate remains were sorted from all 1/8-inch screen samples. All of the bird, reptile, and mammal elements from excavation units and column samples were segregated from artifactual materials, washed, dried, and classified. Faunal remains were identified by direct comparison with reference osteological specimens in the Department of Anthropology's Faunal Analysis Lab, the Santa Barbara Museum of Natural History, and University of California, Davis. The author proposed preliminary identifications of diagnostic terrestrial and marine bone specimens. Phillip Walker reviewed several items, and after his untimely death, Kim Carpenter checked the remaining elements using the reference collection at the University of California, Davis.

Specimens were identified to the most specific taxonomic level possible based on diagnostic elements. Unfortunately, due to the highly fragmented nature of the mammal bone at all four sites, only a small proportion of the specimens could be classified to species. When possible, genus and species were given. Specimens were further identified as to element, part of element, side, and if possible, age. For the purpose of reconstructing diet, minimum numbers of individuals (MNI) were calculated for each site sample. Both units and column samples were analyzed using the taxon-specific mean meat yields reported by Dietz et al. (1988), Hildebrandt (1981), Mitchell (1988), and Simms (1984). The dietary indices used in this analysis are predominantly based on Jones (2003:67) (Table 6.2). The meat weight multiplier for snakes is estimated on the average weight of four adult gopher snakes (Cal/Ecotox 1999). This number is highly speculative and should be further evaluated.

In the absence of distinctive osteological characteristics, or when the bone was too fragmentary to observe diagnostic characteristics at the genus or species level, broader taxonomic categories were used (e.g., order or subclass) based on the size and thickness of the cortical and medullary bone tissue bone fragments. Specimens that could not be assigned to a class are

Table 6.2. Meat Weight Conversions for Mammals, Birds, Reptiles, and Fish Bone.

| TAXON | COMMON NAME | MEAN MEAT WEIGHT (G) | REFERENCE |
|---|---|---|---|
| Terrestrial Mammals | | | |
| *Odocoileus hemionus* | Blacktailed deer | 34.0 | Simms 1984 |
| *Canis* sp. | Coyote | 6.0 | Dietz et al. 1988 |
| *Sylvilagus* sp. | Rabbit | 0.6 | Simms 1984 |
| Land mammal general category | | 10.0 | Tartaglia 1976 |
| Alternative large mammal category [a] | | 34.0 | Estimated here |
| Alternative medium mammal category [a] | | 3.17 | Estimated here |
| Alternative small mammal category [a] | | 1.0 | Estimated here |
| Marine mammals | | | |
| *Callorhinus ursinus* | Northern Fur Seal | 72.0 | Hildebrandt 1981 |
| *Phoca vitulina* | Pacific Harbor Seal | 70.0 | Hildebrandt 1981 |
| *Enhydra lutris* | Sea Otter | 24.0 | Hildebrandt 1981 |
| *Zalophus californianus* | California Sea Lion | 120.0 | Hildebrandt 1981 |
| Pinnipedia | Pinniped | 24.2 | Glassow & Wilcoxon 1988 |
| Aves | Birds | 15.0 | Ziegler 1975 |
| Alternative Aves[a] | Birds | 1.32 | Estimated here |
| Serpents | Snake | 0.48 | Estimated here |
| Actinopterygii [b] | Fish | 27.7 | Tartaglia 1976 |

Note: [a]Alternative bird and mammal multipliers consist of the average of all expected central-coast species within the class size (Jones 2003:67); [b]Includes all fish; individual taxa calculated in Jones (2003:82).

termed indeterminate mammal. Bone condition (e.g., cut, burnt, abraded), quantity, and weight was also characterized. Mammal bone fragments that could not be identified to a taxon more specific than order were assigned to the following taxonomic categories, with bones of larger mammals classified on the basis of their thicker cortical bone.

- Large mammals larger than dogs (e.g., artiodactyls, bear, mountain lion)
- Large sea mammals larger than otter (e.g., pinnipeds)
- Medium mammals that are dog-sized (e.g., rabbits, hares, badgers, bobcat)
- Small mammals which are smaller than dogs (e.g., weasels, rodents)
- Small Aves (e.g., birds typically including passerines)
- Large Aves (e.g., cormorant- or loon-sized)
- Reptiles
- Indeterminate mammal fragment

## Marine Fish

Relatively high proportions of bones recovered during excavations were from marine fishes, primarily species in occupying intertidal waters above a rocky substrate. The sample population included all fish bone from the deposits of the nine control units wet-screened through 1/8-inch (3 mm) mesh, as well as the 1/16-inch (1.5 mm) and 1/8-inch (3 mm) flotation-screened residue from six column samples. Only identifiable vertebrae were collected from the 1/16-inch mesh column samples. Although numerous elements were recovered, including dentary, maxilla, paraspheniod, premaxilla, quadrate, and teeth, vertebrae were the most commonly identified elements. MNI were calculated for each unit and level, and the data derived from the fish remains are summarized as NISP. MNIs were calculated for each taxon represented in every 10 cm level per unit.

Fish remains were identified to the most specific taxon possible, following the naming and classification conventions of Love (1991) and Humann (1996). All fish remains were analyzed using comparative skeletal collections at the Department of Anthropology's Faunal Analysis Lab and the Santa Barbara Museum of Natural History. Ken Gobalet then confirmed (and corrected) preliminary classifications at the Department of Biology, California State University, Bakersfield. Dietary values of the fish were calculated using a mean meat weight conversion (27.7 grams) reported by Tartaglia (1976).

Based on cautions expressed by Gobalet (1997, 2001), my identifications were conservative. Consistent with the methods used by Gobalet and Jones (1995) and adopted for the region, identifications were made to the most specific taxon possible except where distinctions were uncertain. For example, Pacific sardine and Pacific herring (family Clupeidae) elements are difficult to distinguish, as are the different species within the surfperch family (Embiotocidae). Consequently, I did not attempt such distinctions. The problem with differentiating between small vertebrae within the prickleback family also necessitates reporting at the family (Stichaeidae) level. Conversely, certain elements and larger vertebrae are diagnostic.

**SHELLFISH**

The analyzed invertebrate sample is based on the shellfish remains in the 20 x 20-cm column samples from each site. The 1/16-inch mesh shell was dried, left unsorted, and catalogued with the bulk materials. Shellfish remains in the 1/8-inch mesh and larger were dried, sorted, and identified to genus or species level. Unidentifiable fragments are catalogued as 'Undifferentiated shellfish'. The shell samples collected from the excavation units were sorted and weighed, with identified species added to a master list of shellfish species present at each site. Shellfish and other invertebrate remains were identified using reference collections at the Department of

Anthropology's Faunal Analysis Lab and at the Department of Invertebrate Zoology Santa Barbara Museum of Natural History. Identification and nomenclature for shellfish remains follow Coan et al. (2000), Jensen (1995), Morris et al. (1980), and Ricketts et al. (1985).

To assess the dietary importance of the shellfish remains, shell weight was converted to meat values through the use of meat/shell ratios provided in Table 6.3. As a crabmeat weight multiplier was unavailable, an experimental ratio was generated using the hard shell dungeness crab (*Cancer magiste)* to represent the rock crab (*Cancer aniennarius*), which was the predominant *Cancer* species identified in the samples. After calculating the meat to shell ratio for the analogous species, the multiplier was reduced by 10%, the difference in average size between crabs (Phillips 2005).

Once sorted and cleaned, shellfish remains were quantified using the shell weight method, the standard for quantifying archaeological shellfish along the California central coast. Mason et al. (1998) have asserted that this method is an inappropriate form of quantification and argue for the MNI method. Although Glassow (2000) and others have replied to this criticism, at the most fundamental level, the MNI method is not an effective method for quantifying shellfish from the recovered sample. Specifically, MNI cannot always capture morphologically complex species such as barnacles and sea urchin that are abundant in rocky intertidal collections. Secondly, the shell

Table 6.3. Meat Weight: Shell Ratios for Shellfish Identified at Study Sites.

| Taxon | Common Name | Meat/Shell Ratio | Reference |
|---|---|---|---|
| *Haliotis rufescens* | Red abalone | 1.360 | Koloseike 1969 |
| *Haliotis cracherodii* | Black abalone | 0.944 | Vellanoweth et al. 2002 |
| *Haliotis* spp. | Abalone | 1.150 [a] | Rick 2007 |
| *Lithopoma gibberosa* | Red turban | 0.307 [b] | Bleitz 1990 |
| *Mopalia* spp. | Chiton | 1.159 [c] | Koloseike 1969 |
| *Cryptochiton* spp. | | | |
| *Collisella* spp. | Limpet | 0.780 | Jones and Haney 1992 |
| *Protothaca staminea* | Littleneck clam | 0.527 | Dietz el al. 1988 |
| *S. purpuratus* | Purple sea urchin | 0.426 | Jones and Haney 1992 |
| *Tegula funebralis* | Black turban | 0.365 | Erlandson 1994 |
| *Tegula brunnea* | Brown turban | 0.365 [d] | Erlandson 1994 |
| *Mytilus californianus* | California mussel | 0.298 | Erlandson 1994 |
| *Cancer* spp. | Crab | 0.563 | Joslin 2006 |
| Minor food species/unidentified | | 0.952 | Jones and Haney 1992 |

Note: [a]Black and red abalone average; [b]*L. gibberosa* ratio is based on *L. Undosum* reduced by 1/3 or .154; [c]Chiton ratio is based on related *Nuttalina californica;* [d] *Tegula brunnea* ratio is from slightly smaller *Tegula funebralis.*

weight-meat weight method is the predominant method employed by archaeologists for quantifying California shellfish. Although Rick (2007) and Sharp (200) have effectively used a combination of these methods on northern Channel Island assemblages, within the study area a leap to using MNI would produce results that would not be comparable to existing local data sets. As employed in this research, dietary quantification generated from the meat weight of important faunal remains is intended as a relative index and do not intended to necessarily reflect the diet in absolute terms. Similar to calculations derived by other California midden researchers working on subsistence, these calculations are useful for a comparative approach, identifying relative changes in the focus on specific food categories over time.

## California Mussel and Red Abalone Size and Age Profiles

In addition to the standard shellfish species identification and quantification, data were collected to investigate potential intensification of shellfish collection harvesting, possibility of human predation impacts on shellfish populations, and changes in intertidal ecology over time. This included collecting the length of complete or almost complete California mussel umbos and red abalone shells from the four sites using calipers. Thousand of shells in the assemblages, representing a range of shell sizes, were measured and provide excellent opportunity to estimate the average size of these two important dietary contributors over time.

Recovered California mussel shell fragments with intact umbos and red abalone shells were measured to compare the size distribution of the study site populations with other archaeological samples and living populations. California mussels are typically the most abundant rocky open coast species in shellfish assemblages in California and as a result have received much attention regarding their significance in the prehistoric diet (e.g., Jones 1996; Jones and Richman 1995; J. Rudolph 1985; Whitaker 2008b).

The maximum length of mussel shells at the time of harvest was inferred from whole and nearly whole specimens using a size template developed by White (1989) and commonly used by central coast shell midden researchers (Figure 6.3). This template was used over other methods such as measuring umbo thickness, to collect data comparable with that of local researchers. The template allows the use of fragmented shells to estimate length of complete elements, therefore increasing the sample population beyond complete mussel shells.

The recorded information was then used to compare alternative collection practices, defined as two hypothetical harvesting strategies, the “plucking” of individual shellfish, and the “stripping” of mussels which typically grow together in dense beds (White 1989:127-130). The “plucking versus stripping” dichotomy therefore refers to the collection of species based on ecological differences. Building on Whites’ notion of efficiency, and Bouey

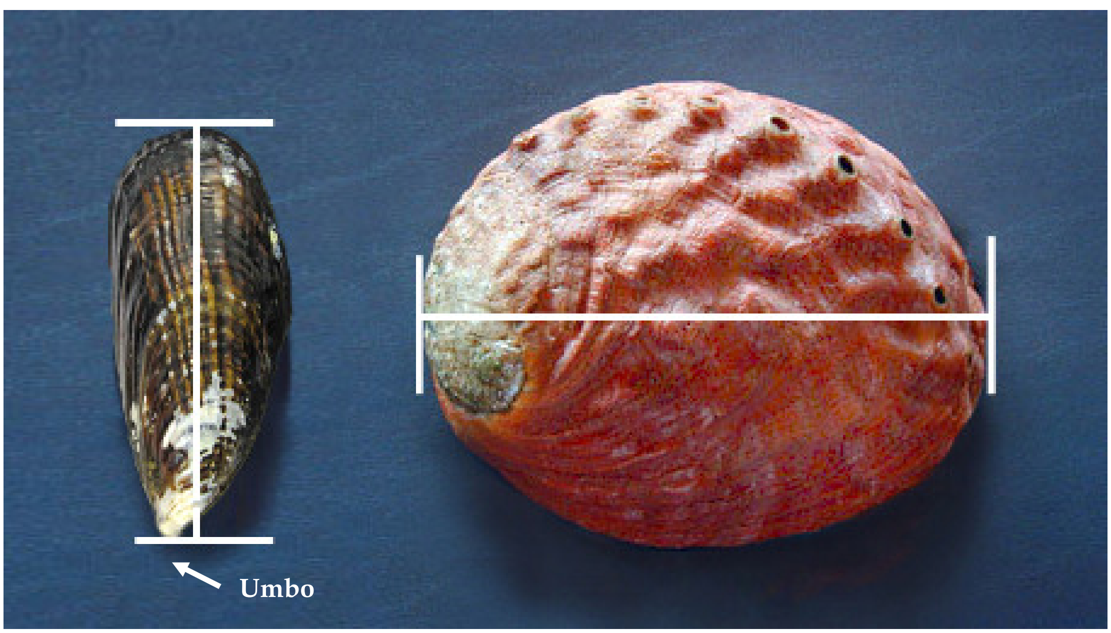


Figure 6.3. California Mussel and Red Abalone Dimensions. Mussel size was quantified using shell fragments with umbo present (White’s 1989 template)(left); red abalone size was quantified using maximum shell length (right).

and Basgall (1991) criticism, Jones and Richman (1995) conducted experiments in mussel collection in contemporary mussel beds and qualitatively evaluated the two techniques. The findings suggest that plucking was indeed the most efficient strategy, and that plucking had the greatest advantage in areas of infrequent human harvesting (Jones and Richman 1995:51). Although the technique of measuring mussel valve length from fragments may be criticized (e.g., the skill and variability among individual data collectors) as well as the harvesting strategy (e.g., the paucity of ethnographic support for such a dichotomy), it is still a useful method for addressing the research question raised here. Additionally, this method has been applied to multiple temporal components, making the quantification of mussel shell size useful for identifying relative changes in the diet over time.

Along a similar line of reasoning, all complete and nearly complete red abalone shells collected from the site samples were measured and compared with contemporary profiles and archaeological specimens from sites along the San Simeon Reef (Figure 6.3; Bouey and Basgall 1991; Ferneau 1998; and Jones and Ferneau 2002a). Shell size was determined by measuring the maximum shell length. As with the mussel shells, size measurements were grouped into two cm intervals. To increase the sample size, fragmentary specimens (greater than 50%) were fitted to templates, which had been drawn on a sheet of paper by tracing the perimeter of complete shells of various sizes. Compared with other shellfish species, the slow growth patterns of the red abalone make them more susceptible to impacts from human predation, as individuals require several years to reach maximum size (Bouey and Basgall 1991).

### FLORAL REMAINS

Analysis of floral remains was conducted to assess whether there was intensive use of plants associated with the dense concentration of ground and battered stone in the vicinity of Unit 3, CA-SLO-1295. After removing the soil matrix during flotation, the buoyant light fraction (floating organic remains) captured in the screens was allowed to dry, size-sorted, and bagged. All materials collected from the Unit 3, 0-40 cm column sample light fraction were submitted to Eric Wohlgemuth for initial, "scan" analysis. The largest light fraction size grade (2 mm) was scanned in its entirety, while 70-80 percent of the smaller grades was scanned. Although scans do not produce the numerical counts of varying plant taxa, they can provide an overall characterization of the nature of archaeological plant remains.

## TAPHONOMY

Our understanding of the taphonomy, site formation processes, and site disturbances has dramatically improved the task of reconstructing and interpreting the past (Lyman 1994; Schiffer 1987). As Schiffer (1987: 121) stated, "The archaeological record is not a safe haven for artifacts". It is therefore important to identify the historic and contemporary activities that have altered the cultural landscape of the study area. First, although the study area is largely undeveloped, ranching activities and infrastructure development (i.e., construction of fences, placement of watering areas, plowing, and hay cultivation) have directly and indirectly altered the landscape. Indirectly, cattle ranching has resulted in stream entrenchment and accelerated erosion along the fragile terrace edge through overgrazing and the stripping of vegetation and soils. Directly, trampling of grazing animals has affected the upper portions of deposits. These processes result in both fragmentation and mixing of cultural materials. Second, burrowing animals have bioturbated the deposits, resulting in additional fragmentation and mixing (Erlandson 1984; Johnson 1989). Finally, numerous natural agents are actively altering the archaeological record within the study area, including marine erosion, fluvial processes, and colluvial slumping, that are resulting in the erosion and redeposition of cultural materials.

However, limitations resulting from such disturbance factors are outweighed by the fact that the lands and archaeological sites studied here are relatively intact compared to the destruction of the landscape due to land development along much of the central California coastline. Both the Reserve and Griswold Ranch are protected from the public, and therefore looting has not taken place, and complete formed artifacts are still present on the surface. Additionally, beyond the ravages of coastal erosion, the stratigraphic profiles are generally intact and represent meaningful chronological intervals. Furthermore, although preservation of archaeological materials is variable, multiple data sets at the regional, site, and artifact level can still provide important information about the prehistory of a little-known region.

# CHAPTER VII: CA-SLO-1295 − THE GRISWOLD SITE
# AN EARLY PERIOD DEPOSIT

The Griswold Site, CA-SLO-1295, is a dense shell midden situated on the southeast side of an unnamed creek (Figures 7.1 and 7.2.). The site is located on a private ranch between Estero Point and Cambria. The deposits date from 5190 to 2860 calBP, representing a single-component site occupied over the course of the Early Period (5500 – 3000 calBP). Measuring 75 x 100 m the site contains an extensive midden that extends across the lower marine terrace. A distinct locus on the northern site margin (Northern Locus) contains a dense surface scatter and subsurface concentration of ground stone, cores, and core tools but no faunal remains (Figure 7.3).

During the approximately 2300 years of site occupation, several significant environmental and cultural events were occurring across California. Notably, between 6000 and 5000 calBP significant changes in technology, land, and resource-use occurred in central California that influenced developments later in prehistory. Since at least the 1920s archaeologists have recognized this interval as largely synchronous with a trend towards the diversification of coastal hunting and fishing technologies, represented by an increasing abundance of mammal, fish, and bird remains in archaeological deposits (e.g., Rogers 1929; Wallace 1955; Warren 1968). However, as Erlandson and Glassow (1997) point out, much remains to be

Figure 7.1. CA-SLO-1295 Site Overview Looking West With Crew Onsite.

learned about the timing, meaning, and causes of such changes and their geographic variation.

Less research has been focused on the Middle Holocene compared to other intervals, as regional studies often focus on Early Holocene subsistence and settlement, and the rise of social complexity in the Late Holocene. Coinciding with the onset of the Middle Holocene, Early Period occupations on the central California Coast are extensive. However, no sites dating to this interval along the open coast of the southern San Simeon Reef had been excavated and analyzed prior to this work.  The Griswold site therefore

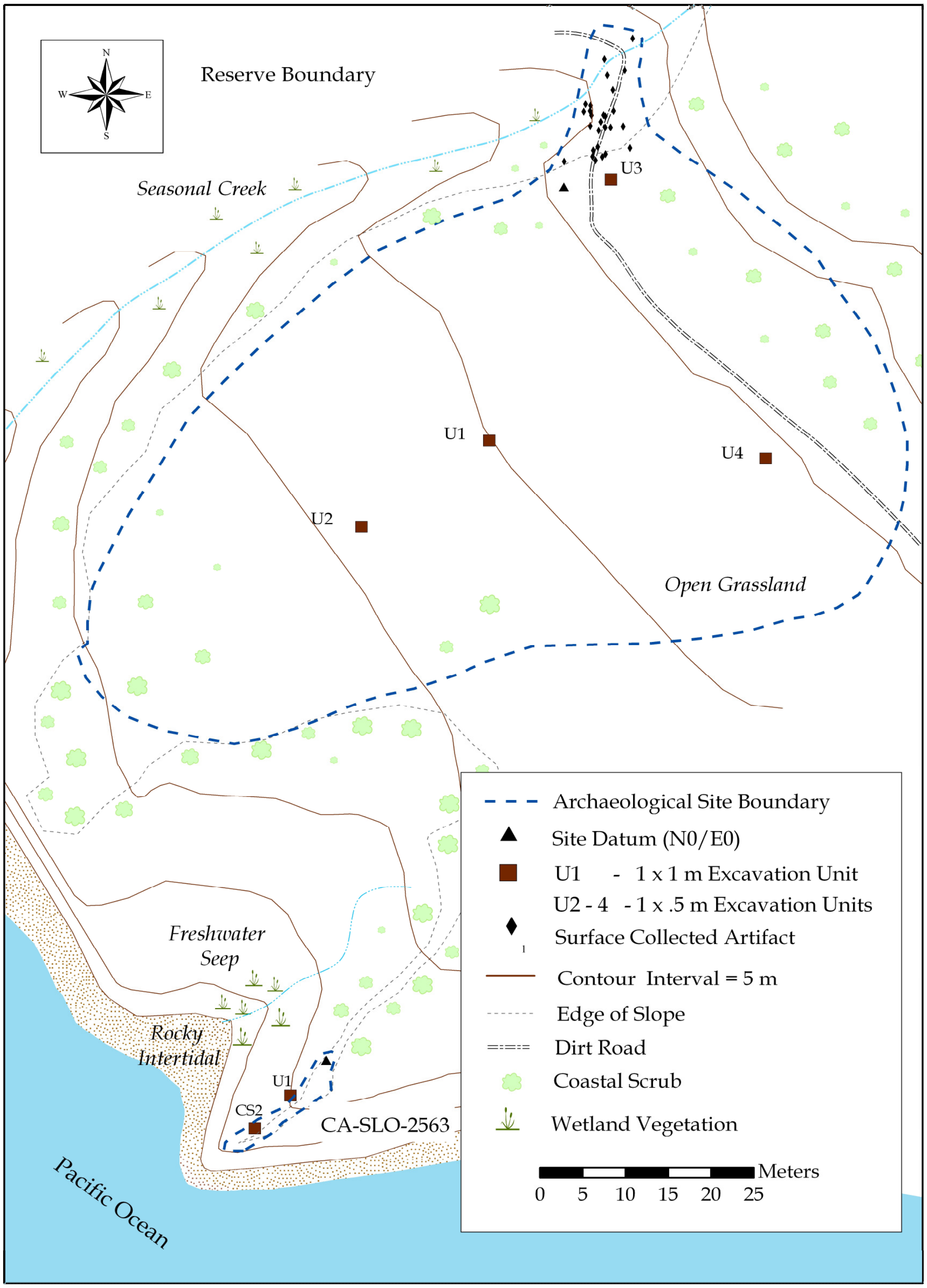


Figure 7.2. CA-SLO-1295 Site Map.

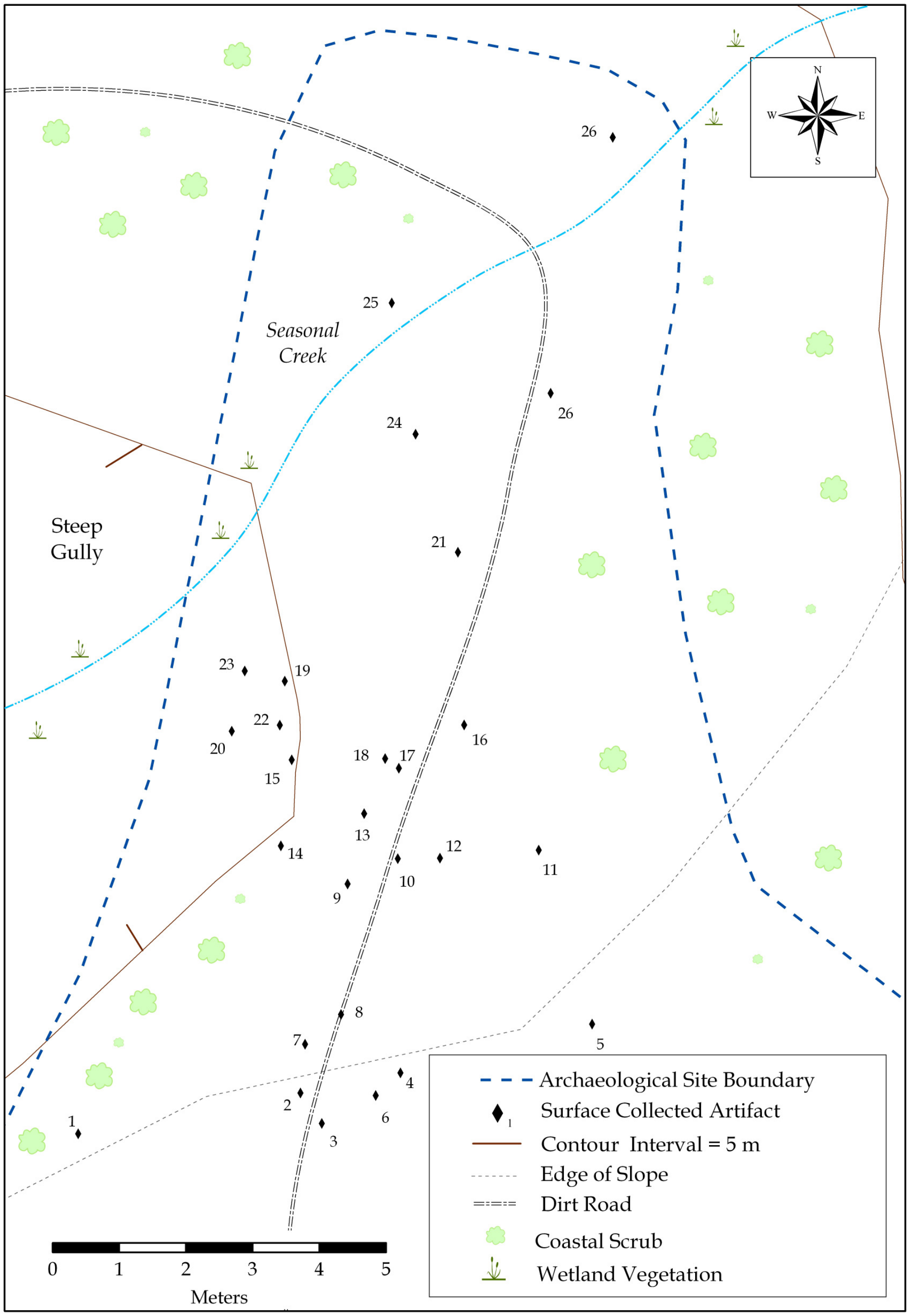


Figure 7.3. CA-SLO-1295 Northern Site Locus with Surface Collected Artifacts.

provides an excellent opportunity to refine local culture history and examine subsistence practices during the Early Period.

## SITE ENVIRONMENT

The site is situated on a broad marine terrace that is rapidly eroding into the Pacific Ocean to the west-southeast. It is located on a southwest-facing slope that extends from the base of the coastal foothills to the terrace edge at elevations between 12 and 60 m above sea level. In the eastern area, the slope is rather steep, at 45 degrees. Freshwater sources are reliable; an unnamed seasonal creek trends along the western edge of the site and flows into the ocean below the site, and a small spring emits of the sea cliff 25 m to the south.

Vegetation on and adjacent to the site includes coastal scrub, annual grassland, riparian, and chaparral communities. Across the terrace edge can be found coffee berries, coastal sagebrush, poison oak, blackberries, lupine, willows, and annual grasses, with riparian annuals occurring along the creek. A productive stand of giant wild rye (*Leymus condensatus*) is located at the spring below the site. On-site vegetation consists of invasive grasses resulting from cattle grazing, with scattered coastal sage, coyote brush, and bush lupine.

## LOCAL ARCHAEOLOGICAL CONTEXT

The Griswold site was recorded in 1990 by members of the San Luis Obispo County Archaeological Society. A nearby site, CA-SLO-1294, is located approximately 350 m southeast on the same marine terrace. Exposed along the eroding marine terrace edge, the site contains the same types of rocky intertidal shellfish as CA-SLO-2563, although a greater proportion of red and black abalone was observed. A radiocarbon date from near the base of the 60 cm thick deposit produced a date of 4360 – 4140 calBP (Dills 1990), suggesting that this portion of CA-SLO-1294 is roughly contemporaneous with the CA-SLO-1295 midden. A third sites (CA-SLO-2563), also excavated for this research, is situated 50 m south of CA-SLO-1295 at the edge of the marine terrace. CA-SLO-2563 dates to between 690 and 920 calBP. Collectively, these sites suggest human occupation of this marine terrace between 5100 and 690 calBP, with an occupational hiatus during the Middle Period, between 3000 and 1000 calBP.

## SITE SOILS AND STRATIGRAPHY

CA-SLO-1295 is situated on a remnant of an uplifted Pleistocene marine terrace (Stokes and Garcia 2008). Surface soils are within the Still-Elder series, in the Still gravelly sandy clay loam phase. These deep soils are characterized by well-drained sand loam and gravelly sandy clay loam formed on alluvial fans and plains and are derived from sedimentary rocks (Ernstrom 1977:85, Sheet 4). In the northern site area, on the steeper slopes, soils are shallow and excessively drained, corresponding to an area mapped as Gazos-Lodo clay (Ernstrom 1977:48, Sheet 4).

Four excavation units were placed across the site in areas that appeared to be relatively intact. A total volume of 2.186 $m^3$ of deposits was excavated. The stratigraphic profile of the unit and exposures along the creek and marine terrace were examined to determine site integrity.

All three units placed in the midden (Units 1, 2, and 4) revealed the same profiles and continuity in site structure, so only Unit 1, the deepest, is characterized here (Figures 7.4 and 7.5). The midden is approximately 120 cm thick, with archaeological materials equally distributed from the surface to 90 cm below datum, showing no distinct concentrations, features, or clear stratigraphic breaks. Burrowing activities are observed in all units.

It appears that the depositional environment, i.e., alluvial and colluvial sediments derived from the adjacent hill slopes, kept pace with soil development, resulting in a thick deposit lacking clear stratigraphic units. This process may be the driving force in the soil profile, and could have carried archaeological materials from upslope as well. There does not appear to be a sudden depositional event, as unsorted decomposing sandstone gravels are throughout the deposit.

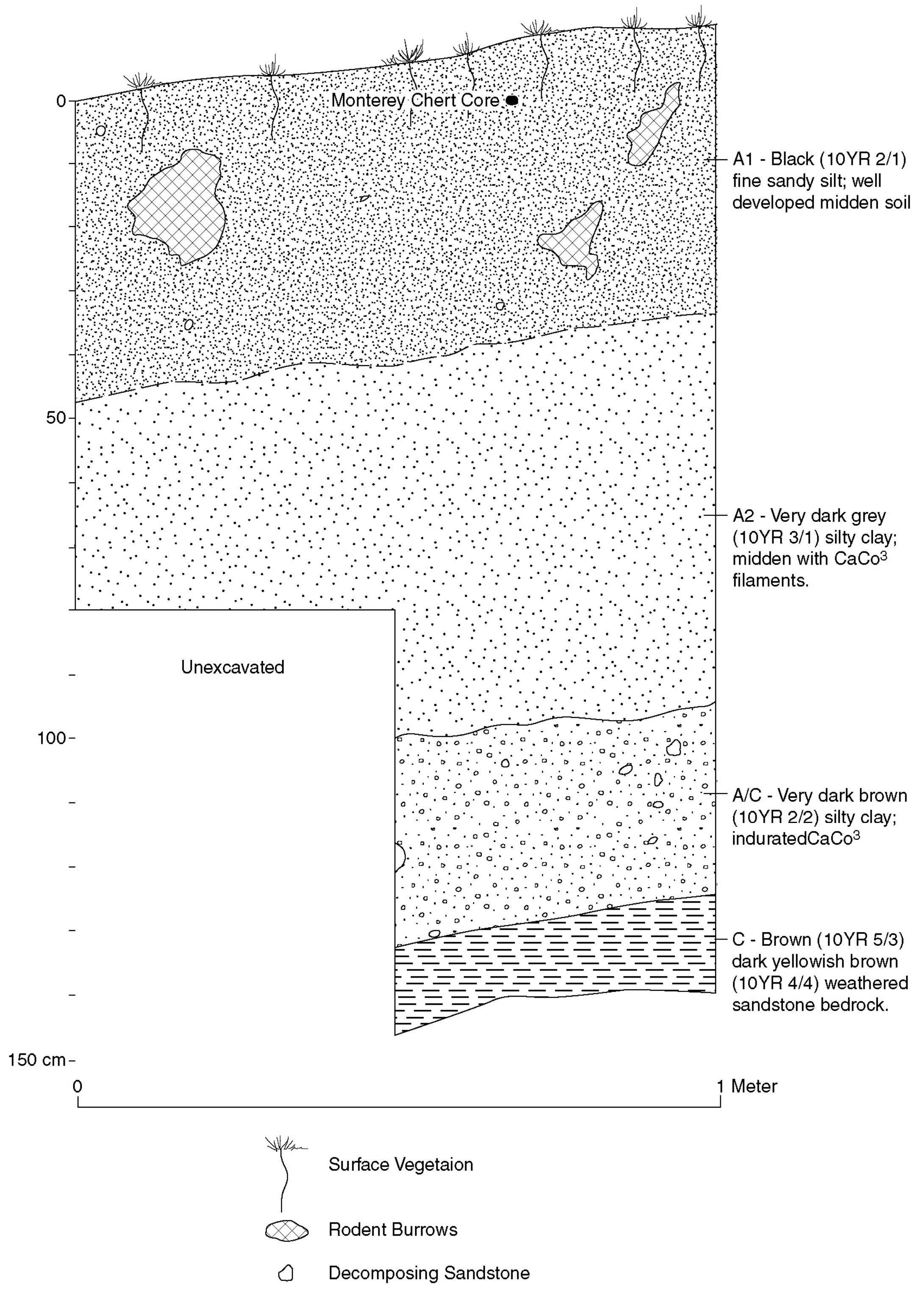


Figure 7.5. CA-SLO-1295 Exavation Unit 1 North Wall Soil Profile.

The upper 50 cm of Unit 1 is a black shell midden (A Horizon: 10 YR 2/1) composed of a fine sandy silt containing sub-rounded pea-sized gravels (Figure 7.5). An indistinct boundary occurs at around 50 cm, where an A2 transition to a very dark grey (10YR 3/2) soil was encountered and continued to approximately 100 cm. In the lower portion of the A2 midden there is a decrease in cultural materials as yellowish brown sandstone pebbles become more common. Dense calcium carbonate (CaCo3) filaments start at 70 cm and increase with depth, indicating leaching from the overlying shell deposits and demonstrating stability in the deposit. Underlying this is an A/C Horizon (10YR 2/2, 100–130 cm) containing indurated clay soils and a sharp decrease in cultural materials. The C Horizon is dark yellowish brown (10YR 5/3) sandstone bedrock.

The cultural deposit in Unit 3 is resting on weathered sandstone bedrock, with little soil development (Figures 7.6 and 7.7). The profile has only two soil horizons, and the deposits of each contain no faunal remains but an abundance of cores, core tools, and ground and battered stone. The first 20 cm (A Horizon) are dark yellowish brown (10 YR 3/4) clay soils with dense blocky sandstone cobbles and gravels. Beneath this is a 20 cm A/C Horizon, distinguished by sticky clay soils and fragments of blocky sandstone bedrock. The sterile C Horizon is an indurated sandstone bedrock.

Figure 7.5. CA-SLO-1295 Excavation Unit 1, North Wall, 0 — 150 cm.

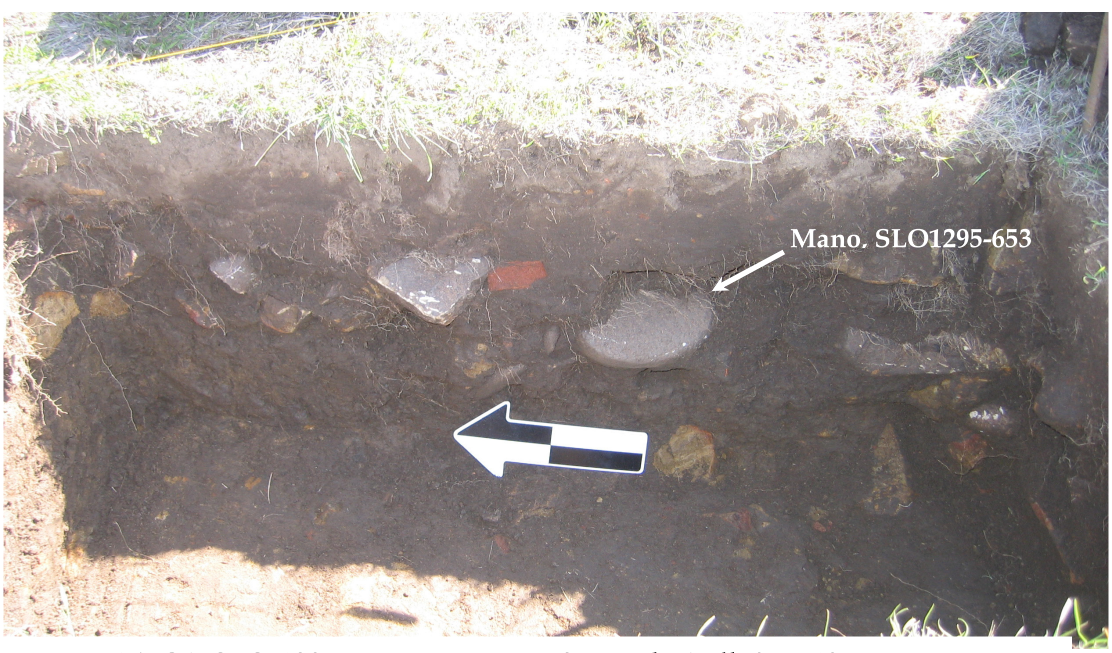

Figure 7.6. CA-SLO-1295 Excavation Unit 3, North Wall, 0 — 40 cm.

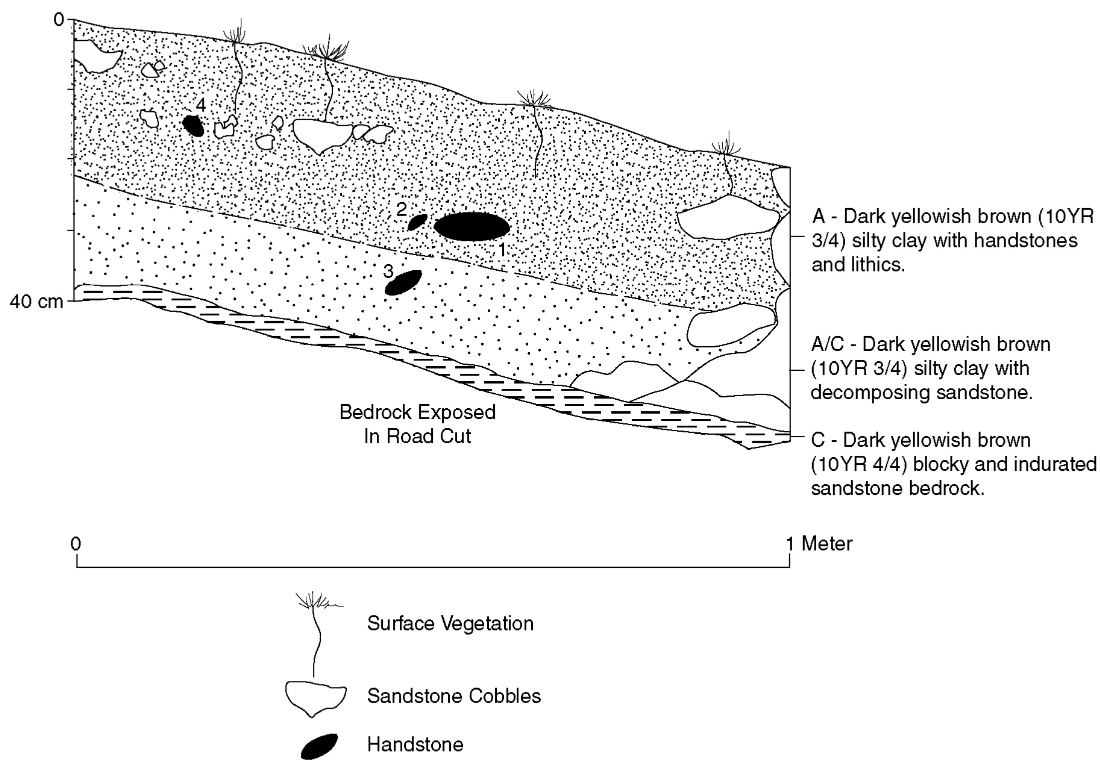


Figure 7.7. CA-SLO-1295 Exavation Unit 3 East Wall Soil Profile.

## Chronology

The chronology of CA-SLO-1295 was established though radiocarbon dating and the presence of one diagnostic *Olivella* bead. No temporally diagnostic projectile points or obsidian were recovered to support the radiocarbon dates.

Four AMS radiocarbon dates were obtained from the deepest, intermediate, and uppermost levels of the midden deposit (Table 7.1). The dates were obtained from single pieces of red abalone shell collected from intact stratigraphic contexts. Radiocarbon dates indicate that CA-SLO-1295 is a single-component Early Period (5500 — 3000 calBP) site occupied during the interval from about 5190 to 2860 calBP. The distribution of dates suggests the site is horizontally stratified, which is surprising given the amount of stratigraphic mixing from burrowing rodents, as often occurs in central coast sites.

The single *Olivella* bead is an Oblique spire-removed (Bennyhoff and Hughes 1987:119; B and H Type A2a) recovered from the 70-80 cm. In central California and the Great Basin *Olivella* beads with spires removed are known to date to the Early Period and therefore this bead form supports the radiocarbon dates.

No chronological information is available from Unit 3, the area of dense ground and battered stone and core tools in the northern site area.

Table 7.1. CA-SLO-1295 Radiocarbon Dates.

| Lab No. CAMS | Material | Unit | Depth cmbd | Measured Radiocarbon Age (BP) | Conventional Radiocarbon Age (BP)[a] | Calendar Age Range 1 Sigma[b] |
|---|---|---|---|---|---|---|
| 143916 | *Haliotis rufescens* | 4 | 7 | - | 3420± 30 | 2930 (2860) 2800 calBP 980 (910) 850 B.C. |
| 141624 | *Haliotis rufescens* | 1 | 26 | - | 4405± 30 | 4210 (4130) 4060 calBP 2260 (2190) 2100 B.C. |
| 143915 | *Haliotis rufescens* | 4 | 75 | - | 5080± 40 | 5110 (4500) 4880 calBP 3130 (3030) 2930 B.C. |
| 141625 | *Haliotis rufescens* | 1 | 127 | - | 5190± 35 | 5270 (5190) 5110 calBP 3320 (3240) 3160 B.C |

Note: CAMS Lawrence Livermore National Laboratory Number AMS dates, [a]Corrected $^{13}C/^{12}C$; [b]Calibrated using 325± 35 UC CALIB REV 5.0.1 (Stuiver et al. 2005) rounded calendar ages include midpoint; cmbd - Centimeters below datum.

## CA-SLO-1295 Artifacts

Artifacts reflecting a variety of manufacturing and processing activities were obtained from the excavated deposits and surface collection. These include an abundance of flaked, ground, and battered stone, as well as small shell and bone artifacts (Table 7.2).

### Shell Artifacts

Four shell artifacts include two beads and two casually shaped shell objects. The two shell beads came from strata dated to between 5110 and 4880 calBP (Table 7.3; Figure 7.8). The first is an *Olivella* oblique spire-removed bead (Bennyhoff and Hughes 1987:119; B and H Type A2a). In central California and the Great Basin *Olivella* beads with an end-ground spire are known to have been used in greater quantity at the end of Early Period. The second bead is a single square fragment of *Mytilus californianus*, rectangular,

Table 7.2. Summary of CA-SLO-1295 Artifacts.

| Artifact Class | Midden | Northern Locus | Total |
|---|---|---|---|
| **Flaked Stone** | | | |
| Drills | 2 | – | 2 |
| Bifaces | 7 | – | 7 |
| Formed flake tools | 1 | – | 1 |
| Simple flake tools | 19 | 2 | 21 |
| Core tools | 4 | 6 | 10 |
| Cores | 15 | 7 | 22 |
| Debitage | 2,758 | 9 | 2,767 |
| **Ground and Battered Stone** | | | |
| Pestles | – | – | 1 |
| Millingslabs | – | 2 | 2 |
| Bowl mortars | – | 1 | 1 |
| Manos | 2 | 5 | 7 |
| Handstones | 1 | 1 | 2 |
| Miscellaneous handstones | 2 | 4 | 6 |
| Pitted stones | 6 | 23 | 29 |
| Cobble hammerstones | 1 | 1 | 1 |
| Battered cobbles | 1 | – | 1 |
| **Shell Artifacts** | | | |
| *Olivella* oblique spire removed bead, A2a | 1 | – | 1 |
| *Mytilus californianus* drilled rectangle bead | 1 | – | 1 |
| *Haliotis rufescens* worked shell | 2 | – | 2 |
| **Bone Tools** | 6 | – | 6 |
| **Total** | 2,829 | 61 | 2,890 |
| Artifacts per cubic meter | | | 1,322 |

Note: Derived from 2.186m$^3$ of excavated deposit and surface collection.

Table 7.3. CA-SLO-1295 Shell Beads.

| Cat. no. | Unit | Depth (cm) | Bead Type | Description | Max Dia | Min Dia | TH | Perf Dia | Perf Type |
|---|---|---|---|---|---|---|---|---|---|
| 450 | 1 | 60-70 | - | *Mytilus* rectangle? | 7.7 | 5.2 | 1.2 | 1.2 | C |
| 451 | 4 | 70-80 | A2a | *Olivella* Oblique Spire-removed | 5.1 | 0.0 | 8.2 | 1.2 | G |

Note: All measurements are mm; Max Dia- Maximum Diameter; Min Dia-Minimum Diameter; TH – Maximum thickness; Perf Dia-Perforation Diameter; Perf Type-Perforation Type; B-Biconical; C- Conical Drilled; G- Ground.

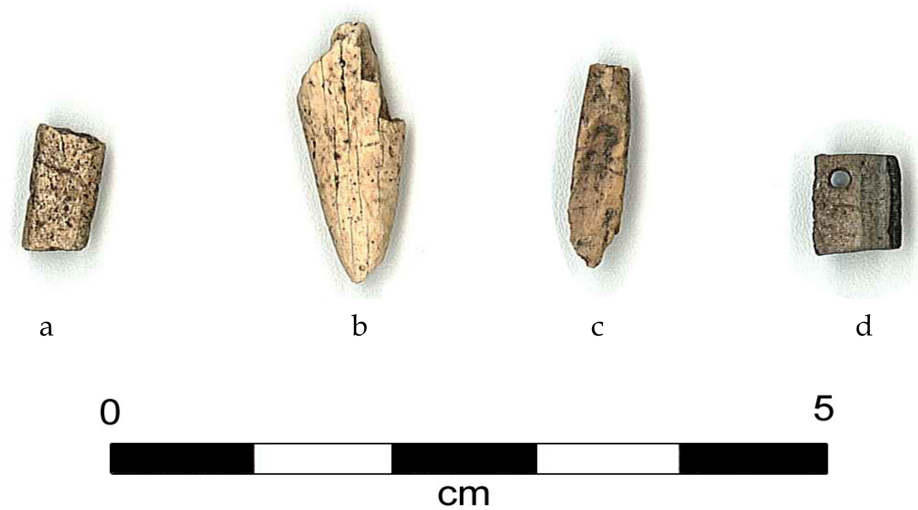


Figure 7.8 Selected Bead and Bone Tools from CA-SLO-1295. a-c: Bone tool fragments; d: Retangle *Mytilus* Bead.

with a small hole in one corner. The margins appear smooth and ground flat, with no obvious striations. Rectangular drilled *Mytilu*s beads are date to the Early Period in the Santa Barbara Channel region (Eya; King 1990a).

Two *Haliotis rufescens* objects from the lower levels of Unit 1 were shaped by abrasion and micro-chipping. One is an oval piece of nacre from the flat portions of the shell, shaped by micro-chipping along most of the perimeter (22.3 mm long, 17.4 mm wide, and 1.6 mm thick). Another is an irregular piece of nacre near an aperture that is ground and abraded along one margin (24.3 mm long, 19.1 mm wide, and 1.2 thick). Both items are too small to function as shell fishhook blanks and are suggestive of manufacturing detritus.

**BONE ARTIFACTS**

Six bone tool fragments were recovered from Units 1 and 4, in the upper levels of the deposit (Figure 7.8; Table 7.4). All artifacts are polished, exhibit some striations, and are shaped fragments of long bone from a medium/large mammal, most likely deer. The most distinctive, well-shaped artifact (SLO1295-447) shows polish and displays use-wear at the tip.

**FLAKED STONE TOOLS AND DEBITAGE**

The CA-SLO-1295 flaked stone collection includes a tool assemblage dominated by casual tools and an abundance of debitage (Table 7.5).

Table 7.4. Bone Artifacts from CA-SLO-1295.

| Cat no. | Description | Wt | L | W | TH | DD |
|---|---|---|---|---|---|---|
| 444 | Needle – Unburnt, tip fragment | 0.5 | 14.9 | 2.0 | 1.6 | 0.6 |
| 445 | Pin(?)– Unburnt, midsection fragment | 0.21 | 9.3 | 4.7 | 3.3 | – |
| 446 | Indeterminate, cut polished midsection fragment | 0.62 | 29.6 | 5.7 | 3.9 | – |
| 447 | Awl– Unburnt, tip fragment | 0.47 | 20.7 | 7.0 | 3.6 | 1.0 |
| 448 | Awl(?)– Burnt, midsection fragment | 0.36 | 9.5 | 4.6 | 4.5 | – |
| 447 | Pin– Burnt, midsection fragment | 0.22 | 16.0 | 3.5 | 2.9 | – |

Note: Cat no–Catalog Number; Wt – Weight in grams; L – Maximum length in mm; W – Maximum width in mm; TH – Maximum thickness in mm; DD–Distal diameter in mm

Table 7.5. Flaked Stone Assemblage from CA-SLO-1295.

| Artifact | MNT Chert | FRN Chert Con | FRN Chert | QTZ | Slate | Total |
|---|---|---|---|---|---|---|
| Drill | 2 | – | – | – | – | 2 |
| Biface | 7 | – | – | – | – | 7 |
| Simple flake tool | 17 | 1 | 2 | – | – | 20 |
| Formed flake tool | – | – | – | – | 1 | 1 |
| Core tool | 8 | – | 2 | – | – | 10 |
| Cores | 21 | – | 1 | – | – | 22 |
| Debitage | 2,617 | 19 | 128 | 3 | – | 2,767 |
| Total | 2,672 | 20 | 133 | 3 | 1 | 2,829 |

Note: MNT- Monterey; FRN- Franciscan; Con- Conglomerate; QTZ-Quartz

Bifaces are represented by seven specimens—six Monterey chert and one Franciscan chert—most (86%) of which are broken. Early-stage manufacturing is common (Stage 1, n=2; Stage 3, n=4; Stage 4, n=1). The majority of bifaces are fractured due to material flaws. Over half of the artifacts display modifications, including edge crushing and micro-chipping.

Flaked stone tools include two drills, one formed flake tool, and 21 flake tools. Two complete small drills were fashioned of Monterey chert derived from interior and secondary reduction flakes. Both artifacts are bifacially micro-chipped, and one exhibits polish and edge-rounding along the tip. The formed flake artifact is an unusual slate tool exhibiting bifacial shaping, battering, and dulling (Figure 7.9c; SLO1295-595) that appears to have functioned as a perforator or awl for gouging larger objects or prying open shellfish. This artifact is similar to one identified at CA-SLO-115 in the northern study area. The simple flake tools, predominantly of Monterey chert, show use-wear along either one or two, convex or straight working edges, and display unifacial micro-chipping or flaking. The wear patterns indicate use for cutting, slicing, and scraping tasks.

Twenty of the 21 recovered cores were made of locally available Monterey chert; the other was of Franciscan chert. These artifacts are made of as flat, fist-sized cobbles typical of those found in the adjacent creek. Half of the ten cores, eight of Monterey and two of Franciscan chert, were surface-collected in the northern site area within a dense concentration that also included ground stone artifacts. All exhibited some form of bifacial edge battering and dulling with over half displaying extreme battering. Three artifacts resemble choppers (SLO1295-567, 606, and 607: Figure 7.9a,b,d). These implements are useful for a variety of heavy-duty cutting, chopping, and scraping tasks.

A total of 2,767 pieces of debitage was recovered, including 2,617 of Monterey chert, 128 of Franciscan chert, 19 of Franciscan chert conglomerate, and three of quartz. A sample of 1,595 pieces of debitage from the Unit 1 1/4-

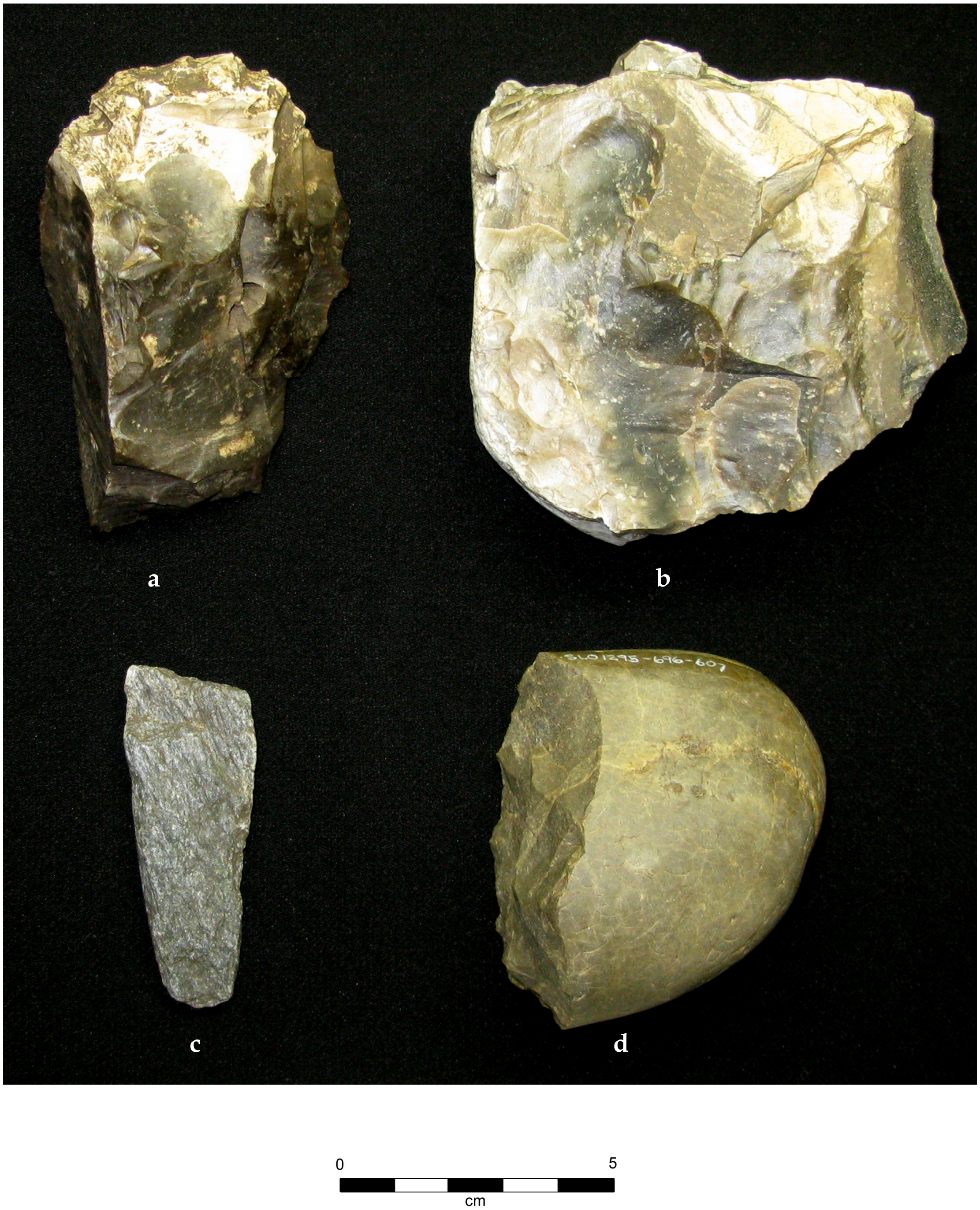


Figure 7.9 Selected Flaked and Ground and Battered Stone Artifacts from CA-SLO-1295. a-b, d: Cobble core tools/choppers; c: Slate tool.

inch mesh portion, and 244 pieces from the 1/8-inch mesh portion of Column Sample 1 is presented here (Tables 7.6 and 7.7). Consistent with the larger flaked stone assemblage, Monterey chert comprises the bulk of the debitage (n=1,787), with Franciscan chert (n=44), Franciscan chert conglomerate (n=7), and quartz (n=1) present in low frequencies. Of interest, the smaller 1/8-inch mesh was carefully scrutinized for small obsidian pressure flakes, and although the sample did indeed have a higher proportion of small pressure flakes, none of obsidian was identified.

Given the small amount of Franciscan chert debitage in the sample, the following discussions will primarily concentrate on Monterey chert. Among the diagnostic flake classes, interior percussion flakes are the most prevalent, making up 46 percent in the 1/4-inch mesh and 42 percent in the 1/8-inch mesh. In the 1/4-inch mesh, decortication (37% total; 23% secondary and 14% primary), biface thinning (8%), pressure flakes (7%), and core rejuvenation flakes (1.5%) make up the remainder of the assemblage. As expected, the finer 1/8-inch mesh portion contains a higher proportion of pressure flakes (26%), followed by similar proportions of decortication (27% total; 15% secondary and 12% primary), biface thinning (4%), and core rejuvenation flakes (0.5%).

These proportions reflect a focus on the earlier stages of lithic production and on core-flake reduction techniques rather than the production of bifacial tools from core or flake blanks. Biface thinning and pressure

Table 7.6. CA-SLO-1295 Debitage Attributes from 1/8-inch Mesh Sample.

| | Monterey Chert | Franciscan Chert | Total |
|---|---|---|---|
| Primary reduction | 21/4 | – | 21/4 |
| Secondary reduction | 27/5 | – | 27/5 |
| Core rejuvenation | 1/– | – | 1/– |
| Interior | 74/29 | 3 | 77/29 |
| Biface thinning | 7/– | – | 7/– |
| Pressure | 46/2 | – | 46/2 |
| Subtotal | 176/40 | 3 | 179/40 |
| Non-diagnostic | 65/18 | – | 65/18 |
| Total | 241/58 | 3 | 244/58 |

Note: #/#-Total number of flakes/Number of heat-altered flakes.

Table 7.7. CA-SLO-1295 Debitage Attributes from 1/4-inch Mesh Sample.

| | Monterey Chert | Franciscan Chert | Franciscan Chert Conglomerate | Quartz | Total |
|---|---|---|---|---|---|
| Primary reduction | 166/44 | 2/– | 2/– | – | 170/44 |
| Secondary reduction | 264/76 | – | – | – | 264/76 |
| Core rejuvenation | 17/3 | – | – | – | 18/3 |
| Interior | 534/248 | 9/– | 2/– | 2/– | 261/248 |
| Biface thinning | 94/5 | 12/– | – | – | 106/5 |
| Pressure | 78/8 | 3/– | – | – | 81/8 |
| Subtotal | 1153/384 | 26/– | 4/– | 2/– | 1,185/384 |
| Non-diagnostic | 392/149 | 14/– | 3/– | – | 409/149 |
| Total | 1,545/533 | 41/– | 7/– | 2/– | 1,595/533 |

Note: #/#-Total number of flakes/Number of heat altered flakes.

flakes, however, do suggest some production, finishing, and maintenance of local Monterey chert bifacial tools. Two observations support this finding. First, decortication flakes are present in large numbers and are nearly evenly split between primary and secondary, with cortical shatter present in comparable quantities. Second, heat alteration (e.g., pretreatment) is common on one-third of the sample, suggesting that initial reduction took place at the site, as opposed to early-stage bifaces having been brought to the site. The marked distinction in the Franciscan chert debitage collection is that almost half of the identified flakes (46% of the 1/4-inch sample) are late stage biface thinning flakes, suggesting finishing and maintenance of tools brought from off-site. This technological profile is generally in keeping with the artifact assemblage characterized by an abundance of cores and early-stage bifaces, and a relative lack of finely finished tool forms.

CA-SLO-1295 appears to have been a location where a primary activity of the occupants was reducing Monterey chert cobbles into core tools and bifaces. Technologically, the flaked stone debitage and artifacts are concordant in that they suggest, i.e., all stages of stone tool production. What is unexpected, however, is the absence of finished projectile points. The lack of obsidian in this collection is also perplexing, as the site dates to a period known for increased importation of obsidian into the San Simeon Reef, much of it imported from the eastern Sierra Nevada.

### GROUND AND BATTERED STONE

A diverse assemblage of 50 ground and battered stone artifacts was recovered from CA-SLO-1295 (Table 7.2). The majority of the collection, all but 11 artifacts (six pitted stones, two manos, one cobble hammerstone, and two handstones), was obtained from either Unit 3 or the surface of the locus at the base of the hill slope. Pitted stones are the most abundant tools within this artifact class, totaling over half (58%) of the assemblage (e.g., SLO1295-

611, Figure 7.9). All but one of the stones are of soft sandstone. A common artifact in San Simeon Reef middens, these specimens have discrete pits (generally two), display battering on opposing ends, and show a discrete area of polish on the opposing face. Approximately half of the pitted stones are reused manos or handstones.

The second most common artifact category includes a variety of handstones (manos, 14%; handstones, 4%; miscellaneous handstones, 12%), which total 30% of the collection. All of the tools are of local materials, including sandstone (n=3), greenstone (n=5), shale (n=1), quartzite (n=2), and greywacke (n=4). The majority of the artifacts exhibit multiple working surfaces, with slight polish on one face and secondary use-wear along the edges and/or ends, with nine tools displaying slight polish. Over half of the artifacts have pecking on at least one face, and nine have end battering. One mano exhibits grinding wear, has well defined shoulders, peck mark clusters on both surfaces, and end battering. (Figure 7.9, SLO1295-653).

The remaining artifacts are a complete cobble pestle, two millingslab fragments, a bowl mortar fragment, and a cobble hammerstone. The large (2,257.2 g) unshaped pestle, showing only slight polish, abrasion, and end battering, was surface-collected immediately above the creek. The two small interior millingslab fragments display flat working surfaces with polish and rejuvenation pecking. A small bowl mortar fragment exhibits exterior pecked and ground surfaces and a pecked, ground, and polished mortar cavity. The cobble hammerstone, covered with asphaltum, has unique step fractures and heavy battering, with wear concentrated on ends and edges; these tools are often associated with lithic resources procurement.

## SUBSISTENCE STRATEGIES

Faunal remains were the most abundant materials recovered from excavation (Tables 7.8 and 7.9). All of the analyzed faunal remains were from the 1/4-inch residuals of excavation Units 1, 2 and 4, and the 1/8-inch Column Sample 1 materials. Due to the homogenous midden with highly fragmented constituents, the 1/8-inch portion from Unit 1 was scanned in the lab for diagnostic fish, bird, and mammal elements only. The vertical distribution of bone in the deposit shows the highest density of elements between 10 and 60 cm below datum (Table 7.8).

### MAMMAL, BIRD, AND REPTILE BONE

A total of 533 mammal, bird, and reptile bones were identified in the excavated midden (Table 7.10). Unfortunately, due to fragmentation, most of bones only could be identified to genus or species and were therefore classified into general categories. Some of the identified specimens (n=145) are most likely of intrusive rodents (mouse, pocket gopher, California ground squirrel) and are excluded from further analysis.

Table 7.8. Vertical Distribution of CA-SLO-1295 Mammal, Bird, Reptile and Fish Bone by Weight.

| | Unit 1[a] | | Unit 2[b] | | Unit 4[b] | | |
|---|---|---|---|---|---|---|---|
| Depth (cm) | Fish | Mammal, Bird, Reptile | Fish | Mammal, Bird, Reptile | Fish | Mammal, Bird, Reptile | Total |
| 0-10 | 0.21 | 0.14 | 0.00 | 0.00 | 0.00 | 1.32 | 1.67 |
| 10-20 | 0.25 | 9.83 | 0.00 | 0.00 | 0.00 | 2.64 | 12.72 |
| 20-30 | 0.64 | 9.04 | 0.00 | 3.33 | 0.15 | 0.62 | 13.78 |
| 30-40 | 0.00 | 2.48 | 0.00 | 0.54 | 0.00 | 1.65 | 4.67 |
| 40-50 | 0.63 | 3.56 | 0.10 | 4.78 | 0.26 | 0.69 | 10.02 |
| 50-60 | 0.26 | 7.92 | 0.00 | 1.26 | 0.00 | 2.17 | 11.61 |
| 60-70 | 0.28 | 2.35 | 0.00 | 1.36 | 0.00 | 0.99 | 4.98 |
| 70-80 | 0.15 | 0.49 | 0.00 | 3.59 | 0.00 | 2.89 | 7.12 |
| 80-90 | 0.12 | 0.65 | - | - | - | - | 0.65 |
| 90-100 | 0.00 | 0.59 | - | - | - | - | 0.59 |
| 100-110 | 0.00 | 3.04 | - | - | - | - | 3.04 |
| 110-120 | 0.20 | 0.24 | - | - | - | - | 0.24 |
| 120-130 | 0.36 | 2.94 | - | - | - | - | 2.94 |
| **Total** | **3.10** | **43.27** | **0.10** | **14.86** | **0.41** | **12.97** | **74.03** |

Notes: Rodent bones are excluded. [a]1 x 1-meter excavation unit screen through 1/8-inch mesh; [b]1 x 0.5-meter excavation unit screen through 1/4-inch mesh; Weight in grams; (-) — level unexcavated; Unit 3 did not contain shell; Levels correspond to cm excavated below datum.

Table 7.9. Vertical Distribution of CA-SLO-1295 Shellfish by Weight.

| | Shell Weight | | | |
|---|---|---|---|---|
| Depth (cm) | Unit 1[A] | Unit 2[B] | Unit 4[B] | Subtotal |
| 0-10 | 10,139.3 | 257.8 | 702.8 | 11,099.9 |
| 10-20 | 14,141.8 | 284.3 | 889.9 | 15,316.0 |
| 20-30 | 11,979.9 | 290.7 | 1,103.8 | 13,374.4 |
| 30-40 | 10,341.6 | 420.5 | 1,285.2 | 12,047.3 |
| 40-50 | 13,460.1 | 388.7 | 1,704.1 | 15,552.9 |
| 50-60 | 15,783.1 | 411.8 | 1,587.9 | 17,782.8 |
| 60-70 | 11,577.5 | 401.2 | 1,703.0 | 13,681.7 |
| 70-80 | 10,087.8 | 519.2 | 1,424.8 | 12,031.8 |
| 80-90 | 11,295.5 | — | — | 11,295.5 |
| 90-100 | 7,246.6 | — | — | 7,246.6 |
| 100-110 | 8,891.5 | — | — | 8,891.5 |
| 110-120 | 8,822.5 | — | — | 8,822.5 |
| 120-130 | 7,808.8 | — | — | 7,808.8 |
| **Total** | **141,576.0** | **2974.2** | **10,401.5** | **154,951.7** |

Notes: [a]1 x 1-,meter excavation unit screened through 1/8-inch mesh; [b]1 x 0.5-meter excavation Unit screened through 1/4-inch mesh; Weight in grams; (—) level unexcavated; Unit 3 did not contain shell; Levels correspond to cm excavated below datum

Table 7.10. Identified Mammal, Bird, and Reptile Bones from CA-SLO-1295.

| COMMON NAME | TAXON | NISP | WEIGHT (G) |
|---|---|---|---|
| **Terrestrial Mammals** | | | |
| Brush rabbit | *Sylvilagus bachmani* | 6 | 1.38 |
| Deer | *Odocoileus* spp. | 11 | 7.87 |
| Medium carnivore | Carnivora | 1 | 3.10 |
| Mammal | Unidentified mammal | 70 | 2.35 |
| Large mammal | Mammalia | 98 | 34.14 |
| Medium mammal | Mammalia | 123 | 12.64 |
| Small mammal | Mammalia | 14 | 0.62 |
| Subtotal | | 323 | 62.10 |
| **Marine Mammal** | | | |
| Large | Pinnipedia | 3 | 5.92 |
| Medium | Pinnipedia | 5 | 3.30 |
| Subtotal | | 8 | 9.22 |
| **Rodent** | | | |
| Rodent | Rodentia | 63 | 4.03 |
| Mouse | *Peromyscus* sp. | 1 | 0.00 |
| California ground squirrel | *Spermophilus beecheyi* | 2 | 0.33 |
| Pocket gopher | *Thomomys bottae* | 79 | 6.56 |
| **Subtotal** | | 145 | 10.92 |
| **Birds** | | | |
| Medium bird | Aves | 9 | 0.72 |
| Large bird | Aves | 3 | 0.81 |
| **Subtotal** | | 12 | 1.53 |
| **Reptiles** | | | |
| Pacific gopher snake | *Pituophis catenifer catenifer* | 2 | 0.15 |
| Snake | Serpentes | 2 | 0.32 |
| Reptile | Indeterminate | 6 | 0.05 |
| **Subtotal** | | 10 | 0.52 |
| Indeterminate | | 35 | 1.04 |
| **Total** | | 533 | 85.33 |

Note: NISP – number of identified specimens.

Excluding intrusive specimens, 353 bones were identified. Of the identified species most are either artiodactyl (likely black-tail mule deer; n=11); brush rabbit (n=6) or sea mammal (n=8), and equal proportions of reptiles and birds, and a medium-sized carnivore. The unidentified remains sorted by size class indicate that medium mammals dominate (35%), followed closely by large mammals (28%), small mammals (4%), birds (3%), and reptiles (3%). This pattern is consistent with that suggested by the identifiable remains, and indicates some reliance on deer.

### MARINE FISH

A small amount of marine fish, 7.77 g and 114 elements, was recovered, mostly from the Unit 1 column sample (Table 7.11). Although the paucity of fish may be due to the small size of fish captured (e.g., pricklebacks), the bones of which would fall through the screen mesh, this does not appear to be the case. Even when mesh size is considered, relatively equal proportions of fish were identified; i.e., 1/4-inch=33; 1/8-inch=45; 1/16-inch=36, suggesting that fishing was not an important activity. Because their vertebrae or centra are well preserved, numbers of identifiable fish bone are larger than is the case with other vertebrate faunal categories. Over half (59%) of the analyzed fish bone was identifiable to family, genus, or species. Due to the low minimum number of individuals (MNI), the following discussion will be primarily based on NISP unless otherwise noted.

Common to sites along the San Simeon Reef, pricklebacks account for about half, 48 percent, of fish the bone. The next most common fishes are equal proportions of cabezon and rockfishes, accounting for 15 percent each. The next most abundant taxon is kelp greenlings, at six percent,

Table 7.11. Marine Fish Remains from CA-SLO-1295.

| Common Name | Taxon | Mesh Size 1/4″ NISP | 1/8″ NISP | 1/16″ NISP | Total NISP | MNI | Wt (g) |
|---|---|---|---|---|---|---|---|
| Inshore/Offshore Migrators | | | | | | | |
| Silversides | Atherinidae | - | - | 1 | 1 | 1 | 0.02 |
| Rocky Intertidal | | | | | | | |
| Cabezon | *Scorpaenichthys marmoratus* | 6 | 4 | - | 10 | 6 | 1.58 |
| Clinids | Clinidae | - | - | 2 | 2 | 2 | 0.01 |
| Pricklebacks | Stichaeidae | - | 4 | 26 | 30 | 11 | 0.49 |
| Kelp greenlings | *Hexagrammos decagrammus* | 2 | 4 | - | 6 | 3 | 0.28 |
| Northern clingfish | *Gobiesox maeandricus* | - | - | 2 | 2 | 2 | 0.01 |
| Rockfishes | *Sebastes* spp. | 9 | 1 [a] | - | 10 | 4 | 1.28 |
| Rock or black prickleback | *Xiphister* spp. | 1 | 1 | - | - | 2 | 0.15 |
| Kelp Beds | | | | | | | |
| Giant kelpfish | *Heterostichus rostatus* | 2 | - | 2 | 4 | 3 | 0.06 |
| Ray-finned fishes | Actinopterygii | 13 | 31 | 5 | 47 | | 1.90 |
| Totals | | 33 | 45 | 38 | 112 | 34 | 5.77 |

Note: [a]*Sebastes* spp. count includes one otolith; Weight in grams.

followed by a small variety of fishes that appears to be of relatively minor significance to the diet. Most of these fishes could have been caught in the rocky intertidal or tidepools by hand or in nearshore waters above the rocky intertidal zone using hook and line, spears, or a variety of nets.

**SHELLFISH**

The three units excavated in the midden (Units 1, 2, and 4) recovered a total of 154.951 kg shell remains and column samples 8,506.83 g (Table 7.12). At least 41 different shellfish taxa were identified in the samples, most from rocky intertidal habitats (Appendix A; Table A2). To investigate research questions surrounding ecology, subsistence and intensification two types of samples were collected and analyzed, as discussed in *Chapter VI: Archaeological Methods, Shellfish.*

Unit 1, situated in the richest area of the shell midden, produced 141,575 g of shell (134,833 g/m$^3$), while the less dense outlying shell midden yielded between 2,974 and 10,401 g (7,435 and 26,002 g/m$^3$) of shell. Even when corrected for screen size, the midden in the vicinity of Unit 1 still contains the highest density, an estimated 67,416 g/m$^3$. Shellfish density decrease slightly in the 30 to 40 cm level, similar to fish and mammal bone density.

Table 7.12. Contribution of Significant Shellfish Species from CA-SLO-1295.

| COMMON NAME | TAXON | TOTAL (G) | TOTAL (%) |
|---|---|---|---|
| California mussel | *Mytilus californianus* | 3,910.34 | 45.9 |
| Black turban snail | *Tegula funebralis* | 3,604.15 | 42.4 |
| Chiton | *Mopalia* spp. | 279.83 | 3.3 |
| Crab | Cancer | 152.85 | 1.8 |
| Barnacle | *Balanus* spp. | 129.41 | 1.5 |
| Red turban | *Lithopoma gibberosa*[a] | 66.13 | 0.8 |
| Red abalone | *Haliotis rufescens* | 37.54 | 0.4 |
| Limpet | *Collisella* spp. | 32.28 | 0.4 |
| Purple sea urchin | *S purpuratus* | 22.49 | 0.3 |
| Slipper shell | *Crepidula* sp. | 16.09 | 0.2 |
| Pacific littleneck clam | *Protothaca staminea* | 16.03 | 0.2 |
| Brown turban snail | *Tegula brunnea* | 13.04 | 0.2 |
| Abalone | *Haliotis* spp. | 6.43 | 0.0 |
| Misc. gastropod | | 1.41 | 0.0 |
| Indeterminate | | 182.97 | 2.1 |
| Total | | 8,506.83 | 100 |

Note: Shell samples are based on two column samples screen through 1/8-inch mesh, a total of 0.052; Weight in grams;% - proportion of site shell assemblage; *S-Strongylocentrotus*
[a]*Lithopoma gibberosa* was formerly classified as *Astrea gibberosa*.

California mussel and black turban snail are the most prevalent species represented in the sample, present in almost equal proportions in the analyzed sample (46% and 42%, respectively; Table 7.12). The remaining shell species appear to have been of minor dietary importance in the areas of the site excavated here. All species inhabit the open, rocky intertidal zone adjacent to CA-SLO-1295. In the middle to high intertidal zone are typically found California mussel, barnacle, black turban snail, limpet, and chitons. Inhabiting the middle to lower intertidal zone are black abalone, with red abalone and sea urchin commonly occurring solely in the lower intertidal zone (Ricketts and Calvin et al. 1985). Many of the small, predatory snail species (slipper shell, periwinkle, and limpet) found in the assemblage were probably collected inadvertently by site inhabitants in that they came to the site attached to purposefully collected resources.

### PLANT RESOURCES

Given the high density of ground stone, particularly milling equipment, in the deposit all the light fraction materials recovered from Unit 3 were analyzed for charcoal and charred seeds. The analysis conducted by archaeobotanist Dr. Eric Wohlgemuth unfortunately revealed no plant materials aside from small fragments of wood charcoal.

### CALIFORNIA MUSSEL AND RED ABALONE SIZE-FREQUENCY DATA

To address research questions regarding dietary reconstruction, resource intensification, and local ecology, recovered California mussel shell fragments with beaks and red abalone shells were measured to compare the size distribution, and relative age of study site populations with other archaeological samples and living populations. Methods and a discussion on this approach are presented in Chapter VI, and long-term changes in the species profiles are addressed in Chapter XI.

#### RED ABALONE

Only 25 red abalone shells were analyzed from CA-SLO-1295 (Table 7.13). Red abalone lengths from the site ranged from two to 11 cm, and the average size for the site only 4.02 cm. The data demonstrate that largest size class is 2-3 cm, which includes 32 percent of the red abalones. The majority of abalone shells, 92 percent, are smaller than 7 cm long. CA-SLO-1295 is the earliest site studied along this section of coastline, and it was unexpected that red abalones would occur in low frequencies and small sizes.

Even in the lowest levels of the site, abalone shells are small and occur in low frequencies, suggesting occupants harvested juvenile species over the 2,300-years of site occupation.  Either foragers over-harvested red abalone and the population had not recovered, disease decimated the population, or

Table 7.13. Red Abalone Lengths and Frequencies from CA-SLO-1295.

| Abalone Size CM | 0-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | 7-8 | 8-9 | 9-10 | 10-11 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency within age profile | 3 | 8 | 4 | 3 | 2 | 3 | 1 | 0 | 0 | 1 | 25 |
| Percent | 12 | 32 | 16 | 12 | 8 | 12 | 4 | 0 | 0 | 4 | 100 |

Notes: Abalone data from Units 1, 2, and 4.

| Unit Level cm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 1 | 0 | 3 | 1 | 5 | 4 | 3 | 3 | 1 | 2 | 1 | 1 | 25 |
| Percent | 4 | 0 | 12 | 4 | 20 | 16 | 12 | 12 | 4 | 8 | 4 | 4 | 100 |

Notes: Levels correspond to 10 cm intervals, e.g., 0-10 cmbd is Level 1

large marine fish predators (e.g., cabezon that feed on young individuals) or sea otters depressed the population.

### California Mussel

California mussel is one of the primary shellfish collected, accounting for 46 percent of the analyzed sample. It is therefore not surprising that a large number (4,025 MNI) of mussel shell fragments with umbo are in the assemblage, the largest quantity collected at any of the excavated sites (Table 7.14). This robust sample showed that mussel shell sizes ranged between 1.0 and 8.8 cm, with an average shell length of only 2.9 cm. Average sizes remain constant around 3.9 to 3 cm through the deposit. Ninety-four percent of measurements are 4 cm or smaller suggesting that although site occupants were focused on collecting mussels, juveniles were being harvested in large numbers.

Table 7.14. California Mussel Lengths and Frequencies from CA-SLO-1295.

| Class Size (cm) | Frequency within age profile | Percent |
|---|---|---|
| 0-2 | 1,365 | 34 |
| 2-3 | 1,602 | 40 |
| 3-4 | 907 | 23 |
| 4-5 | 109 | 3 |
| 5-6 | 26 | 0.6 |
| 6-7 | 10 | 0.2 |
| 7-8 | 3 | 0.07 |
| 8-9 | 3 | 0.07 |
| **Total** | 4025 | 100 |
| Unit Level (cm) | Frequency | Percent |
| 0-10 | 157 | 4 |
| 10-20 | 164 | 4 |
| 20-30 | 292 | 7 |
| 30-40 | 138 | 3 |
| 40-50 | 221 | 5 |
| 50-60 | 368 | 9 |
| 60-70 | 662 | 16 |
| 70-80 | 152 | 4 |
| 80-90 | 292 | 7 |
| 90-100 | 235 | 6 |
| 100-110 | 397 | 10 |
| 110-120 | 458 | 11 |
| 120-130 | 489 | 12 |
| **Total** | 4,025 | 100 |

## Dietary Reconstruction

Dietary reconstruction is based on two methods to provide a rough estimate of the relative importance of the faunal classes. To look at general trends, the density of NISP and weight per cubic volume of excavation were calculated to establish the relationship between subsistence remains. Second, weight of bone and shell is used to give a more specific idea of relative dietary importance of animal taxa. These two methods are discussed further in Chapter VI: *Archaeological Methods, Subsistence Remains.*

Based on density data (Table 7.15) site occupants focused on intertidal shellfish species, followed by terrestrial mammals (deer) and marine fish. Marine mammals , birds, and reptiles were only minor components of the diet. The relative importance of various faunal classes was estimated by calculating the significance of each animal category using the meat weight multipliers (Table 7.16, See Chapter VI for multipliers).

Dietary reconstruction of all faunal remains supports the fauna density data, and show that shellfish were the dominant contributor of meat to the diets, providing approximately 98 percent of the estimated meat yield, with only minor contributions from the other classes. Terrestrial mammals contributed roughly one percent, and marine mammals, birds, reptiles, marine fish and reptiles contributed less that one percent.

Table 7.15. Shell and Bone Densities from CA-SLO-1295.

| FAUNAL CLASS | DENSITIES PER CUBIC METER |
|---|---|
| Shellfish (g) | 85,823 |
| Terrestrial mammal (NISP/g) | 170/32.7 |
| Marine mammal (NISP/g) | 4.2/4.8 |
| Bird (NISP/g) | 6.3/0.8 |
| Reptile (NISP) | 5.6 |
| Fish (NISP/g) | 60/3.0 |

Note: Data derived from 1.902 $m^3$; Terrestrial bone includes unidentified class size and identified species; g – grams; NISP – number of identified specimens.

Table 7.16. CA-SLO-1295 Estimated Dietary Reconstruction Based on Meat Weight.

| TAXON | BONE/SHELL WEIGHT (G) | MEAT WEIGHT (G) | PERCENT (MEAT WEIGHT) |
|---|---|---|---|
| Terrestrial mammals | 62.1 | 1,503.12 | 0.98 |
| Marine mammal | 9.22 | 221.94 | 0.15 |
| Birds | 1.53 | 2.02 | 0 |
| Reptiles-snakes | 0.47 | 0.22 | 0 |
| Marine fish | 5.77 | 173.74 | 0.11 |
| Shellfish | 163,237.61 | 150,841.41 | 98.7 |
| **Total** | 163,316.70 | 152,742.45 | 100 |

Notes: Appendix D provides detailed data for meat weight reconstructions.

These data suggest that the people at CA-SLO-1295 were focused on marine resources for subsistence. Regardless of the method used to evaluate diet, terrestrial mammals were of little significance to the diet. The high proportion of shellfish and moderately high proportion of fish obviously reflects the proximity to rich intertidal and kelp forest resources immediately adjacent to the site.

## SYNTHESIS

The Griswold Site, CA-SLO-1295, contains a rich shell midden created between about 5190 to 2860 calBP. A black, homogeneous midden between 80 and 130 cm thick is a result of occupation during the Early Period. The deposit contains an array of flaked, ground, and battered stone tools and faunal remains. No evidence of features, structures, or burials was observed. A potentially earlier Millingstone presence is indicated in the northern site margin, suggested by a locus of dense surface and subsurface ground and battered stone and core and cobble tools. With no diagnostic tools or organic materials, this component may date anytime from the Millingstone to the Early Period.

The site was probably a seasonal residential camp or base where occupants repeatedly collected shellfish from the intertidal and carried out limited game hunting and fishing. California mussel and black turban snail are the dominant species represented in the shellfish remains throughout the midden deposit, in almost equal proportions in the analyzed samples (46% and 42%, respectively) with no change over time. The density of shell is high compared to other local contemporaneous deposits, with 81,468 $g/m^3$ compared to 253 $g/m^3$ at Arroyo de los Chinos (CA-SLO-273/H and -274, Hildebrandt et al. 2002) and 50,150 $g/m^3$ at CA-SLO-265, (Hildebrandt et al. 2007). The relative importance of shellfish through site occupation is apparent when the ratio of shell weight to mammal, bird, and reptile bone is calculated, i.e., 2179:1. The focus on California mussel is consistent with data generated from several site components spanning the Early to Late Periods along the northern San Simon Reef and north to Big Sur. Site faunal assemblages in this region typically contain shell that includes 70 to 90% California mussel (Hildebrandt et al. 2002, 2007; Jones and Ferneau 2002a; Jones and Waugh 1995). In contrast, sites along the southern San Simeon Reef, in the Cambria vicinity, have greater proportions of black turban snail and a more balanced array of other species throughout (Joslin 2006).

The subsistence remains suggest some expected and unexpected trends. As with other Early Period sites, marine fish are of minor importance to the diet, only 3 g per cubic meter, and are limited to species that could be caught in waters above the rocky intertidal substrate immediately below the site, i.e., pricklebacks, rockfishes, and cabezon. Unanticipated is the paucity of terrestrial and marine mammals. Butchering practices, with only partial transport of large game (e.g., deer) remains back to the site, may have reduced the abundance of large mammal bones in the deposit.

The artifact assemblage shows a relatively diverse range of tool types that appear to represent residential activities of complete social groups. Flaked stone tools include implements focused on hunting and butchering activities (e.g., bifaces), as well as those used to process or manufacture various types of material such as flake tools, drills, and core tools). The flaked stone assemblage shows that occupants used the nearby sources of Monterey chert, reducing cobbles into core tools and bifaces. The absence of projectile points, generally abundant at central coast Early Period sites, is surprising. Heavy-duty processing tasks (e.g., shellfish preparation and lithic production) are reflected in the large amount of handstones, choppers, pitted stones, and multi-functional ground stone with pitting and end-battering. Millingslabs, manos, a bowl mortar, and a pestle indicate plant processing (e.g., bulbs, rhizomes, or tubers) during habitation along the open coastline, perhaps of more importance than previously thought (Jones and Ferneau 2002a). Although the analysis for plant remains and charcoal did not reveal a focus on plants, the sample was small and may need to be expanded before discounting the importance of bulbs, tubers, and seeds.  The relatively high proportion of bone tools  suggests delicate sewing tasks, such as basket weaving, as well as heavier drilling and perforating.

## CHAPTER VIII: CA-SLO-1622 —THE NORRIS SITE AN EARLY PERIOD DEPOSIT

The Norris Site, CA-SLO-1622, is situated on a level upper marine terrace within the UC Reserve (Figures 8.1 and 8.2.). This secondary or short-term residential site is located at the base of Lodge Hill with an expansive view of the Pacific Ocean. Dating between 4660 to 3760 calBP, the deposit represents a single-component site occupied over the Early Period (5500 – 3000 calBP). The synthesis of archaeological and ecological information from the Norris Site, when combined with information from other Early Period occupations (i.e., CA-SLO-1295 and SLO-1677), provides important details about human cultural development during the Middle Holocene. The data derived from the site collections provide fundamental insights into land and resource use along the southern San Simeon Reef, and establish a framework for comparing human cultural adaptations in the area though time.

### SITE DESCRIPTION

Subsurface excavation and surface survey revealed a large (200 x 80 m) site characterized by a dense debitage and flake tool scatter extending across the terrace. Two discrete shell-rich midden deposits are situated in the northern site area (Locus A) and the southern extent (Locus B). The primary focus of this analysis is the data collected from two excavation units, one placed in the wide-spread flaked stone deposit and the second located in the

Figure 8.1. CA-SLO-1622 Looking North from Excavation Unit 1.

Locus A midden. The flaked stone deposit contains debitage, a modest number of stone tools, bone tools, a shell bead, and a low density of faunal remains. The distinct locus contains dense, dark shell middens including the shells of rocky intertidal invertebrates, primarily black turban snail and red abalone.

Excavations revealed the deposits also contain a variety of terrestrial mammal and marine fish bones as well as ground and battered stones, fire-altered rock, flake tools, obsidian and chert debitage, shell beads, and bone tools. These data are supplemented by the analysis of artifacts obtained during a 1995 surface collection and salvage project (Singer 1995). During the

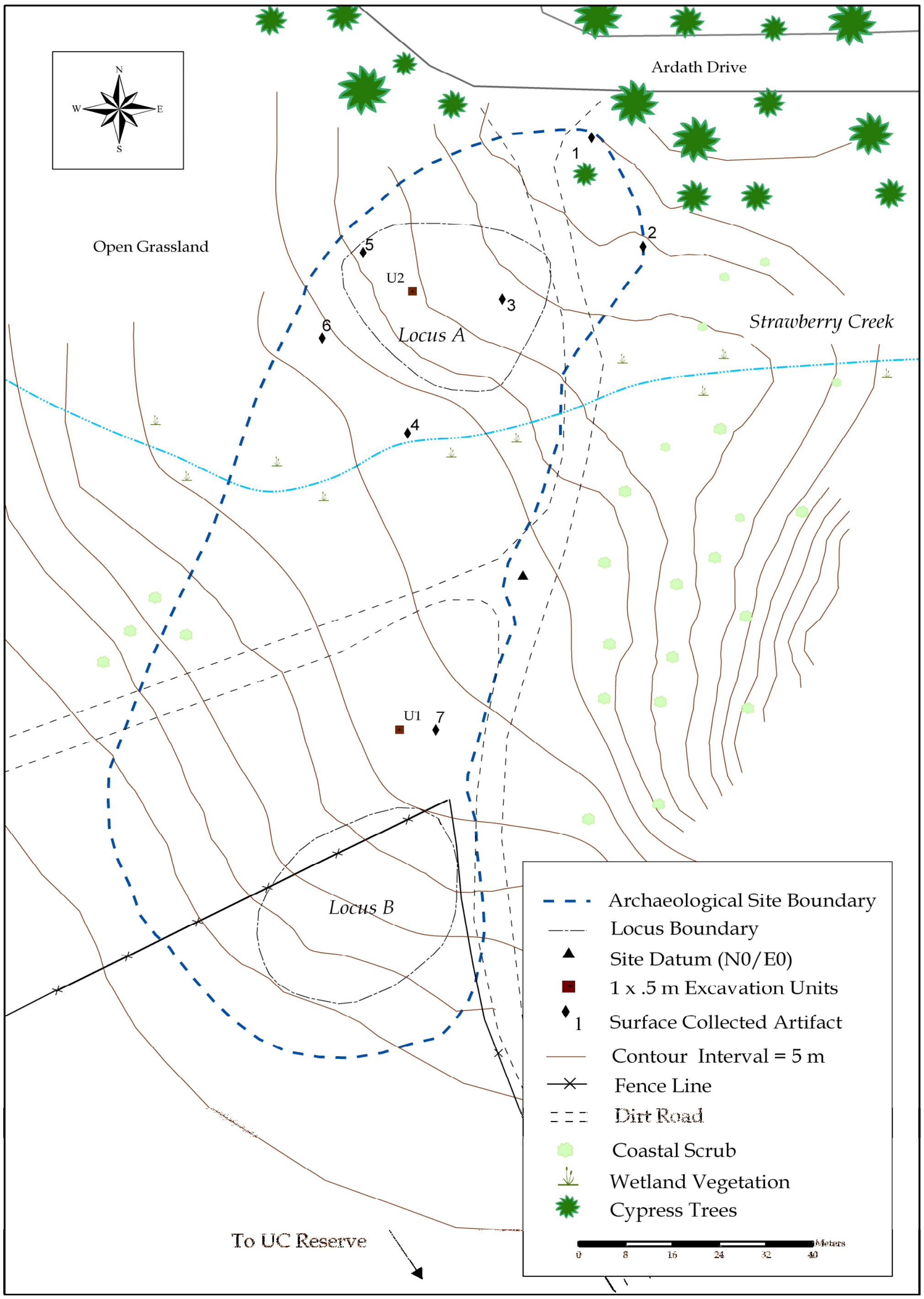


Figure 8.2. CA-SLO-1622 Site Map.

1995 project two 25-cm-wide utility trenches were cut through the site, one parallel to the northwest-southeast trending dirt road (Trench 1) and another along a road perpendicular to the UC Reserve office (Trench 2).

## SITE ENVIRONMENT

The Norris Site is situated in an environmentally rich area, with a wide variety of faunal and floral habitats and reliable fresh water nearby. The site is positioned on a broad, open marine terrace (between 80 and 55 feet above sea level) that gently slopes towards the Pacific Ocean located 200 m to the west. Expansive rocky intertidal and kelp forest habitats are adjacent to the site, as well as offshore reefs and rock islands. Unique to this location, the site is at the mouth of a sheltered canyon at the base of prominent Lodge Hill and is bounded by hillslopes to the east. Fresh water is available in Strawberry Creek, which drains the coastal foothills and flows south, bisecting the northern site area. Vegetation communities on and adjacent to the site include annual grasslands, coastal prairie, riparian, and a Monterey pine forest cascades downslope along the site margin. A productive stand of *Juncus* spp. is located at the northern site margin.

## LOCAL ARCHAEOLOGICAL CONTEXT

CA-SLO-1622 was originally recorded during a cultural resources compliance survey (Parker 1993). A number of additional sites are in the immediate vicinity, most on Lodge Hill, have been destroyed by development. Two trans-Holocene sites are situated on the prominent Lodge Hill. The first is CA-SLO-369, located about one km north on a north-facing slope, were Parker (2004) established three site occupations between 9,800 calBP and 910 calBP. The second is an expansive site complex (CA-SLO-177/178) situated on the south facing slope approximately 200 m north of CA-SLO-1622. Radiocarbon dates have established site occupations from the Millingstone (9420-8910 calBP, Pierce 1979; 9110-8780 calBP, Rudolph 1983) through the Late Period (510 – 0 calBP, Gibson 1979a). Site CA-SLO-697, on a marine terrace 700 m northwest of CA-SLO-1622, dates between 4300-3970 and 5520-5120 calBP (Breschini and Haversat 2004; Gibson 1979a), almost the same time as the current study site. Late Period occupations are situated 200 m south of CA-SLO-1622 on a terrace edge at CA-SLO-115 (690-0 calBP; Joslin 2006) and one km north at SLO-460 (209 - 60 calBP; Gibson 1979a). Collectively, these sites suggest a relatively intensive human occupation of the Lodge Hill area over 10,000 years.

### SITE SOILS AND STRATIGRAPHY

The site is situated on a remnant of the uplifted Pleistocene Cambria slab marine terrace (Stokes and Garcia 2008). Soils at the terrace surface are San Simeon-Conception series, in the Conception Loam phase (Ernstrom 1977:131, Sheet 4). Water permeability in these soils is very slow and may account for the weathered shell in Unit 2. Soils at and in the vicinity of CA-

SLO-1622 formed during distinct episodes of alluvial fan deposition and colluvial flow from the surrounding hillslopes followed by periods of relative stability.

Although soils in the two units revealed the same profiles and continuity in site structure, the vertical and horizontal distribution of cultural remains vary (Figures 8.3 and 8.4). Units 1 and 2 were placed in areas of the site that appeared to be relatively intact (see Chapter VI for excavation method details). A total volume of 0.81 $m^3$ of soil was excavated. Cultural materials are relatively shallow, extending to only 50 cm (Unit 1) and 80 cm (Unit 2) below the surface. In both units soil in the upper 10 cm is classified as an Ap plow zone (10 YR 2/1) resulting from the tilling and planting of hay crops (harding grass) from 1940 to the mid 1950s. Underlying this disturbed stratum, soils have remained relatively intact, as they have stratigraphic integrity, clay films, and calcium carbonate (CaCo3) filaments.

In Unit 1 a distinct boundary occurs at around 12 cm below datum, where a compact, moderately granular structure A1 Horizon extends in depth for 10 cm. The black (10 YR 2/1) midden soils continue to the base of the deposit ,with a vague boundary at 22 cm below datum, below which deposits have a subangular blocky structure and a higher clay content (20%). Small, round gravels are common throughout the deposit, with yellowish brown sandstone pebbles becoming more common with depth. The midden

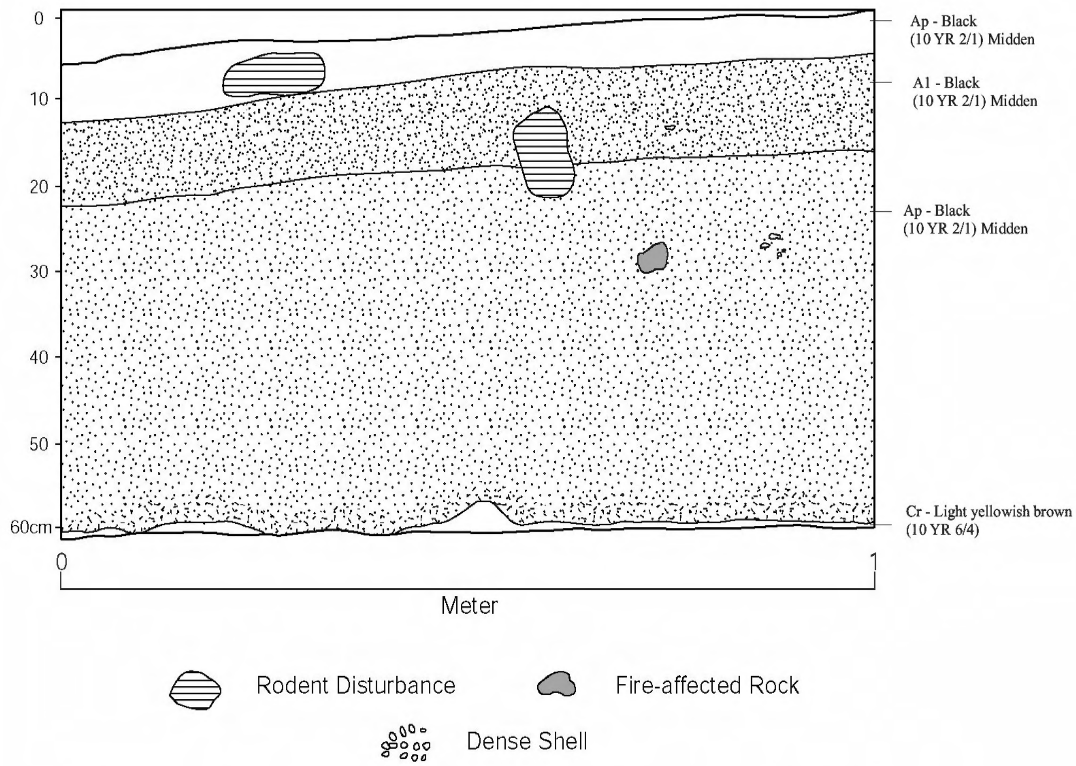


Figure 8.3. CA-SLO-1622 Excavation Unit 1 North Wall Soil Profile

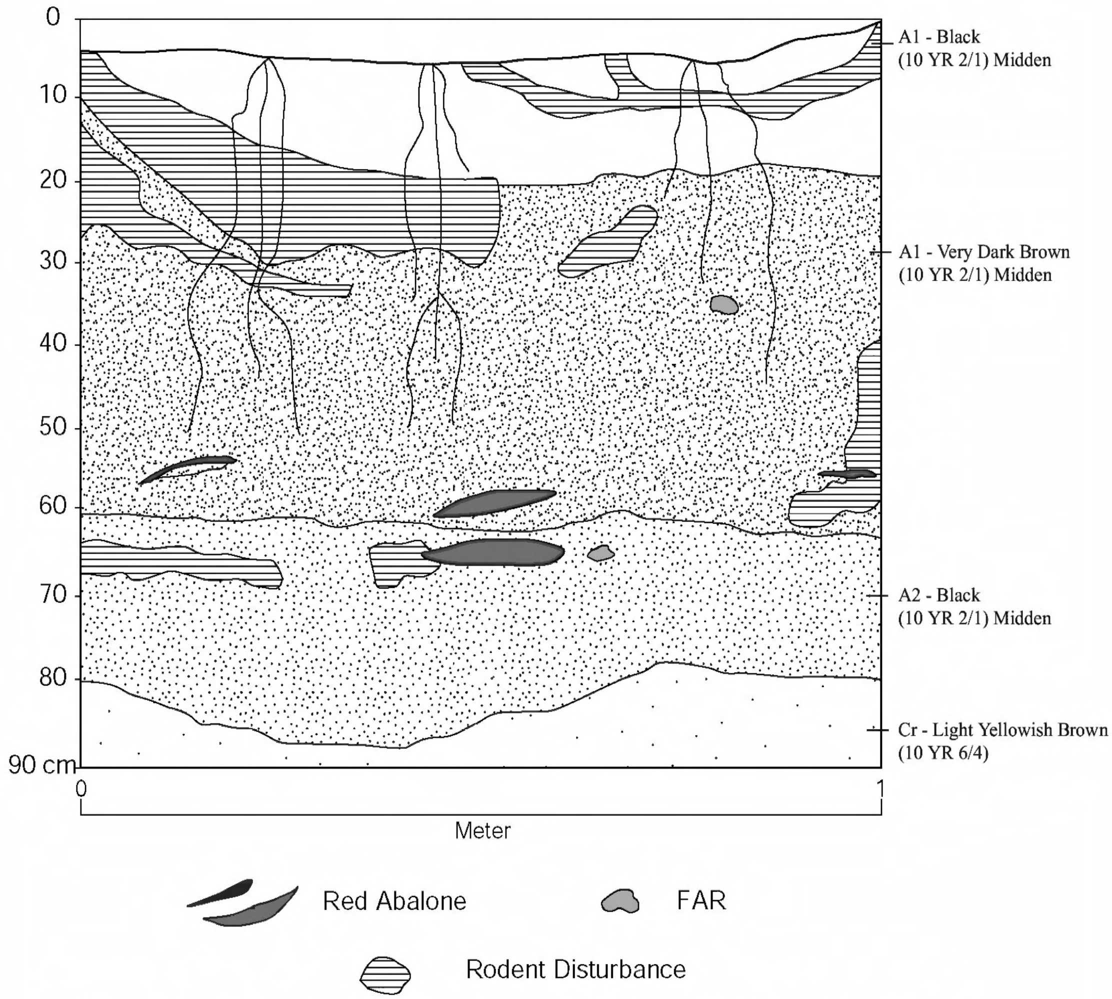


Figure 8.4. CA-SLO-1622 Excavation Unit 2 North Wall Soil Profile

soils grade into a culturally sterile C Horizon, defined by deposited aeolian sands immediately above weathering light yellowish brown (10 YR6/4) sandstone with massive structure. The density of cultural materials corresponds rather closely with the soil horizons.

A similar stratigraphic profile was observed in the black (10 YR 2/1) midden deposit excavated in Unit 2. The A1 Horizon is characterized by a sandy loam with a weak and blocky structure and limited subrounded pebbles, and it ends at a distinct boundary at 15 cm below datum. The highest density of faunal remains and artifacts was observed in this horizon. Between 30 and 70 cm in depth a red abalone midden interspersed with the shells of black turban snail and fire-altered rock was encountered. At 60 cm below datum, soils become very dark brown (10 YR 2/2) and moist, and contain a higher sand content. Between 80 and 90 cm below datum is the same sterile sandstone bedrock (C Horizon) seen in Unit 1. Deposits in Unit 2 appear more mixed by burrowing rodents.

## CHRONOLOGY

Site chronology was established through radiocarbon dating, diagnostic projectile points, *Olivella* beads, and obsidian hydration.

### RADIOCARBON DATES

Four radiocarbon dates were obtained from the site, all from single pieces of red abalone shell (Table 8.1). Two are from the current research and

Table 8.1. CA-SLO-1622 Radiocarbon Dates.

| Lab No. Beta | Material | Unit | Depth | Measured Radiocarbon Age (BP) | Conventional Radiocarbon Age (BP) | Calendar Age Range, 1 Sigma[a] |
|---|---|---|---|---|---|---|
| 186772 | *Haliotis rufescens* | 2 | 35[c] | 3690± 60 | 4140± 60 | 3860 (3760) 3670 calBP<br>1910 (1820) 1720 B.C. |
| 186773 | *Haliotis rufescens* | 2 | 73[c] | 4350± 80 | 4790± 80 | 4780 (4660) 4550 calBP<br>2830 (2710) 2600 B.C. |
| 87628[b] | *Haliotis rufescens* | T2 | 55[d] | 4020±30 | 4450±40 | 4260 (4180) 4090 calBP<br>2320 (2230) 2140 B.C. |
| 87627[b] | *Haliotis rufescens* | T2 | 30[d] | 4220±40 | 4650±40 | 4530 (4460) 4390 calBP<br>2580 (2510) 2440 B.C. |

Note: [a]Calibrated using 325± 35 UC CALIB REV 5.0.1 (Stuiver et al. 2005), rounded calendar ages include midpoint; [b]Previously unreported dates from Beta Analytic data sheets (1996); [c]cmbd – Centimeters below datum; [d]cmbs - Centimeters below surface.

two are previously unreported dates (Beta Analytic 1996) from samples collected from midden exposure in trench walls. The dates obtained for this research are from upper and lower portions of the rich shell midden (Unit 2). The two unreported dates pertain to unknown horizontal contexts along a long trench cut through the site. The vertical depths from which the samples for dating were obtained demonstrate that the deposit is temporally discrete. The radiocarbon dates suggest that portions of CA-SLO-1622 deposits date between 4660 and 3760 calBP, that is, within the Early Period.

### PROJECTILE POINTS

Four temporally diagnostic Franciscan chert projectile points were identified, a small fragment from a fifth point could not be classified (Figure 8.5). Two are from the lithic concentration: a side-notched point (SLO1622-336) recovered in the upper 10 cm of Unit 1, and a Contracting-

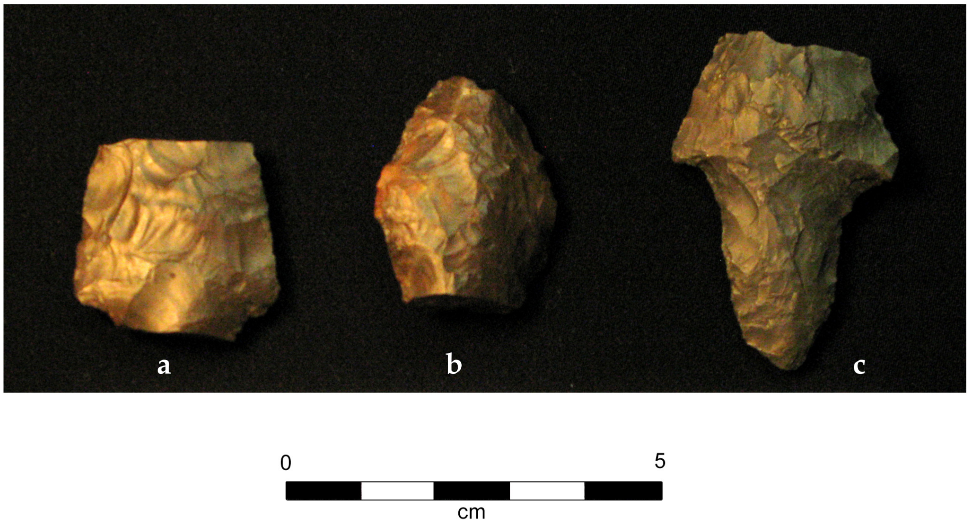


Figure 8.5. Projectile Points from CA-SLO-1622. a: Side-notched; b-c: Contracting stemmed.

stemmed point (SLO1622-357) surface collected near the unit. A second side-notched point was surface-collected near Unit 2 (SLO1622-358). An unprovenienced Contracting -stemmed point was also collected during the salvage project (SLO1622R-4).

**SHELL BEADS**

Two Olivella shell beads were recovered from CA-SLO-1622 (Table 8.2; Figure 8.6) The first is a small barrel from the upper portion of Unit 1 (Type Type B3a beads are commonly found in southern California but not the central coast (Milliken 2002:54). King (1990a:228, 239) suggested these beads were common during his Early Period (6,000-2600 BP), Middle 3 (1,550-1,250 BP) and Middle 5b through Late Period 1B (950-550 BP). Gibson (2009) placed the Type B3a bead in the early Middle Period. The second is an Olivella cup bead recovered from Unit 2 (Type K1; Bennyhoff and Hughes 1987:119). Olivella cups are chronological indicators of the Late Period.

Table 8.2. CA-SLO-1622 Shell Beads.

| Cat. no. | Unit | Depth (cm) | Bead Type | Description | Max Dia | Min Dia | TH | Perf Dia | Perf Type |
|---|---|---|---|---|---|---|---|---|---|
| 814 | 1CS | 20-30 | B3a | *Olivella* small barrel | 5.3 | 0.0 | 5.0 | 3.0 | G |
| 813 | 2 | 30-40 | K1 | *Olivella* Cup | 2.4 | 2.4 | 1.7 | 1.0 | B |

Note: All measurements are in mm; Max Dia- Maximum Diameter; Min Dia-Minimum Diameter; TH – Maximum thickness ; Perf Dia-Perforation Diameter; Perf Type-Perforation Type; B-Biconical; G- Ground.

## OBSIDIAN HYDRATION

Five pieces of obsidian debitage were recovered, all from Unit 2 (Table 8.3). Ternary plots of trace elements in these small artifacts show that four flakes are from the Casa Diablo area, with the fifth falling within the range of the Coso Volcanic Field, more specifically to the Fish Springs composition range (Hughes 2009).

All five flakes had measurable hydration rims. The four artifacts from the Casa Diablo source have hydration means ranging between 3.2 and 2.7 microns (mean 2.9, std 0.2), with one scavenged piece with a reading of 5.4 microns (second rim). The single specimen from the Coso Volcanic Field has a hydration reading of 2.8 microns.

Following the interpretations of Jones (2003), Jones and Ferneau (2002a:68), and Mikkelsen et al. (2000), five of these obsidian hydration readings fall within the Middle to Middle/Late Transition periods. The second rim Early Period hydration reading is consistent with radiocarbon dates from the site. The second reading may indicate that the piece was an

Table 8.3. Summary of Obsidian Hydration and XRF Results from CA-SLO-1622.

| Cat No. | Artifact Type | Unit | Depth (cm) | Hydration Mean (microns) | Obsidian Source |
|---|---|---|---|---|---|
| 358 | Debitage | 2 | 20-30 | 3.2 | Casa Diablo area |
| 359 | Debitage | 2 | 40-50 | 3.0 | Casa Diablo area |
| | 2nd Rim | | | 5.4 | |
| 360 | Debitage | 2 | 50-60 | 2.8 | Coso-Fish Springs |
| 361 | Debitage | 2 | 50-60 | 2.8 | Casa Diablo area |
| 362 | Debitage | 2 | 60-70 | 2.7 | Casa Diablo area |

old waste flake picked up at the quarry and later modified. These data fuel the debate among central coast researchers (Bouey and Basgall 1991; Jones 2003; Jones and Ferneau 2002a; Jones and Waugh 1997; Mikkelsen et al. 2000) on the use of obsidian as a precise dating tool, hydration conversion rates, radiocarbon versus hydration dates, and the accuracy of hydration analysis.

Based on the vertical distribution of radiocarbon dates and temporally diagnostic artifacts, CA-SLO-1622 represents a discrete Early Period site, with some indication of later occupation. The radiocarbon dates suggest an Early Period occupation spanning approximately 900 years from 4660 to 3760 calBP. The temporally diagnostic Contracting-stemmed and Large side-notched projectile points support the radiocarbon dates. The single *Olivella* small barrel bead is common to Early Period contexts. An *Olivella* small barrel Type B3a was also recovered from the Early Period component at Arroyo De Los Chinos to the north (Hildebrandt et al. 2002). The *Olivella* cup bead (Type K1) recovered from Unit 2 is a chronological Late Period indicator and suggests a possible later component in this portion of the site, mixed into earlier midden by burrowing rodents. The small sample of obsidian illustrates the problems with assigning absolute ages to hydration readings along the central coast. These readings may be a product of more recent and less intensive occupation at the site and brief stone tool production events.

## CA-SLO-1622 ARTIFACTS

For a small excavation sample, a rather high diversity of artifacts was recovered during the current research (Table 8.4). The previously unanalyzed 1995 CA-SLO-1622 artifact assemblage, which lacks vertical provenance, increases the number and diversity of tools.

### SHELL ARTIFACTS

The only shell artifact is an unshaped fragment of heated red abalone shell (97.41 g) with a small amount of asphaltum adhered to the nacre.

### BONE ARTIFACTS

Four bone tools were recovered from excavations, three from Unit 2 and one from Unit 1 (Table 8.5.). All artifacts are polished, exhibit some striations, and are shaped fragments of long bone from a medium/large mammal, most likely deer. Two (SLO1622-699 and –701) are small tip fragments that show minor modification and appear to have been used in a casual fashion. More distinctive are two well-shaped pins that show polish and striations from use (Figure 8.6, c and d). These include a midsection that tapers to a broken tip (SLO1622-700) and a fire-hardened finely made tip fragment that displays polish from use (SLO1622-702).

Table 8.4. Summary of CA-SLO-1622 Artifacts.

| ARTIFACT CLASS | 2010 | 1995 [a] | TOTAL |
|---|---|---|---|
| **Flaked Stone** | | | |
| Projectile points | 5 | 1 | 6 |
| Drills | 1 | 2 | 3 |
| Reamer | 1 | 2 | 3 |
| Bifaces | 3 | 13 | 16 |
| Formed flake tools | – | 5 | 5 |
| Simple flake tools | 8 | 57 | 65 |
| Core tools | 3 | 7 | 10 |
| Cores | 5 | 30 | 35 |
| Cobble tool | 1 | 2 | 3 |
| Tested cobble | – | 7 | 7 |
| Debitage | 3,646 | 460 | 4,106 |
| Subtotal | 3,673 | 586 | 4,259 |
| **Ground and Battered Stone** | | | |
| Millingslab | – | 5 | 5 |
| Bowl mortar | – | 2 | 2 |
| Cobble pestle | – | 1 | 1 |
| Handstone | – | 6 | 6 |
| Hammerstone | – | 5 | 5 |
| Pitted stones | 8 | 55 | 63 |
| Notched stone | – | 2 | 2 |
| Battered cobbles | 1 | 7 | 8 |
| Subtotal | 9 | 83 | 91 |
| **Shell Artifacts** | | | |
| *Olivella* small barrel, Type B3a | 1 | – | 1 |
| *Olivella* cup bead, Type K1 | 1 | – | 1 |
| *Haliotis rufescens* with asphaltum | 1 | – | 1 |
| **Bone Tools** | 4 | – | 4 |
| **TOTAL** | 3,689 | 669 | 8,708 |
| Artifacts per cubic meter[b] | 4,510 | | |

Note: [a]Previously Unanalyzed Collection; [b]Based on 0.818m$^3$ of excavated deposit and surface collections.

Table 8.5. Bone Artifacts from CA-SLO-1622.

| Cat. no. | Description | Wt | L | W | TH | DD |
|---|---|---|---|---|---|---|
| 699 | Indeterminate – Unburnt, tip fragment | 0.07 | 11.7 | 3.1 | 1.5 | 0.6 |
| 700 | Pin– Burnt, tip fragment | 0.23 | 14.2 | 4.2 | 3.2 | 0.8 |
| 701 | Indeterminate – Unburnt, tip fragment | 0.08 | 11.9 | 3.6 | 1.7 | 0.5 |
| 702 | Pin– Burnt, midsection fragment | 0.52 | 2.37 | 4.0 | 3.4 | 0.0 |

Note: All measurements are in mm; Wt – Weight in grams; L – Maximum length in mm; W – Maximum width; TH – Maximum thickness; DD–Distal diameter .

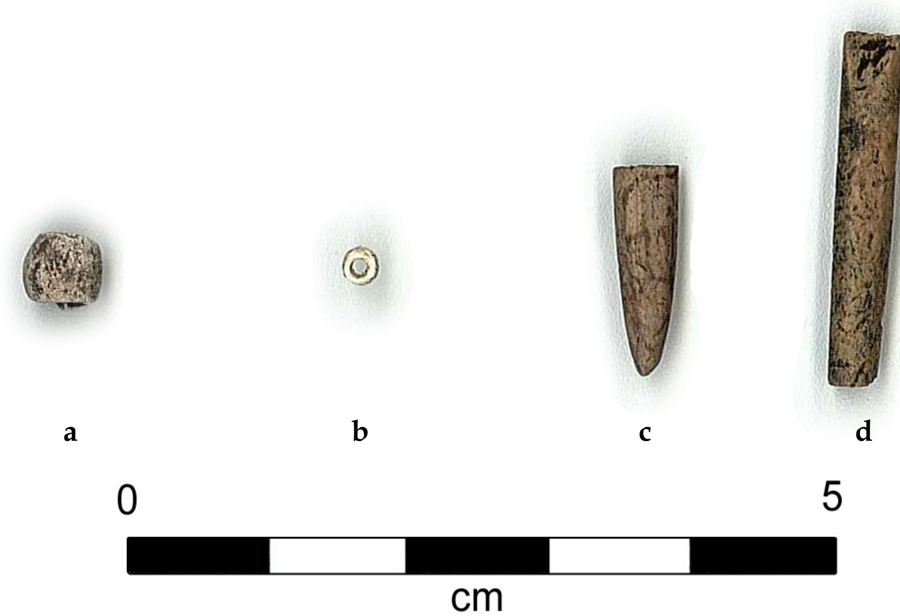


Figure 8.6. Selected Beads and Bone Tools from CA-SLO-1622. a: *Olivella* small barrel; b: *Olivella* Cup; c-d: Bone tools.

## Flaked Stone Tools and Debitage

The flaked stone tool and debitage assemblages from both the current research and the 1995 project consists of 153 tools and cores and 4,106 pieces of flaking debris (Table 8.6.). Twenty-seven formed tools and cores were collected from provenienced locations during the current excavations, and 126 are from unknown horizontal contexts during the 1995 project.

The flaked and ground stone assemblage from the previous salvage project and the current excavation largely mirror one another in terms of material selection, reduction strategies, and tool morphology and function. Simple flake tools represent almost half (42%) of the formed artifacts, followed by cores (23%), bifaces (10%), core and cobble tools (8%), projectile points (4%), formed flake tools (3%), reamers (2%), and drills (2%). As expected, Monterey chert dominates the material profile (89%), followed by Franciscan chert (11%), and a small number of obsidian, quartz, andesite, and diabase flakes. Formed artifacts and cores reflect a similar material selection, 75 percent Monterey chert and 25 percent Franciscan chert. Although the imported Franciscan chert is present in significantly lower counts, this higher quality material is preferred for smaller tool types such as the projectile points.

Bifaces are represented by 16 specimens—14 from Monterey chert and two from Franciscan chert—only one of which is a complete artifact. Of the 15

Table 8.6. Flaked Stone Assemblage from CA-SLO-1622.

| | MNT Chert | | FRN Chert | | OBS | QTZ | AND/ DIA | |
|---|---|---|---|---|---|---|---|---|
| Artifact | 2010 | 1995 | 2010 | 1995 | 2010 | 2010 | 1995 | Total |
| Projectile points | 1 | – | 4 | 1 | – | – | – | 6 |
| Drills | 1 | 2 | – | – | – | – | – | 3 |
| Reamers | 1 | 1 | – | 1 | – | – | – | 3 |
| Bifaces | 3 | 11 | – | 2 | – | – | – | 16 |
| Formed flake tools | – | 3 | – | 2 | – | – | – | 5 |
| Simple flake tools | 6 | 44 | 1 | 12 | – | – | 1 | 63 |
| Core tools | 2 | 6 | 1 | 1 | – | – | 2 | 13 |
| Tested cobbles | – | 3 | – | 4 | – | – | – | 7 |
| Cobble tools | – | – | – | 1 | – | – | 1 | 2 |
| Cores | 3 | 22 | 2 | 6 | – | – | – | 33 |
| Debitage | 3,238 | 426 | 393 | 32 | 5 | 7 | – | 4,101 |
| Total | 3,255 | 518 | 401 | 62 | 5 | 7 | 4 | 4,252 |

Note: MNT- Monterey; FRN- Franciscan; QTZ-Quartz; OBS-Obsidian AND-Andesite; DIA-Diabase.

complete enough to classify with regard to stage of manufacture. Early stage manufacturing is most common, with ten Stage 1, four Stage 2, and one Stage 4 specimen. The majority of bifaces are fractured due to materials flaws. Only four display modifications including edge crushing, unifacial micro-chipping, and use wear.

Small stone artifacts include three drills, three reamers, five formed flake tools, and 65 casual flake tools. Three complete Monterey chert drills were identified. Fashioned from interior and bifice thinning flakes, the artifacts are bifacially flaked and micro-chipped. Reamers are typical in the San Simeon Reef assemblages, and all three are thick specimens that appear to have been hafted. Formed flake tools include five Franciscan chert artifacts in the 1995 collection that are suggestive of spokeshaves and modified scrapers. The simple flake tool assemblage shows clear preference for local Monterey chert (77%). The imported, higher quality Franciscan chert is much less used (22%). Despite experimental research that shows edge modifications can result from human trampling (Gifford et al. 1985) this collection does show some patterns. These casual artifacts show use-wear along either one or two convex or straight working edges, and they display unifacial micro-chipping or flaking. The high proportion of these tools is suggestive of a variety of butchering (cutting, scraping, and slicing) and processing activities. Cores (n=35), core tools (n=10), and cobble tools (n=3) represent thirty-one percent of the artifact assemblage. Of the 35 cores, 25 are locally available Monterey Chert from flat, fist-sized cobbles typical of those found in the adjacent creek and intertidal zone. Eight Franciscan chert and two andesite cores were also identified. Ten cores, eight Monterey and two Franciscan chert, were classified as core tools. All exhibited some form of bifacial edge battering and dulling, with over half displaying extreme battering. These implements would have been useful for a variety of heavy-duty cutting, crushing, chopping, and scraping tasks. Two artifacts resemble choppers. Three cobble tools reflect minor battering and use.

A total of 4,103 pieces of debitage was recovered in the course of the current research and the 1995 project (Table 8.7.). As the assemblage from the current excavations was obtained through formal excavation, all of the debitage from both column samples and units was selected for analysis. The sample is composed of 3,646 pieces of debitage, 2,813 of which are non-diagnostic and were excluded from further analysis. The remaining 833 flakes include 746 (90%) of Monterey chert, 75 (9%) of Franciscan chert, seven (<1%) of quartz, five (<1%) of obsidian, and one (<1%) of glass (Table 8.7).

Among the diagnostic flake classes, decortication flakes are the most prevalent (52% total, with 30% primary flakes and 22% secondary flakes), pressure flakes (28%), interior flakes (17%), biface thinning flakes (3%), and core rejuvenation flakes (<1%) making up the remainder. The relatively large number of pressure flakes recovered appears to be a result of the finer 1/8-inch mesh, which retained a higher proportion of small flakes. Monterey chert flakes conforms to the overall reduction sequence, with 57 percent decortication flakes, 25 percent pressure flakes, 14 percent interior flakes, 3 percent biface thinning flakes, and less than one percent core rejuvenation flakes. Imported Franciscan chert flakes diverge, with pressure flakes (48%) and interior flakes (39%) comprising most of the assemblage, a pattern reflecting tool finishing or rejuvenation. Also reflecting this pattern are the three obsidian flakes and single biface thinning flake.

These flake profiles, similar to those of CA-SLO-1295, reflect a focus on the earlier stages of lithic production and on core-flake reduction techniques

Table 8.7. CA-SLO-1622 Debitage Attributes.

| | MNT Chert | FRN Chert | QTZ | OBS | Glass | Total |
|---|---|---|---|---|---|---|
| Primary reduction | 253/40 | 5/– | 1/– | – | – | 259/40 |
| Secondary reduction | 174/34 | 1/– | – | – | – | 175/34 |
| Core rejuvenation | 4/– | 1/– | – | – | – | 5/0 |
| Interior | 107/20 | 30/2 | 5/– | – | – | 142/22 |
| Biface thinning | 19/2 | 2/– | – | 1/– | – | 22/2 |
| Pressure | 189/15 | 36/– | 1/– | 3/– | 1/– | 230/15 |
| Subtotal | 746/111 | 75/2 | 7/– | 4/– | 1/– | 833/113 |
| Non-diagnostic | 2492 | 318 | – | 1 | – | 2813 |
| Total | 3,238 | 393 | 7 | 5 | 1 | 3,646 |

Note: MNT-Monterey, FRN-Franciscan, OBS-Obsidian, QTZ-Quartz; Debitage analysis based on the unit excavations wet screened through 1/8-inch mesh; #/# -Total Number of Flakes/ Number of Heat Altered Flakes.

rather than the production of bifacial tools from core or flake blanks. Biface thinning and the abundance of pressure flakes, however, suggests the production, finishing, and maintenance of the local Monterey chert bifacial tools. The high proportion of pressure flakes, which may reflect the use of finer mesh than is typical of other excavations along the San Simeon Reef, reflects an emphasis on tool finishing. Also of interest is the large number of pressure flakes relative to the small amount of biface thinning flakes and finished bifaces. The small numbers of biface thinning flakes may be in part due to their greater length-to-thickness ratio, making them the most susceptible to fracture during manufacture and to post-depositional factors and leading to their exclusion from analysis.

Overall, the lithic collection is represented by a small number of task-specific tools, an abundance of simple flake tools, and a profusion of manufacturing refuse. The flaked stone assemblage from CA-SLO-1622 is somewhat unique in that cores and core tools both outnumber bifaces by approximately two to one.

### GROUND AND BATTERED STONE

Ninety-one ground and battered stone tools were recovered from CA-SLO-1622, nine from the current research and 83 from the 1995 project (Table 8.4). Overall, these tools exhibit light to moderate use-wear on unshaped locally available cobbles, indicative of expedient, non-curated tools. Most of the artifacts are of local sandstone (95%), with a small number of mudstone, andesite, and diabase cobbles.

A focus on pounding and battering is evident in the large number of pitted stones (69%) in the ground stone assemblage, a common artifact found in shell middens on the central coast. Similar to other local pitted stone collections, the tools have two (50%) or more (8%) pits per stone formed either on small beach cobbles or on re-used handstones. The stones are pecked, battered, polished, and spalled, indicative of an expedient tool with multiple uses. In this shell-rich site, the density of pitted stones suggests an association with extracting meat from the black turban snails or abalone.

Handstones (6%), battered cobbles (8%), and hammerstones (5%) total 19 percent of the collection. The six handstone fragments are all unshaped, exhibit slight polish on one or more faces, secondary use-wear along the edge or ends, and limited pecking on one or more faces. Two are suggestive of manos. Battered cobbles and hammerstones, as the designations imply, show extensive end battering, pitting, spalls, and wear that suggest multiple uses. These artifacts are associated with processing very hard resources, such as shell, nuts, bone, or with the modification and manufacture of stone tools. The small cobble pestle and six handstones, as well as the two bowl mortar and five millingslab fragments, provide evidence of milling and food processing of vegetal resources or crushing and pounding animal resources not evidenced in the excavations. A small cobble pestle exhibits signs of truncated end grinding often associated with pestles; however, its diminutive size (13.5 x 6.5 cm), soft sandstone material, and thick spalls are notable (SLO-1622R-221, Figure 8.7b). The complete bowl mortar (mortar cup: 10 cm in diameter; exterior diameter: 20 cm) is impressive. It is a small, well-shaped artifact made from a small beach cobble that exhibits similar degrees of exterior pecked and ground surfaces and pecked, ground interior mortar cavity that is indicative of investment in shaping. The two complete flat-surfaced millingslabs are fashioned on otherwise unmodified tabular bedrock. The largest (35 x 26 x 4 cm) is oval-shaped with polish and pecking on both faces and spalls removed from one margin. The second is round (22 cm diameter), flat, and polished on one face, and it has a small pit on the second face. The bowl mortar and complete millingslabs are asphaltum-stained. A single notched stone or net/line weight was fashioned from an unshaped cobble and has a distinct latitudinal groove created by pecking in a linear pattern across one face (SLO1622R-142, Figure 8.7a).

### Charcoal

A modest amount of Monterey pine wood and cone scale charcoal was distributed throughout the deposit, with small fragments (between 0.04 and 0.68 g) collected in both units at every level.


Figure 8.7. Selected Ground and Battered Stone Artifacts from CA-SLO-1622. a: Notched stone or net/line weight; b: Small cobble pestle.

### SUBSISTENCE STRATEGIES

A diverse collection of faunal remains was recovered from CA-SLO-1622, predominantly from the higher density midden at the location of Unit 2. Unit 1 contained the same range of faunal remains, but a higher proportion of terrestrial mammal bone. Analyzed faunal remains are from the two 1 x 0.5 excavation units and associated column samples wet screened over 1/8-inch mesh. Although derived from a small volume, the remains of shell, and fish, mammal, bird and reptile bone provide adequate data to evaluate subsistence patterns at the site. As Table 8.8. demonstrates, the highest densities of dietary materials were recovered between 20 and 70 cm below datum.

### MAMMAL, BIRD, AND REPTILE BONE

The bones of birds, reptiles, and terrestrial and marine mammals account for roughly 84 percent of the vertebrate remains at

Table 8.8. Vertical Distribution of CA-SLO-1622 Faunal Remains by Weight.

| | Shell | | | Fish Bone | | | Mammal and Bird Bone | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth (cm) | Unit 1 | Unit 2 | Total | Unit 1 | Unit 2 | Total | Unit 1 | Unit 2 | Total |
| 0-10 | 2.2 | 745.6 | 747.8 | 0.08 | 1.35 | 1.43 | 1.62 | 10.92 | 12.54 |
| 10-20 | 7.0 | 555.4 | 562.4 | 0.35 | 1.42 | 1.77 | 8.90 | 9.98 | 18.88 |
| 20-30 | 10.5 | 588.9 | 599.4 | 0.21 | 1.37 | 1.58 | 7.48 | 9.58 | 17.06 |
| 30-40 | 121.0 | 1,077.3 | 1,198.3 | 1.37 | 2.35 | 3.72 | 12.45 | 12.83 | 25.28 |
| 40-50 | 8.6 | 2,348.7 | 2,357.3 | 0.88 | 2.56 | 3.44 | 11.88 | 15.62 | 27.50 |
| 50-60 | 0.5 | 3,627.1 | 3,627.6 | 0.42 | 0.27 | 0.69 | 6.37 | 3.29 | 9.66 |
| 60-70 | — | 1,552.0 | 1,552.0 | — | 3.66 | 3.66 | — | 21.01 | 21.01 |
| 70-80 | — | 1052.8 | 1052.8 | — | 1.88 | 1.88 | — | 4.47 | 4.47 |
| 80-90 | — | 26.6 | 26.6 | — | 0 | 0 | — | 4.47 | 4.47 |
| Total | 149.8 | 11,574.4 | 11,724.2 | 4.31 | 16.86 | 18.17 | 49.7 | 89.87 | 139.57 |

Notes: Rodent bones excluded; Weigh in grams; — level not excavated; Levels correspond to levels excavated below datum; Includes 11.09 g of *Haliotis cracherodii* from level 10-20; Includes 1908.76 g from *Haliotis rufescens* from 30 through 70 levels;

CA-SLO-1622 (Table 8.9). A total of 3119 elements weighing 138.21 g was recovered from the excavation. Due to the highly fragmented condition of the remains, less than one percent of the assemblage could be identified beyond general class level. Eighty-four elements identified as rodents are most likely intrusive as they do not exhibit heat alteration or other signs of modification and are better preserved that the other bones, suggesting a more recent age. These elements are excluded from further analysis.

Of the identified elements, brush rabbit and black-tail deer are represented by five elements each. Based on general categories, terrestrial mammals account for most of the bone (98%), followed by minor contributions of bird (<1%), marine mammal (<1%), and reptile (<1%). Unidentified remains sorted by size indicate that medium mammals dominate (76%), followed by large mammals (17%), and small mammals (6%). This pattern is relatively consistent with the identified remains. In particular, the abundance of artiodactyl-sized elements is consistent with Early Period occupations. Sixteen percent of the bones are heat altered.

### Marine fish

Only 18.17 g of fish bone, 805 bones, and a minimum of 34 fishes were identified at CA-SLO-1622 (Table 8.10). The fish bone assemblage is derived from units and column samples that were wet screened in the laboratory.

Table 8.9. Identified Mammal, Bird, and Reptile Bones from CA-SLO-1622.

| COMMON NAME | TAXON | NISP | WEIGHT |
|---|---|---|---|
| **Terrestrial Mammals** | | | |
| Brush rabbit | *Sylvilagus bachmani* | 5 | 0.47 |
| Deer | *Odocoileus* sp. | 5 | 6.04 |
| Mammal | Unidentified mammal | 921 | 16.19 |
| Large mammal | Mammalia | 357 | 42.15 |
| Medium mammal | Mammalia | 1,565 | 50.46 |
| Small mammal | Mammalia | 125 | 2.26 |
| Subtotal | | 2,978 | 117.57 |
| **Marine Mammal** | | | |
| Medium | Pinnipedia | 15 | 16.94 |
| **Rodent** | | | |
| Rodent | Rodentia | 70 | 1.99 |
| Pocket gopher | *Thomomys bottae* | 14 | 0.61 |
| Subtotal | | 84 | 2.6 |
| **Birds** | | | |
| Large bird | Aves | 10 | 0.34 |
| Medium bird | Aves | 1 | 0.05 |
| Small bird | Aves | 12 | 0.45 |
| Bird | Aves | 7 | 0.24 |
| Subtotal | | 30 | 1.08 |
| **Reptiles** | | | |
| Lizard | Indeterminate | 3 | 0.02 |
| **Total** | | 3,119 | 138.21 |

Note: NISP – number of identified specimens.

This analysis of fish bone pertains to the 1/8-inch mesh sample, as no diagnostic fish vertebrae were recovered in the 1/16-inch mesh sample. Because their vertebrae or centra are generally well preserved, numbers of identifiable fish bone are much larger than is the case with other vertebrate faunal categories. However, in this collection, only 11 percent or 92 elements could be identified to family, genus, or species due to the fragmented and heat-altered condition (19 taxa altogether). Just over half (413 of 805 elements) show signs of burning, with prickleback bones most commonly

Table 8.10. Fish Remains from CA-SLO-1622.

| COMMON NAME | TAXON | 1/8-INCH MESH NISP | MNI | WEIGHT (G) |
|---|---|---|---|---|
| ROCKY INTERTIDAL | | | | |
| Cabezon | *Scorpaenichthys marmoratus* | 10 | 4 | 0.70 |
| Clinids | Clinidae | 5 | 3 | 0.07 |
| Pile perch | *Rhacochilus vacca* | 1 | 1 | 0.01 |
| Pricklebacks | *Stichaeidae* | 27 | 8 | 0.32 |
| Kelp greenlings | *Hexagrammos decagrammus* | 1 | 1 | 0.00 |
| Northern clingfish | *Gobiesox maeandricus* | 1 | 1 | 0.00 |
| Rockfishes | *Sebastes* spp. | 19 | 6 | 0.89 |
| Rock or black prickleback | *Xiphister* spp. | 21 | 6 | 0.38 |
| Sculpins | Cottidae | 2 | 1 | 0.03 |
| Wooly sculpin | *Clinocottus* spp. | 3 | 2 | 0.1 |
| KELP BEDS | | | | |
| Giant kelpfish | *Heterostichus rostatus* | 2 | 1 | 0.02 |
| Ray-finned fishes | Actinopterygii | 713 | | 15.65 |
| Totals | | 805 | 34 | 18.17 |

Note: Sample Volume =0.81m$^3$; Weight in grams; No fish elements recovered in 1/16-inch sample; *Sebastes* spp. and *Xiphister* spp. counts includes one otolith.

heat altered. Due to the low MNI values, the following discussion will be primarily based on NISP unless otherwise noted. By weight, the stratigraphic distribution of fishbone is concentrated in Unit 1 between 30 and 50 cm (Table 8.8). A total of 995 bone elements was recovered, and the density of fish bone in the deposit, including all ray-finned fishes, is 22.4 per cubic meter.

Pricklebacks (including rock and black pricklebacks) account for 52 percent of the fish NISP and 28 percent of the weight. The second most common are rockfishes, accounting for 21 percent of the NISP and 35 percent of the weight, a higher weight proportion due to the larger fish bone size. The next most abundant species is cabezon, 11 percent of the NISP and 28 percent of the weight. A small variety of fishes appear to have been relatively minor dietary contributors. When MNI is considered, the ranking is the same: pricklebacks (n=14), rockfishes (n=6), and cabezon (n=4).

The majority of identified fishes inhabit nearshore waters above a rocky substrate (98%; e.g., pricklebacks, rockfish, and cabezon). The remaining species are common to kelp forests (e.g., giant kelpfish). Most of these fishes could have been caught in the rocky intertidal by hand or in nearshore waters above rocky substrate using hook and line, spears, or a variety of nets. The giant kelpfish, common to the offshore kelp beds, may have required some watercraft to capture.

#### SHELLFISH

Shellfish remains were obtained from the two excavation units (11,628 g) and the two column samples (1,672.13 g; Table 8.11). Thirty-seven different shellfish taxa were identified in the sample, most of which inhabit rocky intertidal habitats (Appendix A; Table A2). To investigate research questions surrounding ecology, subsistence and intensification two types of samples were collected and analyzed, as discussed in *Chapter VI: Archaeological Methods, Shellfish.* Unit 2 contained the highest density of shell, a total of 11,576.39 grams, or 25,724 g/$m^3$. The shell is concentrated in the 30 to 70 cm levels that correspond to a discrete red abalone midden, where a total of 1908.76 g of red abalone was recovered. In comparison, only about 41.67 g, or 138.9 g/$m^3$, of shell were recovered from Unit 1.

Table 8.11. Contribution of Significant Shellfish Species from CA-SLO-1622.

| COMMON NAME | TAXON | TOTAL (G) | TOTAL (%) |
|---|---|---|---|
| Red abalone | *Haliotis rufescens* | 788.37 | 47.1 |
| Black turban snail | *Tegula funebralis* | 429.97 | 25.7 |
| California mussel | *Mytilus californianus* | 147.93 | 8.8 |
| Red turban | *Lithopoma gibberosa*[a] | 92.92 | 5.5 |
| Chiton | *Mopalia* spp. | 80.54 | 4.8 |
| Abalone | *Haliotis* spp. | 35.31 | 2.1 |
| Limpet | *Collisella* spp. | 27.58 | 1.6 |
| Crab | Cancer | 17.46 | 1.0 |
| Brown turban snail | *Tegula brunnea* | 15.29 | 0.9 |
| Purple sea urchin | *S purpuratus* | 6.34 | 0.4 |
| Slipper shell | *Crepidula* spp. | 1.37 | 0.4 |
| Monterey top | *Tegula montereyi* | 0.83 | 0.0 |
| Barnacle | *Balanus* spp. | 0.51 | 0.0 |
| Pacific littleneck clam | *Protothaca staminea* | 0.42 | 0.0 |
| Purple olive | *Olivella biplicata* | 0.05 | 0.0 |
| Indeterminate | | 25.89 | 1.5 |
| Total | | 1670.78 | 100 |

Note: Shell samples are based on two column samples screen through 1/8-inch mesh, a total of 0.060 $m^3$; Weight in grams; % - proportion of site shell assemblage; *S-Strongylocentrotus* [a]*Lithopoma gibberosa* was formerly classified as *Astrea gibberosa*.

Based on the high frequencies of red abalone shell in Unit 2, it is not surprising the species is almost half of the shell weight, 47 percent (Table 8.11). Black turban snail contributes about 25 percent of the weight, California mussel only nine percent, and red turban (*Lithopoma gibberosa)* five percent. All other taxa appear to be of minor dietary importance, generally making up less than two percent of the total sample. *Olivella*, a species not common in middens, may have been brought to the sites for bead making. Most of the shell species occur in intertidal habitats: California mussel, barnacle, tegula, limpet, and the chitons are typically found in the mid-to-high intertidal zone; the mid-low intertidal zone is populated by black abalone; and red abalone and sea urchin tend to concentrate in the low intertidal zone (Rickets et al. 1985; Coan et al. 2000). The small amount of Pacific littleneck clam was probably obtained from the sandy beach or gravelly shoal habitats approximately two miles north at the mouth of Santa Rosa Creek.

### CALIFORNIA MUSSEL AND RED ABALONE SIZE-FREQUENCY DATA

The remains of all complete and nearly complete mussel shells from all samples were measured to evaluate the size at the time of harvesting. My methods are presented in Chapter VI, and long-term changes in the taxon sizes are in Chapter XI.

#### RED ABALONE

A total of 32 red abalone shells from CA-SLO-1622 was analyzed (Table 8.12). Red abalone lengths ranged from three to 18 cm, with an average of 9.8 cm, but 47 percent of the abalone are adults over 10 cm long. The highest class frequencies are 11-12 and 13-14 cm, which include 26 percent of the red abalones. The data suggest that foragers collected both juvenile and adult red abalones over the course of site occupation, with slightly higher shell sizes during the initial site use. All of the abalone shells were recovered from the initial occupation of the midden, between 40 and 70 cm below datum and dating to around 4660 calBP.

Table 8.12. Red Abalone Lengths and Frequencies from CA-SLO-1622.

| SIZE CLASS (CM) | FREQUENCY WITHIN AGE PROFILE | PERCENT |
|---|---|---|
| 0-2 | 0 | 0 |
| 2-3 | 0 | 0 |
| 3-4 | 2 | 6 |
| 4-5 | 3 | 9 |
| 5-6 | 1 | 3 |
| 6-7 | 3 | 9 |
| 7-8 | 3 | 9 |
| 8-9 | 3 | 6 |
| 9-10 | 3 | 9 |
| 10-11 | 2 | 6 |
| 11-12 | 4 | 13 |
| 12-13 | 0 | 0 |
| 13-14 | 4 | 13 |
| 14-15 | 2 | 6 |
| 15-16 | 0 | 0 |
| 16-17 | 2 | 6 |
| 17-18 | 1 | 3 |
| Total | 33 | 100 |
| UNIT LEVEL (CM) | FREQUENCY (AVERAGE SIZE CM) | PERCENT |
| 0-10 | 0 | 0 |
| 10-20 | 0 | 0 |
| 20-30 | 0 | 0 |
| 30-40 | 2 (10) | 3 |
| 40-50 | 10 (8.7) | 34 |
| 50-60 | 7 (10.8) | 22 |
| 60-70 | 14 (10) | 41 |
| Total | 32 | 100 |

**CALIFORNIA MUSSEL**

Indicative of the low dietary contribution of California mussel at CA-SLO-1622, representing les than nine percent of the shell identified in the column samples only three small mussel fragments with umbos were size-measured. These fell within the three smallest mussel class sizes (i.e., 0-4 cm) and with a mean of 2.5 cm.

## DIETARY RECONSTRUCTION

Two methods were applied to provide an estimate of the relative importance of various faunal classes, the density of NISP and weight per cubic volume of excavation and dietary reconstructions based on the weight method. These two methods are discussed further in Chapter VI: *Archaeological Methods, Subsistence Remains.*

Based on the density data, shellfish were clearly a major contributor to the diet, followed by terrestrial mammals, marine fish, and marine mammals (Table 8. 13). The relative importance of shellfish over the course of site occupation is clearly documented by the ratio of shell weight to terrestrial mammal bone weight, i.e., 113:1. Birds and reptiles represent only supplementary parts of the diet.

Table 8.13. Shell and Bone Densities from CA-SLO-1622.

| FAUNAL CLASS | DENSITIES PER CUBIC METER |
|---|---|
| Shellfish (g) | 16,231 |
| Terrestrial mammal (NISP/g) | 3,641/144 |
| Marine mammal (NISP/g) | 15/20.9 |
| Bird (NISP/g) | 37/1.3 |
| Reptile (NISP) | 4 |
| Fish (NISP/g) | 995/22 |

Note: Data derived from 0.81 m3; Terrestrial bone includes unidentified class size and identified species.

Dietary reconstruction of the CA-SLO-1622 faunal assemblage using the weight method provides another estimate of the relative importance of different categories. According to these conversions, shellfish contributed 80 percent of most meat weight to the diet (Table 8.14). It is relatively clear that the large meat packages in the form of individual red abalone shellfish were targeted by site occupants. Terrestrial mammals represent 11 percent of the diet, followed by minor contributions of marine mammal (7%), and marine fish (3%). Regardless of the method of quantification used, this analysis reveals that shellfish and other marine mammals contributed roughly 90 percent of the meat diet.

Table 8.14. CA-SLO-1622 Estimated Dietary Reconstruction Based on Meat Weight.

| TAXON | BONE WEIGHT (G) | MEAT WEIGHT (G) | PERCENT (MEAT WEIGHT) |
|---|---|---|---|
| Terrestrial mammals | 117.57 | 1,962.86 | 11 |
| Marine mammals | 16.94 | 1,185.80 | 7 |
| Birds | 1.08 | 1.42 | 0 |
| Reptiles | 0.02 | 0.00 | 0 |
| Marine fish | 18.17 | 503.30 | 3 |
| Shellfish | 13,276.61 | 14,354.29 | 80 |
| Total | 13,430.39 | 18,007.67 | 100 |

## SYNTHESIS

The Norris Site, CA-SLO-1622, is a short-term secondary residential base occupied primarily between 4660 and 3760 calBP with a potential, brief Middle-Middle/Late Transition component. At this Early Period habitation site, occupants targeted immediately available littoral and terrestrial resources and performed a variety of domestic activities. The site is a large and dense scatter of flaked stone tools and debitage. The deposit is shallow, only about 50 cm thick, and has a limited range and density of faunal remains. Within the larger flake scatter are two habitation loci characterized by rich shell middens. A small unit placed in Locus A revealed a diversity of faunal remains and artifacts in an 80-cm-thick deposit. No evidence of features, structures, or burials was observed. However, a high proportion of burnt bone and thermal crazing on shellfish indicate food remains were processed and consumed on site.

Faunal remains suggest that people were primarily targeting the rocky intertidal habitats for shellfish, as well as coastal prairies for terrestrial game (i.e., deer and rabbits). Along the shoreline and on offshore rocky haul-outs, marine mammals were captured. Although fish were procured in nearshore waters, tidal pools, and kelp forests, they do not appear to have been an major dietary contribution.

The abundance of rocky intertidal shellfish remains is not surprising, given that most Early Period sites along the San Luis Obispo's open coast conform to this pattern. The large proportion and large size of the red abalone, however, is intriguing. The red abalone midden observed in Unit 2 is also mentioned in the 1995 field notes documenting the trench excavated through the length of the site. The southern San Simeon Reef, and Cambria in particular, have a rather high frequency of this unique site type. Although occupations are known in the Lodge Hill vicinity dating over a 10,000-year interval, red abalone middens appear only during the Middle Holocene and deserve specific attention. Black turban snails are abundant in the deposit and California mussel are of minor importance.

The artifact assemblage shows a diverse range of tools that represent residential activities carried out by complete social groups. Flaked stone tools include implements focused on hunting and butchering activities (e.g., projectile points, bifaces) as well as those used to process or manufacture various types of material (e.g., flake tools, drills, core tools). Although occupants clearly utilized nearby sources of Monterey chert by reducing, the presence of obsidian from the eastern Sierra Nevada demonstrates interregional trade. Most of the ground and battered stone tools can be characterized as incipient, showing slight modifications and wear, as reflected by the abundance of pitted stones and multi-functional tools. The wear on a single tool is variable and indicates multiple, intermittent episodes of use. The investment in large, non-portable millingslabs and bowl mortars, along with a pestle, indicates plant processing. Asphaltum residue on most of the milling equipment suggests its use as both an adhesive (e.g., attaching baskets) and a waterproofing agent.

# CHAPTER IX: CA-SLO-1677 —THE SPRING SITE
# AN EARLY PERIOD DEPOSIT

CA-SLO-1677, the Spring Site, is located on an upper marine terrace in the northern portion of the UC Reserve (Figures 9.1 and 9.2). The site is situated in a sheltered location at the base of the coastal foothills with a panoramic view of the Pacific Ocean. The portion of the deposit excavated dates between about 4910 and 3640 calBP. Perhaps the most distinguishing aspect of this coastal habitation site is the well-developed red abalone midden encountered in both units, suggesting a more focused subsistence strategy than other San Simeon Reef sites. Red abalone middens are one of the most distinctive coastal site types, but most research on these unique deposits has predominantly focused on the northern Channel Islands (Braje et al. 2007, 2009; Erlandson et al. 2005; Glassow 1993b; Glassow et al. 2008; Kennett 2005; Orr 1968; Rick et al. 2006; Salls 1991; Sharp 2002; Vellanoweth et al. 2006). These sites are common during the Middle Holocene but are known to date to other periods. We still know comparatively little about the diversity of this site type on California's mainland coast and its relationship to broader subsistence and settlement patterns along the Pacific coast.

Significantly, although this site type is known to be present in Cambria area, CA-SLO-1622 and -1677 are the first excavations of a red abalone midden along the north coast of San Luis Obispo County. The research

Figure 9.1. CA-SLO-1677 Looking West with Kristina (Pistola) Gill at Unit 2.

presented here on a temporally discrete site spanning more than a millennium of the Early Period, provides an opportunity to better understand cultural developments at the local level and, more specifically, Early Period subsistence and settlement patterns.

## SITE DESCRIPTION

Subsurface excavations and surface surveys at the Spring Site revealed a large coastal shell midden covering an area roughly 80 by 100 m. The site is characterized by a rich black midden interspersed with a dense scatter of flaked, ground, and battered stone artifacts. This chapter presents results of analysis of materials recovered in two excavation units located in the center

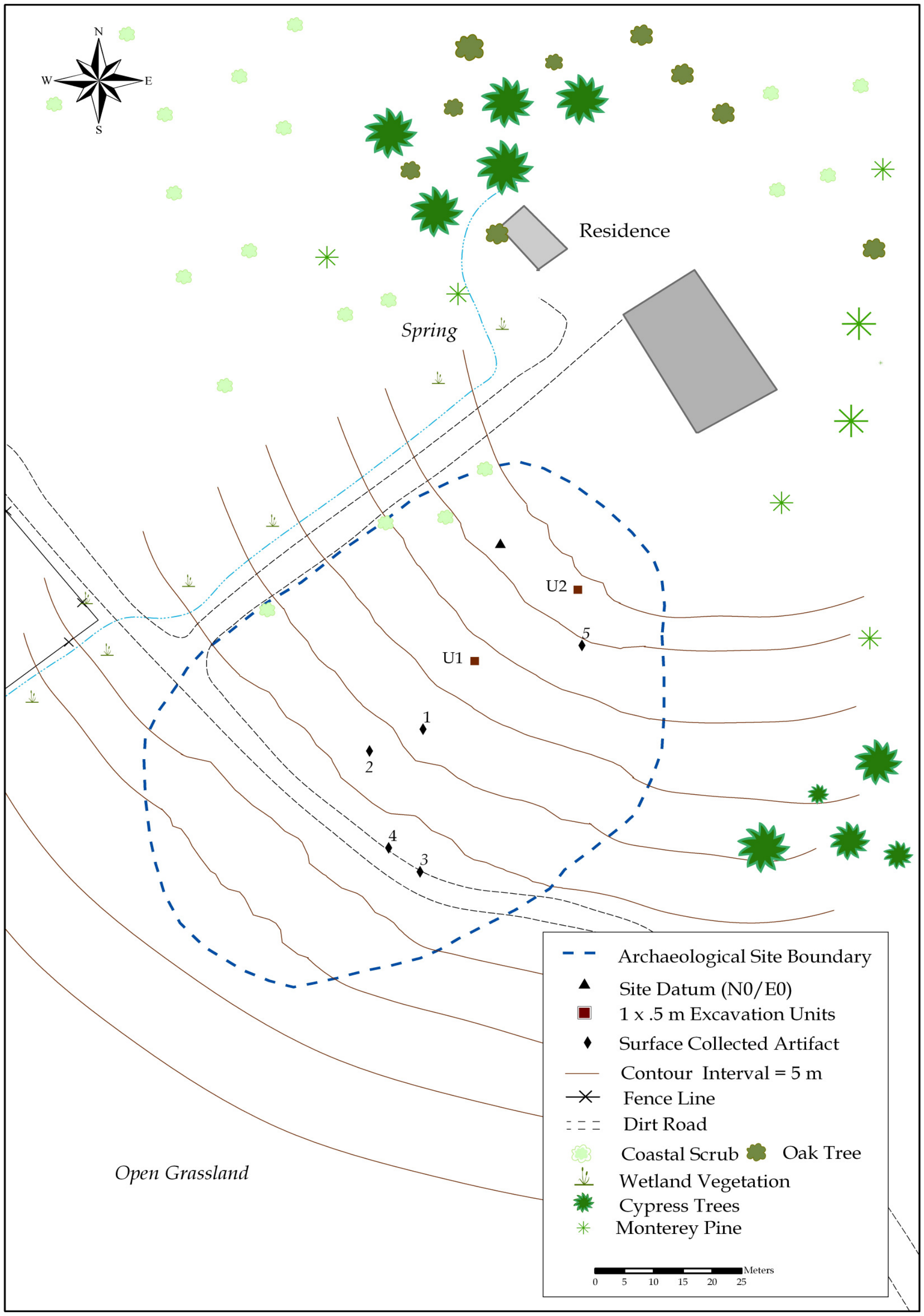


Figure 9.2. CA-SLO-1677 Site Map.

of the site. These data are supplemented by the analysis of artifacts obtained during a 1995 surface collection and salvage project (Singer 1995). During the 1995 project two utility trenches, each measuring 25 cm wide, were cut through the center of the site, one parallel to a northwest-southeast-trending dirt road (Trench 1) and the other in the northern site area along the road to a house (Trench 2). Historically, cattle grazing have impacted the site, although the deposit appears to have been spared from nearby hay cultivation. In the northern site area deposits have been leveled for a residence.

## SITE ENVIRONMENT

The Spring Site is located in an ideal environment, abundant in both marine and terrestrial resources. The site is positioned at the northern extent of a wide marine terrace approximately 60 to 70 feet above sea level. Situated at the mouth of a small canyon, the site is sheltered by coastal hill slopes that gently extend across the terrace towards the Pacific Ocean located 100 m west. The site if flanked by productive rocky intertidal and kelp forest habitats, offshore reefs and rock islands. Vegetation communities on and adjacent to the site include annual grasslands, coastal prairie, riparian, and Monterey pine forest. Most distinctive is the mature Monterey pine forest, mixed with an understory of live oaks that extends along the northern site margin (Figure 9.3). Fresh water is available in a productive spring that flows south along the western site area. The spring's stability as a fresh water source is indicated by productive stands of riparian vegetation such as tules, present even during the fall months.

## LOCAL ARCHAEOLOGICAL CONTEXT

CA-SLO-1677 was recorded during a cultural resources compliance survey (Parker 1993). As the rich surrounding environment suggests, there are numerous sites located in the immediate vicinity. In addition to the Lodge Hill sites discussed in previous chapters, there are two sites (CA-SLO-1543 and SLO-1727) situated on the hilltop approximately 250 m to the north. During the survey discussed in Chapter VI, steep-shouldered handstones with rejuvenation pecking and cobble core tools were located at these sites,

Figure 9.3. CA-SLO-1677 Looking Northeast with Crew in Southern Site Area.

even though the area has been leveled during logging and land development. These tools suggest a Millingstone occupation. A third site, CA-SLO-71, is located roughly 400 m southeast along the same marine terrace. This Late Period midden dates between 700 and 400 calBP (Joslin 2006). Collectively, the concentration of sites and their dates of occupation suggest the abundant marine and terrestrial resources created an important locus of occupation in the Lodge Hill vicinity for over 10,000 years.

## SITE SOILS AND STRATIGRAPHY

CA-SLO-1677 is situated on a remnant of the uplifted Pleistocene Cambria marine terrace (Stokes and Garcia 2008). Surface soils are San Simeon-Conception soils series, in the Conception Loam phase (Ernstrom 1977:131, Sheet 4). Water permeability in these soils is very slow and may account for the weathered shell in the upper levels of Unit 1. Soils at and in the vicinity of the site are formed by distinct episodes of alluvial fan deposition and colluvial flow from the surrounding hill slopes that were followed by periods of relative stability.

Units 1 and 2 revealed similar profiles and continuity in site structure, with slight variations in the vertical and horizontal distribution of cultural material (Figures 9.4 and 9.5). Both units were placed in areas of the site that appeared to be relatively intact (see Chapter VI for excavation method

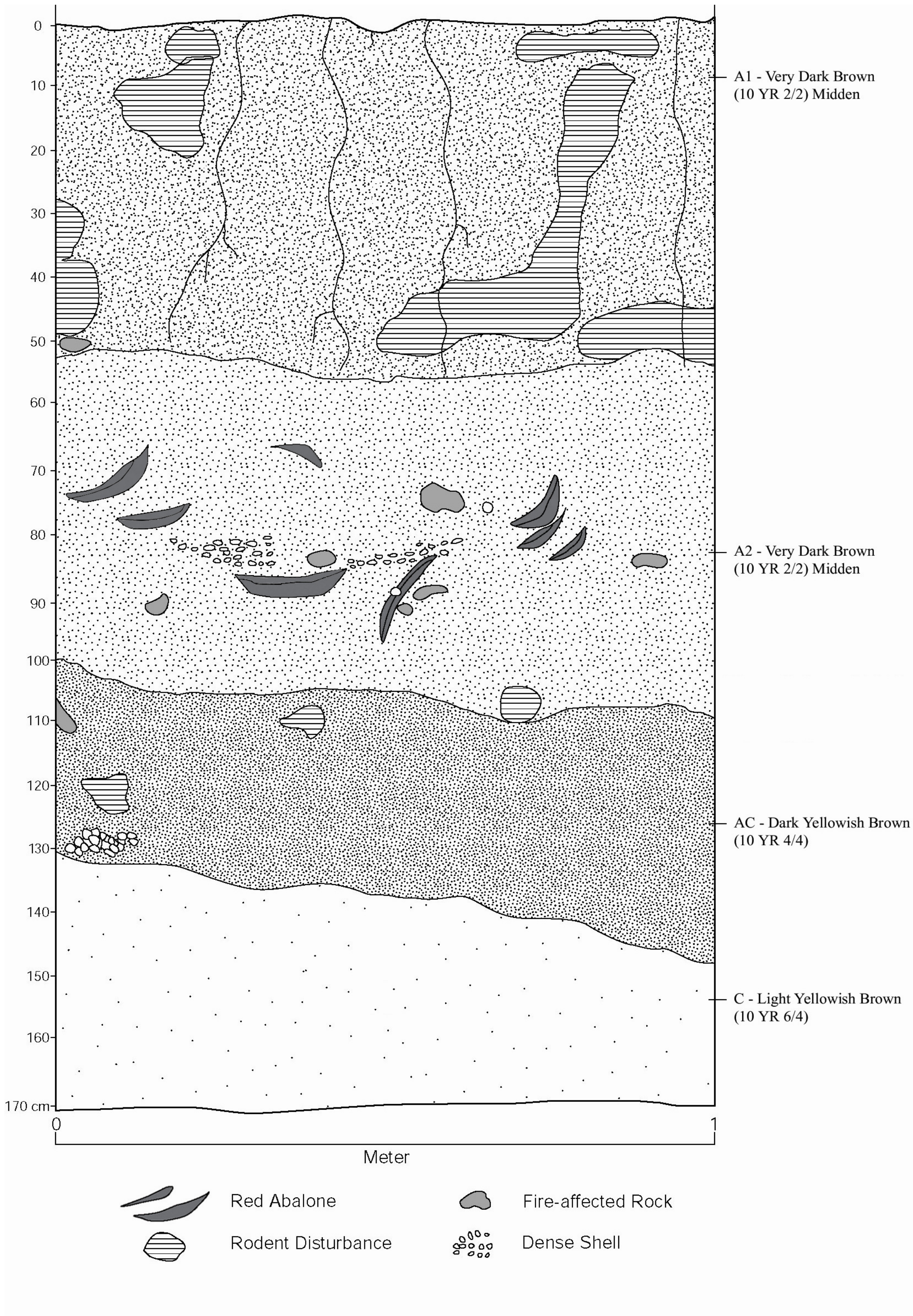


Figure 9.4. CA-SLO-1677 Excavation Unit 1 West Wall Soil Profile.

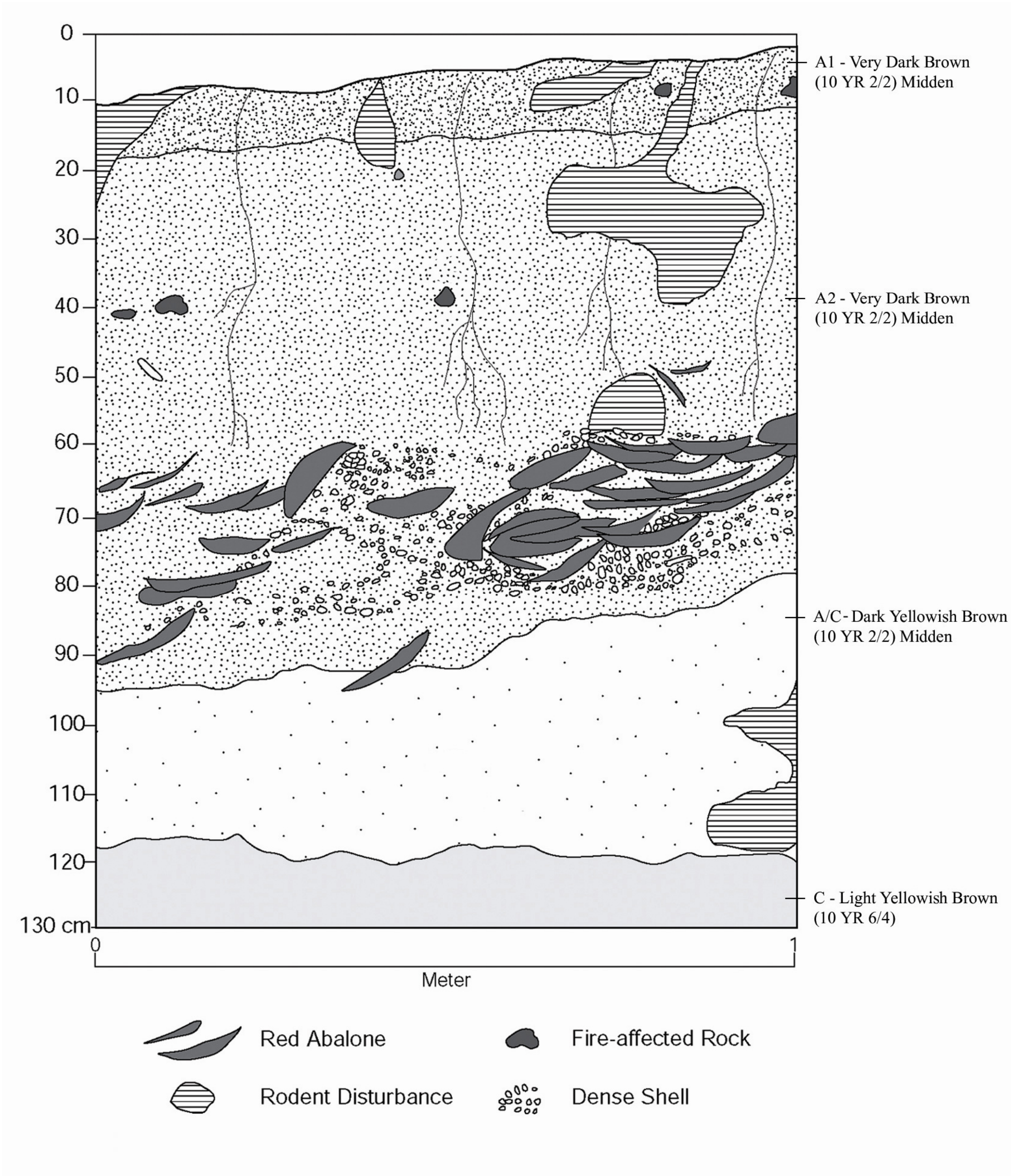


Figure 9.5. CA-SLO-1677 Excavation Unit 2 West Wall Soil Profile.

details). A total of 1.62 $m^3$ of deposit was excavated during this study. Cultural materials extend to 107 cm below surface in both units. Although the upper five to seven cm of soils appear disturbed, there is no plow zone. The deposit has remained relatively intact, as indicated by considerable stratigraphic integrity, clay films, and calcium carbonate (CaCo3) filaments.

The upper 50 cm in Unit 1 and 10-20 cm in Unit 2 begin with a very dark brown (10 YR 2/2) A1 Horizon composed of a moderately compact silty sand containing limited amounts of rounded pea-sized gravel. An indistinct boundary occurs around 50 cm in Unit 1 and 20 cm in Unit 2, where an A2 Horizon is encountered. Also very dark brown in color, the A2 Horizon is a moderately compact silty sand with a slightly higher (14%) clay content and medium granular structure. The transitional A/C Horizon lies beneath an indistinct boundary at around 107 cm in Unit 1 and 95 in Unit 2. The dark yellowish brown (10 YR 4/4) A/C Horizon contains mottled midden soils with a high proportion of indurated CaCo3. This boundary is essentially the basal level of the midden. The midden soils grade into a culturally sterile C Horizon. The C Horizon is defined by deposited aeolian sands immediately above weathering light yellowish brown (10 YR 6/4) sandstone with massive structure.

The vertical distribution of cultural materials, particularly the shell, corresponds rather closely with the soil horizons. The maximum densities occur in the A2 Horizon, decrease in the A/C Horizon, and essentially end in the C Horizon. A distinct and dense red abalone midden is present in both units within the A2 Horizon between 45 and 95-99 cm below datum (Figure 9.6). The lower midden, below the red abalone midden, was created by rodent burrowing, i.e., the downward movement of shell fragments in their burrows.

## CHRONOLOGY

Site chronology was predominantly established through radiocarbon dating, with supporting temporal data derived from diagnostic projectile points, *Olivella* beads, and obsidian hydration.

### RADIOCARBON DATES

Four single pieces of red abalone were submitted to Beta Analytic, Inc. for radiocarbon analysis (Table 9.1). Two were collected from intact stratigraphic contexts during the current research and two are from samples collected from midden exposed in trench walls, the dates from which are previously unreported (Beta Analytic 1996). The dates obtained from the former two samples pertain to the upper and lower extent of the red abalone midden in Unit 2. The two previously unreported dates were acquired from unknown horizontal contexts along a utility trench cut through the center of the site. Although the horizontal location is unknown, the vertical depths known to be associated with these dates are informative in that they

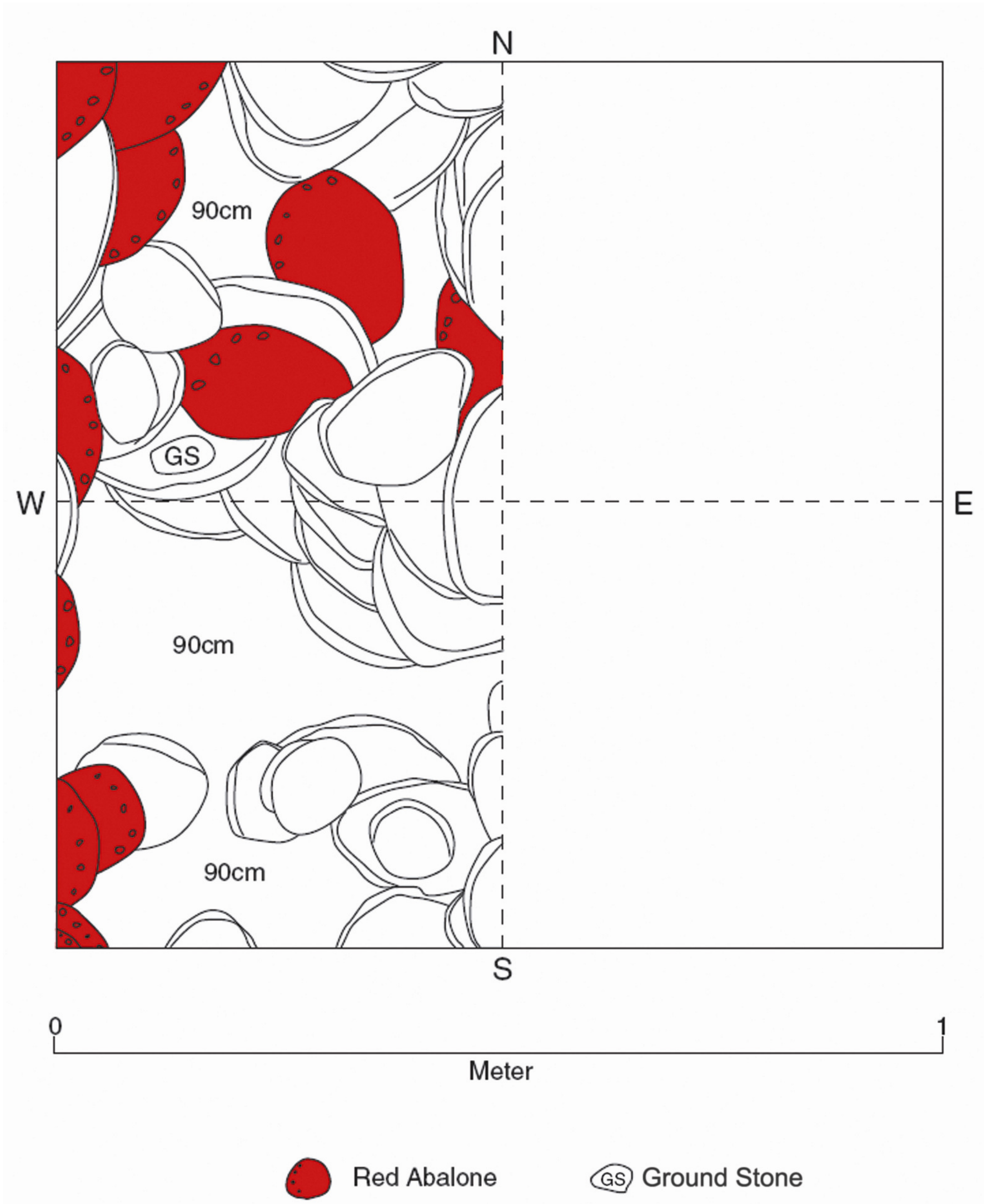

Figure 9.6. Red Abalone Midden Plan View, Excavation Unit 2, Level 80—90 CMBD.

Table 9.1. CA-SLO-1677 Radiocarbon Dates.

| Lab No. Beta | Material | Unit | Depth | Measured Radiocarbon Age (BP) | Conventional Radiocarbon Age (BP)[a] | Calendar Age Range, 1 Sigma[b] |
|---|---|---|---|---|---|---|
| 186774 | *Haliotis rufescens* | 2 | 44[d] | 3590± 70 | 4040± 70 | 3750 (3640) 3540 calBP<br>1804 (1695) 1586 B.C. |
| 186775 | *Haliotis rufescens* | 2 | 65[d] | 4570± 60 | 5010± 60 | 5000 (4910) 4830 calBP<br>3050 (2970) 2880 B.C. |
| 87629[c] | *Haliotis rufescens* | T2 | 80[e] | 3930± 70 | 4380± 80 | 4220 (4090) 3960 calBP<br>2270(4280) 2010 B.C. |
| 87630[c] | *Haliotis rufescens* | T2 | 80[e] | 3950± 70 | 4380± 70 | 4140 (4080) 4010 calBP<br>2190 (2130) 2060 B.C. |

Note: [a]Corrected $^{13}C/^{12}C$; [b]Calibrated using 325± 35 UC CALIB REV 5.0.1 (Stuiver et al. 2005), Rounded calendar ages include midpoint; [c]Previously unreported dates from Beta Analytic data sheets (1996); [d] cmbd - Centimeters below datum; [e] cmbs - Centimeters below surface.

demonstrate a temporally discrete deposit. The radiocarbon dates show the portions of CA-SLO-1677 studied here are an Early Period deposit dating between about 4910 and 3640 calBP.

## PROJECTILE POINTS

Two temporally diagnostic chert projectile points were identified (Figure 9.7). The first is a heat-altered Monterey chert Contracting-stemmed point base recovered from the upper portion of the deposit (10-20 cmbd) in Unit 1 (SLO1677-678). The second is the base of a finely shaped Large Side-notched with an indented base recovered from the lower extent of the red abalone midden in Unit 2 (SLO1677-679). The abalone shell surrounding the point base was submitted for radiocarbon dating and produced a date of 4910 calBP. The date clearly indicates that Large Side-notched points are associated with the Early Period.

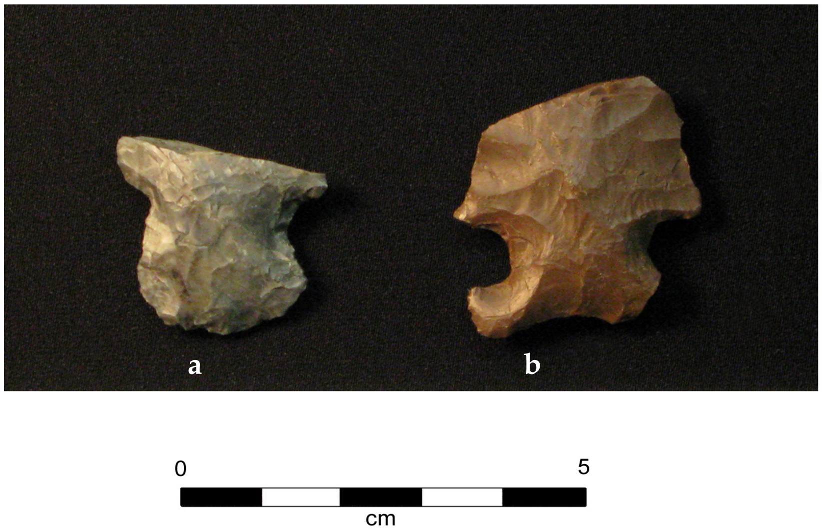


Figure 9.7. Projectile Points from CA-SLO-1622. a: Side-notched; b: Contracting stemmed.

### SHELL BEADS

Eight *Olivella* shell beads were recovered from CA-SLO-1677, evenly distributed in Unit 1 and concentrated from 40 to 90 cm in Unit 2 (Gibson 2009) (Table 9.2, Figure 9.8). Three spire-lopped beads were identified, representing two of the three size subtypes, “a” and “b.” Spire-lopped beads provide limited clues to temporal period along the central coast, as they were used during all times from the Early Holocene to the Protohistoric. However, tiny A1a beads were most common during the Early Period and Phase 1 of the Late Period, while A2 beads are indicative of Early Period occupation in central California (Bennyhoff and Hughes 1987:116-118). Four *Olivella* barrel

Table 9.2. CA-SLO-1677 Shell Beads.

| Cat. No. | Unit | Depth (cm) | Bead Type | Description | Max Dia | Min Dia | TH | Perf Dia | Perf Type |
|---|---|---|---|---|---|---|---|---|---|
| 1710 | 1 | 30-40 | B3a | *Olivella* small barrel | 5.8 | 0.0 | 4.8 | 2.8 | G |
| 1712 | 1 | 80-90 | B3b | *Olivella* medium barrel | 8.0 | 0.0 | 6.3 | 4.0 | G |
| 1714 | 2 | 40-50 | B3a | *Olivella* small barrel | 6.3 | 0.0 | 5.6 | 3.4 | G |
| 1717 | 2 | 50-60 | B3a | *Olivella* small barrel | 5.9 | 0.0 | 5.3 | 3.0 | G |
| 1711 | 1 | 50-60 | A1a | *Olivella* small spire removed | 4.3 | 0.0 | 6.5 | 1.8 | G |
| 1713 | 1 | 130-140 | A1b | *Olivella* medium spire removed | 6.2 | 0.0 | 7.6 | 2.5 | C |
| 1716 | 2 | 80-90 | A2a | *Olivella* oblique spire removed | 4.6 | 0.0 | 6.3 | 2.4 | G |
| 1715 | 2 | 50-60 | B4a | *Olivella* small cap | 5.0 | 0.0 | 3.5 | 2.0 | G |

Note: All measurements are mm; Max Dia- Maximum Diameter; Min Dia-Minimum Diameter; TH -Maximum thickness; Perf Dia-Perforation Diameter; Perf Type-Perforation Type; C-Chipped; G- Ground.

(B3a and B3b) and one cap bead (B4a) were recovered between 30 to 60 cm levels. Type B3 barrel beads are not common in central California. King (1990a:228, 239) suggested that they were common during three separate temporally distinct time periods, including his Early Period (6000-2600 BP). The *Olivella* B4a cap bead is most common during the late and terminal Early Period and from the late Middle Period into the early Late Period in southern California (Bennyhoff and Hughes 1987:122).

### Obsidian Hydration

Two small pieces of obsidian debitage were recovered from Unit 2 (Table 9.3). X-ray fluorescence analysis allowed assignment of one artifact to the Casa Diablo area and the second to the Coso Volcanic Fields (Hughes 2009). Both artifacts have hydration band mean thicknesses (3.3 and 4.0 microns) that correspond to the Middle Period (Jones and Ferneau 2002a:68).

Table 9.3. Summary of Obsidian Hydration and XRF Results from CA-SLO-1677.

| Cat No. | Artifact Type | Unit | Depth (cm) | Hydration Mean | Obsidian Source |
|---|---|---|---|---|---|
| 680 | Debitage | 2 | 20-30 | 4.0 | Coso Volcanic Field |
| 681 | Debitage | 2 | 70-80 | 3.3 | Casa Diablo Area |

Note: Cat no. – Catalog number.

Based on the various chronological data, the portion of CA-SLO-1677 excavated for this research reflects an Early Period site occupied during an interval approximately 1200 years long, from 4910 to 3640 calBP. Supporting the dates is a Large Side-notched point, a clear Early Period indicator, recovered in the middle of the deposit, from the 60-70 cm level. The Contracting-stemmed point was found in the upper portion of the deposit (10-20 cm). Although not temporally diagnostic to the Early Period, the *Olivella* shell beads do not refute the radiocarbon dates. Several non-diagnostic "A" Series *Olivella* beads were distributed through the profile, while the B3a and B3b forms (common in Early Period contexts elsewhere) were located between 30-90 cm. The two obsidian hydration readings fall within the Middle-Middle/Late Transition Periods, even though Early Period radiocarbon dates are from those same depths. This suggests a later brief occupation in the upper portion of the site, or a problem with conversion of the hydration band thicknesses to dates. However, the bulk of the midden, representing the most intensive occupation dates to the Early Period.

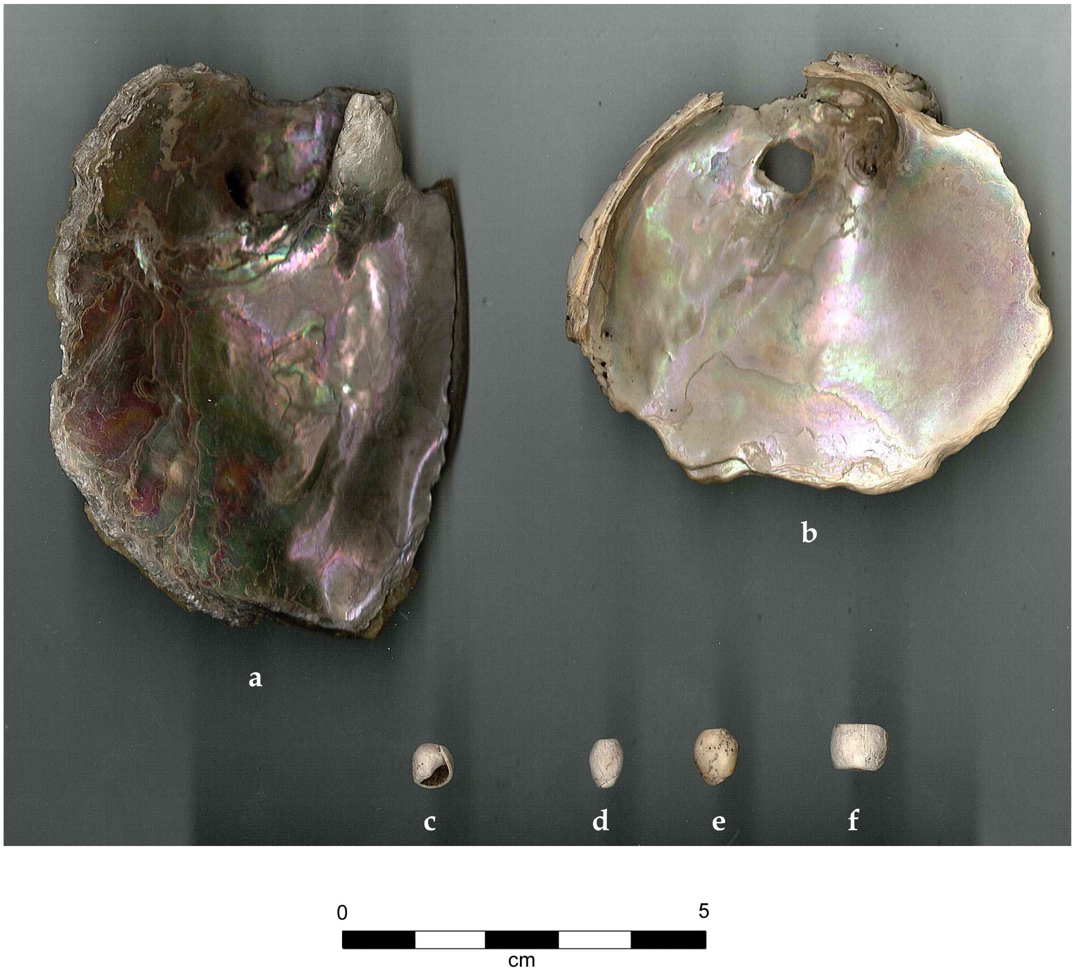


Figure 9.8. Selected Shell Beads and Artifacts from CA-SLO-1677. a-b: *Haliotis rufescens* ornament blanks; c: *Olivella* small barrel; d: *Olivella* small spire removed; e: *Olivella* medium spire removed; f: *Olivella* medium barrel**.**

## CA-SLO-1677 ARTIFACTS

Although from a small excavation sample, a rather large quantity and diversity of artifacts were recovered during the research reported here (Table 9.4). The Early Period assemblage includes 88 flaked stone tools, 34 ground and battered stone implements, nine shell beads and tools, and three bone artifacts. This collection, when combined with the previously unanalyzed 1995 artifact assemblage, provides valuable insights into site activities, prehistoric habitat use, and dietary reconstructions. The 1995 artifacts have no horizontal provenience. They were obtained during surface collection and from two utility trenches cut through in the central site area.

### SHELL ARTIFACTS

Eight *Olivella* shell beads and two *Haliotis rufescens* ornament blanks were recovered during site excavations. The results of the shell bead analysis are presented above. Both of the abalone artifacts seem to represent early stages of production (Figure 9.8). Similar examples of this artifact type along the San Simeon Reef have been identified at CA-SLO-179 (Jones and Ferneau 2002a). One of the blanks is heat crazed and un-perforated, with chipping along half the periphery (83.1 x 58.8 x 9.5 mm, Figure 9.8a, SLO1677-1718). The other is a circular perforated and chipped shell that is a common blank form (63.2 x 63.7 x 9.6 mm, Figure 9.8b, SLO1677-1754).

Table 9.4. Summary of CA-SLO-1677 Artifacts.

| ARTIFACT CLASS | 2010 | 1995[a] | TOTAL |
|---|---|---|---|
| **Flaked Stone** | | | |
| Projectile points | 2 | – | 2 |
| Drills | 1 | – | 1 |
| Bifaces | 8 | 2 | 10 |
| Formed flake tools | – | 1 | 1 |
| Simple flake tools | 52 | 5 | 57 |
| Core tools | 12 | 3 | 15 |
| Cores | 13 | 9 | 22 |
| Tested cobble | – | 1 | 1 |
| Debitage | 6,717 | 32 | 6,749 |
| Subtotal | 6,805 | 53 | 6,858 |
| **Ground and Battered Stone** | | | |
| Millingslabs | – | 1 | 1 |
| Pestles | 1 | – | 1 |
| Handstones | 6 | 2 | 8 |
| Miscellaneous handstones | 4 | – | 4 |
| Hammerstones | – | 2 | 2 |
| Pitted stones | 21 | 19 | 40 |
| Battered cobbles | 1 | 1 | 2 |
| Miscellaneous ground stones | 1 | – | 1 |
| Subtotal | 34 | 25 | 59 |
| **Shell Artifacts** | | | |
| *Olivella* small barrel bead, Type B3a | 3 | – | 3 |
| *Olivella* medium barrel bead | 1 | – | 1 |
| *Olivella* small spire removed bead | 1 | – | 1 |
| *Olivella* medium spire removed bead | 1 | – | 1 |
| *Olivella* oblique spire removed bead | 1 | – | 1 |
| *Olivella* small cap bead | 1 | – | 1 |
| *Haliotis rufescens* ornament blanks | 2 | – | 2 |
| **Bone Tools** | 3 | – | 3 |
| **Asphaltum** | 1.89 g | – | 1.89 g |
| **TOTAL** | 6,852 | 78 | 6,930 |
| Artifacts per cubic meter[b] | 4,229 | | |

Note: [a]Previously unanalyzed collection; [b]Derived from 1.62$m^3$ of excavated deposit.

## BONE ARTIFACTS

Three small bone tool fragments were recovered from excavations, two from Unit 2 and one from Unit 1 (Table 9.5). All are polished, exhibit some striations, and are shaped fragments of long bone from a medium/large mammal, most likely deer.

Table 9.5. Bone Artifacts from CA-SLO-1677.

| Cat. No. | Description | Wt | L | W | TH | DD |
|---|---|---|---|---|---|---|
| 1458 | Pin(?) – Burnt, midsection fragment | 0.9 | 8.9 | 3.0 | 3.0 | 0 |
| 1466 | Pin(?) – Burnt, midsection fragment | 0.15 | 11.0 | 2.3 | 3.0 | 0 |
| 1680 | Pin – Unburnt, tip fragment | 0.11 | 13.7 | 5.6 | 2.3 | 1.3 |

Note: Wt – Weight in grams; L – Maximum length in mm; W – Maximum width in mm; TH – Maximum thickness in mm; DD–Distal diameter in mm

## FLAKED STONE TOOLS AND DEBITAGE

The flaked stone tool assemblage includes a total of 109 artifacts—88 tools and cores from the research reported here and 21 from the 1995 project (Table 9.6.). The flaked stone collections are parallel one another in terms of material selection, reduction, and tool morphology and function.

Simple flake tools represent half (52%) of the flaked stone artifacts, followed by cores, core tools, bifaces, projectile points, a formed flake tool, drill, and a tested cobble. Monterey chert dominates the materials (87%), followed by Franciscan chert (31%) and quartz (n=2). Small flaked stone tools comprise a high proportion of the assemblage. The abundant simple flake tools show clear preference for local Monterey chert (74%) with smaller numbers of higher quality Franciscan chert (23%). These casual artifacts show use-wear along either one or two, convex or straight edges, and they display unifacial micro-chipping or flaking. Crushing on one or more edges is common on over half the artifacts. Three have notches indicating possible use

Table 9.6. Flaked Stone Assemblage from CA-SLO-1677.

| | MNT Chert | | FRN Chert | | OBS | QTZ | |
|---|---|---|---|---|---|---|---|
| Artifact | 2010 | 1995 | 2010 | 1995 | 2010 | 2010 | Total |
| Projectile Points | 1 | - | 1 | - | - | - | 2 |
| Drill | - | - | 1 | - | - | - | 1 |
| Biface | 7 | 1 | 1 | 1 | - | - | 10 |
| Formed Flake Tool | - | - | - | 1 | - | - | 1 |
| Simple Flake Tool | 39 | 3 | 11 | 2 | - | 2 | 57 |
| Core Tool | 8 | 1 | 4 | 2 | - | - | 15 |
| Tested Cobble | - | 1 | - | - | - | - | 1 |
| Cores | 10 | 8 | 3 | 1 | - | - | 22 |
| Debitage | 6,199[a] | 27 | 387 | 5 | 2 | 4 | 6,624 |
| Total | 6,264 | 41 | 408 | 12 | 2 | 6 | 6,733 |

Note: [a]Includes one shale flake; MNT- Monterey; FRN- Franciscan; QTZ-Quartz; OBS-Obsidian.

as casual haft-straighteners. The single formed flake tool is a scraper that is also notched. The single drill, which has a round, polished tip, is formed from a Franciscan chert bifacial thinning flake.

As with CA-SLO-1622, cores and core tools represent a high proportion of the lithic artifact assemblage (n= 37; 39% of the collection). Of the 22 cores, 18 are fashioned from Monterey chert cobbles typical of those found in the adjacent creek and intertidal zone, and four are of Franciscan chert. Fifteen cores, nine of Monterey and six of Franciscan chert, were classified as core tools. All artifacts exhibit some form of use wear, three are unifacially flaked and two have extreme battering. One is asphaltum-stained. These implements would have been useful for a variety of heavy-duty cutting, crushing, chopping, and scraping tasks.

Of the ten include bifaces eight are made of Monterey and one of Franciscan chert, only one of which is complete. The majority are early-stage preforms, i.e., Stage 1 (n=1); Stage 2 (n=4); Stage 3 (n=1). The remaining biface is a Stage 4 preform of very high quality Franciscan chert (Figure 9.9c, SLO1677-1233). Most of the bifaces were broken during manufacture (80%), with many exhibiting heat alteration (90%). Four artifacts display modifications, including edge crushing and unifacial micro-chipping.

The collection of debitage from the excavation units consists of 6,717 pieces; 5,286 are non-diagnostic and are excluded from further analysis. Technological analysis was conducted on the remaining 1,431 flakes (Table 9.7). Consistent with the other flaked stone tool categories, Monterey chert accounted for 90 percent of the sample, followed by Franciscan chert (9%), quartz (<1%), and shale (<1%).

Among the diagnostic flake classes, pressure (45%) and decortification (23%) flakes are the most prevalent, with interior flakes (16%), biface thinning 15%), and core rejuvenation flakes (<1%) making up the remainder. As with the CA-SLO-1622 collection, the greater number of pressure flakes recovered may be a product of the use of finer 1/8-inch mesh screens that retains a higher proportion of small flakes than is typical. Monterey chert follows the same general reduction sequence as the total. Imported Franciscan chert


Figure 9.9 Selected Flaked, Ground, and Battered Stone Artifacts from CA-SLO-1677. a:Handstone/cleaver; b: Handstone/pry tool; c: Franciscan chert biface.

diverges, with pressure flakes (63%) and interior flakes (24%) comprising most of the assemblage.

These flake profiles, similar to those of CA-SLO-1295, reflect a focus on the earlier stages of lithic production and on core-flake reduction techniques rather than the production of bifacial tools from core or flake blanks. Biface thinning and the abundance of pressure flakes, however, suggest the production, finishing, and maintenance of the local Monterey chert bifacial tools. The large proportion of pressure flakes clearly reflects an emphasis on tool finishing. Although this pattern is expected to equate with a larger number of finished tools than is present in the collection, occupants may have taken these artifacts off-site after finishing. The lack of biface thinning flakes may be in part due to their greater length to thickness ratio, making them the most susceptible to fracture during manufacture and post-depositional factors and leading to their exclusion from analysis.

Table 9.7. CA-SLO-1677 Debitage Attributes.

| | MNT Chert | FRN Chert | QTZ | Shale | OBS | Total |
|---|---|---|---|---|---|---|
| Primary reduction | 330/45 | 4/- | 2/- | - | - | 336/45 |
| Secondary reduction | 135/19 | 5/- | 1/- | - | - | 141/19 |
| Core rejuvenation | 6/- | 3/- | - | - | - | 9/- |
| Interior | 202/39 | 30/- | 1/- | 1/- | - | 234/39 |
| Biface thinning | 57/9 | 5/1 | - | - | - | 62/10 |
| Pressure | 570/45 | 79/1 | - | - | - | 649/46 |
| Subtotal | 1,300/157 | 126/2 | 4/- | 1/- | - | 1,430/159 |
| Non-diagnostic | 4,897 | 387 | - | - | 2/- | 5,286 |
| Total | 6,197/314 | 513/4 | 4/- | 1/- | 2/- | 6,716 |

Note: MNT- Monterey, FRN- Franciscan, QTZ-Quartz, OBS-Obsidian; Debitage analysis based on unit excavations screen through 1/8-inch mesh; #/#-Total Number of Flakes/Number of Heat Altered Flakes.

## GROUND AND BATTERED STONE

Fifty-nine ground and battered stone tools were recovered from CA-SLO-1677, 34 from the research reported here and 25 from the 1995 project (Table 9.4). Overall, the ground and battered stone exhibits light to moderate use wear on unshaped locally available cobbles, indicative of expedient, non-curated tools. Most of the artifacts were formed from local sandstone cobbles (85%) available in the bedrock substrate conglomerate observed in the rocky intertidal zone, along with a small number of mudstone, greywacke, and greenstone.

Pitted stones are particularly abundant at CA-SLO-1677. They are the most common artifact form in the assemblage, accounting for 68 percent, or 40 artifacts. The pits range from small incipient indentations to deep, well-formed depressions. Similar to the CA-SLO-1622 pitted stones, the tools generally have two (53%) or more (13%) pits formed either on small beach cobbles or re-used handstones that are pecked, battered, polished, and spalled, indicative of a multipurpose, expedient tool. All of the pitted stones from the excavation units and half of those in the 1995 assemblage exhibit end-battering and edge-wear. Asphaltum residue was found three pitted stones.

Handstones (21%), hammerstones (3%), and battered cobbles (3%) comprise 27 percent of the collection. All have multiple worked surfaces and a variety of types of use-wear. Most of the handstones (n=12) are unshaped and exhibit slight polish on one or more faces, evidence of use-wear along the edge or ends, abrasion striations, and pecking on one or more faces. A small handstone recovered from a red abalone shell in the midden appears to have been used as a prying tool, with a wedge-shaped end (94 x 36 x 22 cm; SLO1677-1737; Figure 9.9b). One shaped handstone also deserves mention, as it is shaped by the removal of spalls along most margins and exhibits heavy use-wear on one end; perhaps from use as a cleaver (SLO1677-1723; Figure 9.9c). The four battered cobbles and hammerstones, as the designations imply, show extensive end-battering, pitting, spalling, and wear suggestive of multiple, heavy uses. These artifacts are associated with processing very hard resources, such as shell, nuts, bone, or with the modification and manufacture of stone tools.

### CHARCOAL

As with CA-SLO-1622, a modest amount of wood charcoal (37.6 g) is distributed throughout the deposit, with small fragments (between 0.2 and 2.57 g) collected from both units at every level. Several of the fragments were identified as Monterey pine wood charcoal and cone scales.

## SUBSISTENCE STRATEGIES

A rich assortment of faunal remains was recovered from the dense midden deposit, providing a wealth of data to evaluate subsistence activities, relative changes in these, and ecology. Perhaps the most distinguishing aspect of site subsistence remains is the well-developed red abalone midden encountered in both units. Faunal remains for dietary analysis were obtained from the two 1 x 0.5 excavation units and associated column samples, the deposits of which were wet screened over 1/8-inch mesh. The highest densities of dietary materials were recovered between 40 and 110 cm in depth, with a distinct concentration of all faunal categories between 60 and 90 cm (Table 9.8).

Table 9.8. Vertical Distribution of CA-SLO-1677 Faunal Materials by Weight.

| Depth (cm.) | --Shell Weight-- | | | --Fish Bone Weight-- | | | --Mammal, Bird, Reptile-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Unit 1 | Unit 2 | Total | Unit 1 | Unit 2 | Total | Unit 1 | Unit 2 | Total |
| 0-10 | 928.2 | 1,123.3 | 2,051.5 | 0.90 | 0.01 | 0.91 | 2.46 | 0.32 | 2.78 |
| 10-20 | 1,602.6 | 2,288.8 | 3,891.4 | 0.97 | 0.51 | 1.48 | 9.25 | 3.05 | 12.3 |
| 20-30 | 2,449.5 | 2,427.9 | 4,877.4 | 2.09 | 0.34 | 2.43 | 10.80 | 3.34 | 14.14 |
| 30-40 | 2,821.8 | 1,543.4 | 4,365.2 | 1.17 | 0.26 | 1.43 | 9.65 | 6.28 | 15.93 |
| 40-50 | 2,305.1 | 4,701.7 | 7,006.8 | 1.60 | 1.33 | 2.93 | 9.51 | 9.28 | 18.79 |
| 50-60 | 4,557.6 | 3,832.8 | 8,390.4 | 3.65 | 1.90 | 5.55 | 9.79 | 8.68 | 18.47 |
| 60-70 | 3,505.5 | 8,597.9 | 12,103.4 | 1.29 | 2.34 | 3.63 | 9.90 | 10.15 | 20.05 |
| 70-80 | 2,765.4 | 9,680.5 | 12,445.9 | 2.61 | 3.03 | 5.64 | 12.88 | 9.19 | 22.07 |
| 80-90 | 3,616.7 | 20,327.5 | 23,944.2 | 2.04 | 6.15 | 8.19 | 6.77 | 16.84 | 23.61 |
| 90-100 | 4,094.0 | 4,569.6 | 8,663.6 | 1.97 | 1.54 | 3.51 | 11.79 | 4.04 | 15.83 |
| 100-110 | 2,162.7 | 2,433.0 | 4,595.7 | 2.29 | 1.77 | 4.06 | 3.96 | 2.77 | 6.73 |
| 110-120 | 2,187.5 | 830.2 | 3,017.7 | 1.89 | 0.18 | 2.07 | 6.27 | 0.20 | 6.47 |
| 120-130 | 2,216.2 | 99.3 | 2,315.5 | 1.43 | 0.13 | 1.56 | 2.06 | 0.00 | 2.06 |
| 130-140 | 3,085.4 | — | 3,085.4 | 1.19 | — | 1.19 | 4.50 | — | 4.50 |
| 140-150 | 1,287.7 | — | 1,287.7 | 0.69 | — | 0.69 | 1.07 | — | 1.07 |
| 150-160 | 867.0 | — | 867.0 | 0.49 | — | 0.49 | 1.39 | — | 1.39 |
| 160-170 | 340.9 | — | 340.9 | 0 | — | 0 | 0.28 | — | 0.28 |
| Total | 40,793.8 | 62,455.9 | 103,249.7 | 26.27 | 20.05 | 46.32 | 113.33 | 76.14 | 186.47 |

Notes: Data from 1 x 0.5-meter excavation units screened through 1/8-inch mesh; (-) — level unexcavated; Levels correspond to cm levels excavated below datum; Includes 3,263.39 g of whole *Haliotis rufescens* from Unit 1, 30 - 130 levels and 17,774.39 from Unit 2.

## Mammal, Bird, and Reptile Bone

The bones of birds, reptiles, and terrestrial and marine mammals account for approximately 67 percent of the vertebrate elements and 80 percent of the bone weight at CA-SLO-1677 (Table 9.9). A total of 3342 elements weighing 189.32 g was recovered from the excavation. Due to the highly fragmented condition of the sample, very few elements in the assemblage could be identified beyond general class level. One hundred elements identified as rodents, only 3 percent of the collection, are most likely intrusive and are therefore excluded from further discussion and dietary analysis.

Of the identified elements, those of black-tail mule deer are the most abundant (n=6), followed by those of dog/coyote (n=2), and a single brush rabbit element. Excluding unidentified mammal and rodent bones, 2048 elements were classified. Unidentified remains sorted by size class show a reliance on medium terrestrial mammals (69%), followed by large mammals (21%), small mammals (5%), and equal numbers of marine mammals (2%) and birds (2%). Reptiles are of minor dietary importance, likely to be intrusive, accounting for less than one percent of the identified remains.

## Marine Fish

Fish remains from Units 1 and 2 column samples are relatively abundant. A total of 46.32 g and 1635 individual fish bones was recovered

Table 9.9. Identified Mammal, Bird, and Reptile Bones from CA-SLO-1677.

| COMMON NAME | TAXON | NISP | WEIGHT (G) |
|---|---|---|---|
| **Terrestrial Mammals** | | | |
| Brush rabbit | *Sylvilagus bachmani* | 1 | 0.80 |
| Deer | *Odocoileus hemionus* | 6 | 4.90 |
| Dog/coyote | *Canis* sp. | 2 | 1.85 |
| Mammal | Unidentified mammal | 1,194 | 23.06 |
| Large mammal | Mammalia | 420 | 73.95 |
| Medium mammal | Mammalia | 1,418 | 59.77 |
| Small mammal | Mammalia | 96 | 2.01 |
| Subtotal | | 3,137 | 166.34 |
| **Marine mammal** | | | |
| Large | Pinnipedia | 2 | 2.18 |
| Medium | Pinnipedia | 5 | 1.47 |
| Marine mammal | Pinnipedia | 42 | 9.33 |
| Subtotal | | 49 | 12.98 |
| **Rodent** | | | |
| Rodent | Rodentia | 90 | 3.30 |
| Pocket Gopher | *Thomomys bottae* | 8 | 0.43 |
| California Ground Squirrel | *Spermophilus beecheyi* | 1 | 0.12 |
| Pocket Mouse | *Perognathus* sp. | 1 | 0.30 |
| Subtotal | | 100 | 4.15 |
| **Birds** | | | |
| Large Bird | Aves | 2 | 1.83 |
| Medium Bird | Aves | 5 | 0.20 |
| Small Bird | Aves | 3 | 0.14 |
| Bird | Aves | 38 | 2.89 |
| Subtotal | | 48 | 5.06 |
| **Reptiles** | | | |
| Pacific Gopher Snake | *Pituophis catenifer catenifer* | 1 | 0.05 |
| Western Rattlesnake | *Crotalus viridis* | 2 | 0.22 |
| Snake | Serpentes | 1 | 0.02 |
| Lizard | Indeterminate | 1 | 0.09 |
| Reptile | Indeterminate | 3 | 0.06 |
| **Subtotal** | | 8 | 0.44 |
| **TOTAL** | | 3,342 | 189.32 |

Note: NISP – number of identified specimens.

and identified to the most specific taxon possible (Table 9.10). Of these, 316 (19%) bones were identified to family, genus, or species, representing at least 16 different taxa. Fish bone densities in Unit 1 and Unit 2 are similar (26.27 and 20.05 g, respectively). Based on weight, the stratigraphic distribution of fish is relatively even, with the densest concentration between 50 and 110 cm. Almost half (760 of the 1,635 elements) are visibly burned, with prickleback bones the most commonly burnt. The density of fish, including all ray-finned fishes, is 1,009 bone elements or 28.5 g/m3.

Pricklebacks (including monkeyface, rock, and black pricklebacks) account for 56 percent of the number of identified fish bone elements and 23 percent of the weight. The second most common are rockfishes, accounting for 16 percent of the total number of identified bones and 32 percent of the total weight, a larger proportion compared to pricklebacks due to the larger size of their bones. The next most abundant species is cabezon, 14 percent of total number of bone elements and 36 percent of the total weight. In addition to these three are a wider variety taxa, the total number of identified fish is larger than was recovered from the other three study sites. Three taxa are represented only at CA-SLO-1677: an elasmobranch (hound shark), lingcod, and surfperch.

The larger variety in fish species reflects a wider use of marine environments. Most of the identified fish in the sample are relatively common

Table 9.10. Marine Fish Remains from CA-SLO-1677.

| | | Mesh size | | | | |
|---|---|---|---|---|---|---|
| Common Name | Taxon | 1/8″ NISP | 1/16″ NISP | Total NISP | MNI | Wt (g) |
| Inshore/Offshore Migrators | | | | | | |
| Silversides | Atherinidae | 1 | – | 1 | 1 | 0.01 |
| Rocky Intertidal | | | | | | |
| Cabezon | *Scorpaenichthys marmoratus* | 43 | – | 43 | 18 | 5.24 |
| Clinids | Clinidae | 6 | 2 | 8 | 6 | 0.06 |
| Pile perch | *Rhacochilus vacca* | 3 | – | 3 | 2 | 0.33 |
| Pricklebacks | Stichaeidae | 143 | – | 143 | 22 | 2.94 |
| Kelpfish | *Gibbonsia* spp. | 1 | – | 1 | 1 | 0.02 |
| Kelp greenlings | *Hexagrammos decagrammus* | 5 | – | 5 | 3 | 0.09 |
| Monkeyface prickleback | *Cebidichthys violaceus* | 1 | – | 1 | 1 | 0.07 |
| Northern clingfish | *Gobiesox maeandricus* | 3 | 3 | 6 | 5 | 0.04 |
| Rockfishes | *Sebastes* spp. | 49 | – | 49 | 22 | 4.66 |
| Rock or black prickleback | *Xiphister* spp. | 23 | 11 | 34 | 8 | 0.44 |
| Kelp Beds | | | | | | |
| Giant kelpfish | *Heterostichus rostatus* | 11 | – | 11 | 7 | 0.33 |
| Señorita | *Oxyjulis californica* | – | 1 | 1 | 1 | 0.00 |
| Sandy Surf/Muddy Bottoms/Bays | | | | | | |
| Hound sharks | Triakididae | 1 | – | 1 | 1 | 0.28 |
| Lingcod | *Ophiodon elongates* | 7 | – | 7 | 5 | 0.21 |
| Surfperches | Embiotocidae | 2 | – | 2 | 2 | 0.04 |
| Ray-finned fishes | Actinopterygii | 1,319 | – | 1 ,319 | – | 31.56 |
| Totals | | 1,618 | 17 | 1,635 | 105 | 46.32 |

Note: [a]*Sebastes* spp. count includes two otoliths; Weight in grams.

in nearshore waters above a rocky substrate (93%). The remaining species are common in sandy surf/muddy waters (3%), kelp forests (3%), or are inshore/offshore migrators (less than 1%). Most of these fishes could have been caught in the rocky intertidal zone or in tidepools by hand or in nearshore waters above rocky substrates or sandy surf using hook-and-line, spears, or a variety of nets. The giant kelpfish and señorita, common to offshore kelp beds, may have required watercraft to capture.

**SHELLFISH**

Excavations at CA-SLO-1677 produced the largest, most diverse, and intriguing shellfish sample of any of the excavated sites. Abundant shellfish were obtained from the two excavation units (103,249.3 g) and two column samples (12,146.0 g). Shell densities are very high for a central coast midden—71,231.69 g/m$^3$, reaching as high as 99,357.8 g/m$^3$ in Unit 2. Forty-four different shellfish taxa were identified in the samples, almost exclusively from rocky intertidal habitats (Appendix A; Table A2).

The stratigraphic distribution of shell suggests a strong focus on shellfish collecting. Shellfish remains are very dense in the 40-110 cm levels, but particularly in a 30-cm-thick interval between 60 and 90 cm (Table 9.9). The high density of shell in these levels corresponds with an impressive red abalone midden that extends between approximately 45 and 95 cm below datum in both units. In Unit 2, heat alteration (color change, decreased luster) was observed on whole abalone shells and on the smaller species between 70 and 40 cm below datum. Small amounts of fire-altered rock, between 125 and 220 g per level, were encountered in these levels.

Similar to many other sites along the San Simeon Reef, at CA-SLO-1677 black turban snail is the most common shellfish by weight, accounting for 40 percent of the shell (Table 9.11). Red abalone, although abundant in the units, is the second most frequent species identified in the two column samples, totaling 33 percent. Red abalones and red turban are underrepresented in column samples because their shells are not as likely to fragment into small pieces as would California mussel and black turban snail (Sharp 2000:32). California mussel accounts for approximately 11 percent, and red turban snail 6 percent of the assemblage. The remaining species appear to be minor dietary contributors. Red turban snails *(Lithopoma gibberosa)* are a large gastropod species that is only present in large numbers in the red

Table 9.11. Contribution of Significant Shellfish Species from CA-SLO-1677.

| Common Name | Taxon | Total (g) | Total (%) |
|---|---|---|---|
| Black turban snail | *Tegula funebralis* | 4,855.23 | 39.9 |
| Red abalone | *Haliotis rufescens* | 4,044.62 | 33.3 |
| California mussel | *Mytilus californianus* | 1,277.48 | 10.5 |
| Red turban | *Lithopoma gibberosa*[a] | 723.86 | 6.0 |
| Chiton | *Mopalia* spp. | 450.47 | 3.7 |
| Brown turban snail | *Tegula brunnea* | 246.82 | 2.0 |
| Crab | Cancer | 153.84 | 1.3 |
| Limpet | *Collisella* spp. | 128.47 | 1.1 |
| Purple sea urchin | *S. purpuratus* | 64.06 | 0.5 |
| Slipper shell | *Crepidula* spp. | 21.60 | 0.2 |
| Black abalone | *Haliotis cracherodii* | 21.05 | 0.2 |
| Barnacle | *Balanus* spp. | 11.93 | 0.1 |
| Abalone | *Haliotis* spp. | 7.98 | 0.1 |
| Pacific littleneck clam | *Protothaca staminea* | 4.20 | 0.0 |
| Monterey top | *Tegula montereyi* | 0.37 | 0.0 |
| Misc. gastropod | | 1.67 | 0.0 |
| Indeterminate | | 132.39 | 1.1 |
| Total | | 12,158.29 | 100 |

Note: Shell samples are based on two column samples screen through 1/8-inch mesh, a total of 0.120 $m^3$; Weight in grams; % - proportion of site shell assemblage; *S-Strongylocentrotus*
[a]*Lithopoma gibberosa* was formerly classified as *Astrea gibberosa*.

abalone middens identified at CA-SLO-1622 and SLO-1677, where they occur in the highest densities, at 252.7 and 355.5 g per level. Although black turban snail and California mussel are commonly found in the mid-to-high intertidal zone, red abalone and red turban are most frequent in the low intertidal zone. This suggests a change in the intertidal ecology such as change in water temperature or change in procurement strategies, e.g., subtidal foraging. In central California red abalone are rare historically in the intertidal zone, most occurring between depths of 5 and 17 m (Ault 1985).

The stratigraphic distribution of shellfish taxa provides interesting insights on changes over time in the use of invertebrates by site inhabitants. The shellfish assemblages contain the same array of rocky inter and subtidal taxa throughout the depth of the deposits. However, the proportions of the taxa differ in the upper 40 cm when compared to the red abalone midden and in the deposits below it (100-160 cm). Above the dense abalone midden, the abundance of taxa is more balanced, with black turban snail the most important species by weight (50%), followed by California mussel (23%), red abalone (only 3%) and red turban snail (6%). However, within the red abalone midden, red abalone is 60 percent of the total shell weight, followed by black turban snails (16%) and low proportions of California mussel (8%) and red turban snail (6%). Below the red abalone midden, the collection is similar to the upper 40 cm: black turban snail is again the most important species (67%) followed by California mussel (12%), red turban snail 6 percent, and red abalone only 2 percent. Chiton species with cold-water affiliations are also present throughout the deposit. Black abalone, present in later site deposits along the same terrace, occurs in trace amounts.

### California Mussel and Red Abalone Size-Frequency Data

As with the other three sites, in addition to species identifications and shell quantification, all complete and nearly complete mussel and abalone shells were segregated to evaluate their size at the time of harvesting.

#### Red Abalone

A sample of 217 red abalone shells was recovered from the rich midden (Table 9.12). Red abalone shell lengths ranged between one and 22 cm, with an average of 11.6 cm. The data show that the highest class frequencies are 11-12, 13-14, and 15-16 cm, with class sizes between 8 and 18 cm accounting for 71 percent of the abalones. This suggests that although occupants collected minor amounts of juvenile abalones, over 60 percent are large adults (over 10 cm). Almost all the shells appear in deposits dating to the initial occupation of the site, around 5000 calBP, with 95 percent of the abalones between 50 and 100 cm below datum. The average size of shell lengths in the dense red abalone midden suggests relatively little change, only a slight size increase from the lowest level (9.5 cm) to around 11.0 cm.

Table 9.12. Red Abalone Lengths and Frequencies from CA-SLO-1677.

| SIZE CLASS (CM) | FREQUENCY WITHIN AGE PROFILE | PERCENT |
|---|---|---|
| 0-2 | 3 | 1 |
| 2-3 | 2 | <1 |
| 3-4 | 2 | <1 |
| 4-5 | 7 | 2 |
| 5-6 | 10 | 5 |
| 6-7 | 17 | 8 |
| 7-8 | 10 | 5 |
| 8-9 | 17 | 8 |
| 9-10 | 13 | 6 |
| 10-11 | 14 | 6 |
| 11-12 | 19 | 9 |
| 12-13 | 14 | 6 |
| 13-14 | 19 | 9 |
| 14-15 | 13 | 6 |
| 15-16 | 20 | 9 |
| 16-17 | 14 | 6 |
| 17-18 | 14 | 6 |
| 18-19 | 1 | <1 |
| 19-20 | 2 | <1 |
| 20-21 | 4 | 2 |
| 21-22 | 2 | <1 |
| Total | 217 | 100 |
| UNIT LEVEL (CM) | FREQUENCY (AVERAGE SIZE CM) | PERCENT |
| 0-10 | 1 | <1 |
| 10-20 | 0 | 0 |
| 20-30 | 1 | <1 |
| 30-40 | 2 | <1 |
| 40-50 | 1 | <1 |
| 50-60 | 16 (11.0) | 7 |
| 60-70 | 28 (11.8) | 13 |
| 70-80 | 58 (11.2) | 27 |
| 80-90 | 87 (11.8) | 40 |
| 90-100 | 18 (9.5) | 8 |
| 100-110 | 1 | <1 |
| 110-120 | 2 | <1 |
| 120-130 | 1 | <1 |
| 130-140 | 1 | <1 |
| Total | 217 | 100 |

### California Mussel

Although California mussel does not appear to be an important dietary contributor, a sizable number (853 MNI) of mussel fragments with umbo was obtained from throughout the deposit, and these were measured to determine the approximate age of the shell at the time of collection (Table 9.13). An evaluation of the data reveals a large number in small classes and a paucity of shells measuring over nine cm. Ninety-five percent of the sample measures between 1 and 5 cm, with an average size of only 3.0 cm. In the site occupation, dating to around 5000 calBP, the deposit contains slightly higher proportions mussel lengths in the 6-7 and 7-8 cm class sizes, but the levels also contain an abundance of small classes sizes and the average remains low.

## Dietary Reconstruction

Two methods were applied to provide an estimate of the relative importance of various faunal classes, the density of NISP and weight per cubic volume of excavation and dietary reconstructions based on the weight method. These two methods are discussed further in Chapter VI: *Archaeological Methods, Subsistence Remains.*

Based on the density data, shellfish were clearly the major dietary contributor, 71.23 kg/$m^3$, followed by terrestrial mammals (1,936.41 g/$m^3$) and low densities of marine mammals, marine fish, birds, and reptiles (Table 9.14.). The relative importance of shellfish over the course of site occupation

Table 9.13. California Mussel Lengths and Frequencies from CA-SLO-1677.

| Size Class (cm) | Frequency within age profile | Percent |
|---|---|---|
| 0-2 | 207 | 25 |
| 2-3 | 257 | 30 |
| 3-4 | 234 | 27 |
| 4-5 | 94 | 11 |
| 5-6 | 36 | 4 |
| 6-7 | 11 | 1 |
| 7-8 | 10 | 1 |
| 8-9 | 4 | <1 |
| 9-10 | 1 | <1 |
| Total | 853 | 100 |

| Unit Level (cm) | Frequency | Percent |
|---|---|---|
| 0-10 | 8 | 1 |
| 10-20 | 31 | 4 |
| 20-30 | 32 | 4 |
| 30-40 | 36 | 4 |
| 40-50 | 72 | 8 |
| 50-60 | 72 | 8 |
| 60-70 | 119 | 14 |
| 70-80 | 107 | 13 |
| 80-90 | 108 | 13 |
| 90-100 | 56 | 7 |
| 100-110 | 61 | 7 |
| 110-120 | 38 | 5 |
| 120-130 | 28 | 3 |
| 130-140 | 30 | 4 |
| 140-150 | 36 | 4 |
| 150-160 | 15 | 2 |
| 160-170 | 4 | <1 |
| Total | 853 | 100 |

Table 9.14. Bone and Shell Densities from CA-SLO-1677.

| FAUNAL CLASS | DENSITIES PER CUBIC METER |
|---|---|
| Shellfish (g) | 71,231.69 |
| Terrestrial mammal (NISP/g) | 1,936.41/102.67 |
| Marine mammal (NISP/g) | 30.25/8.01 |
| Bird (NISP/g) | 27.16/3.12 |
| Reptile (NISP) | 4.94 |
| Fish (NISP/g) | 1,009.3/28.5 |

Note: Data derived from 1.62 m3 of excavated volume; Terrestrial bone includes unidentified class size and identified species.

is clearly documented by the ratio of shell weight to terrestrial mammal bone, i.e., 37:1. Birds and reptiles represent only supplementary parts to the diet.

As with the other sites, the relative importance of various faunal classes was also estimated by calculating the significance of each animal category using the meat weight multipliers (Table 9.15, See Chapter VI for multipliers). Dietary reconstruction based on all faunal remains support the fauna density data in that it shows that shellfish are the principal contributor of meat to the diets, providing approximately 96 percent of the meat yield,

Table 9.15. CA-SLO-1677 Estimated Dietary Reconstruction Based on Meat Weight.

| TAXON | BONE WEIGHT (G) | MEAT WEIGHT (G) | PERCENT (MEAT WEIGHT) |
|---|---|---|---|
| Terrestrial mammals | 166.34 | 3,023.56 | 2.6 |
| Marine mammal | 12.98 | 314.12 | 0.3 |
| Birds | 5.06 | 6.66 | 0 |
| Reptiles | 0.44 | 0.30 | 0 |
| Marine fish | 46.32 | 1,283.08 | 1.1 |
| Shellfish | 115,395.34 | 112,147.05 | 96.0 |
| Total | 115,626.48 | 116,774.77 | 100 |

Notes: Appendix D provides detailed data for meat weight reconstructions.

followed by terrestrial mammals, 2.6 percent. The remaining dietary classes appear to be only minor contributors. These data, along with high shell densities NISP and weights, suggest that the people were focused on shellfish for subsistence, augmented with terrestrial mammals and marine fish.

### SYNTHESIS

CA-SLO-1677 is an impressive coastal midden that appears to have been a residential site intensively occupied sometime between 4910 and 3640 calBP. Excavations in the central site area reveal a number of interesting patterns. The deposit, approximately one m thick, contains a diverse and relatively dense artifact assemblage and faunal remains that represent residential activities by complete social groups. Compared to other Early Period sites along the San Simeon Reef, where populations appear to have had wide and more diverse diets, occupants here appear to have had a more specialized diet.

Although site occupants engaged in a variety of subsistence activities, including hunting terrestrial game and sea mammals, fishing, and collecting intertidal shellfish, changes in the importance of select taxa are clear. The gathering (possibly by diving) and processing of red abalone was an important subsistence activity, revealed in an impressive 50-cm thick red abalone midden. Although dating to the same time as other local Early Period deposits which contain black turban snail, California mussel, and a small number of red abalone, it is appears that people at this site specifically targeted red abalone during initial site occupation. After the initial focus on red abalone, occupants focus on black turban snail and California mussel. Heat alteration, evidenced by thermal crazing on shell, indicates that shellfish were processed and consumed on site. Alternatively, the burnt shell may have resulted from hearth fires on top of or near were the shells were lying.

Based on general categories, terrestrial mammals account for most of the vertebrate bone throughout the deposit, a pattern consistent with the abundance of artiodactyl-sized elements observed at other Early Period sites. Although not a significant dietary contributor compared to shellfish and terrestrial game, a wider variety and higher density of marine fish were procured from tidal pools and nearshore kelp forests than is seen at the other Early Period sites considered here.  There appears to be little evidence for vertical variation in the proportion of fish or marine and terrestrial mammal bone in the deposit.

CA-SLO-1677 has the largest number of shell artifacts of any of the study sites—eight *Olivella* shell beads and two *Haliotis rufescens* ornament blanks. Flake stone tools include implements focused on hunting and butchering activities (e.g., projectile points, bifaces) as well as those used to process or manufacture various types of material (e.g., flake tools, drills, core tools). Although occupants clearly utilized the nearby sources of Monterey chert, reducing cobbles into core tools and bifaces, the presence of obsidian from the eastern Sierra Nevada sources reflects interregional trade. The large proportion of small pressure flakes suggests a focus on retooling during a prolonged occupation. Most of the ground and battered stone tools can be characterized as expedient, showing slight modifications and wear and reflected by the abundance of pitted stones and multi-functional tools. The wear on tools, particularly the pitted stones and handstones, is variable on a single tool and indicates multiple, short term uses. This suggests that shellfish processing would have required little technology to open the shells (pry bars) and process the meat (flake tools). The millingslabs and pestle fragment indicate plant processing and investment in curated artifacts.

# CHAPTER X: CA-SLO-2563 − THE RAVINE SITE
# A MIDDLE/LATE TRANSITION PERIOD DEPOSIT

The Ravine Site, CA-SLO-2563, is a remnant shell midden situated along a very narrow northeast-southwest trending terrace immediately above the rocky intertidal zone (Figures 10.1 and 10.2.) The site is located on a private ranch between Estero Point and Cambria. Radiocarbon dates indicate that the site is a discrete Middle/Late Period Transition component dating between about 920 and 690 calBP. On the central coast, few sites are known to date to this time, with only one single-component deposit (Coon Creek, CA-SLO-9) and a small deposit at Arroyo de los Chinos (CA-SLO-273/H, Locus 2) having been systematically studied (Codding and Jones 2007; Codding et al. 2009; Hildebrandt et al. 2002). The Ravine Site is perched at the edge of a marine terrace subjected to severe erosion from wave undercutting. The excavation reported here recovered a sample from the last intact vestige of the deposit, providing information that will add to our knowledge of cultural history and allow an examination of subsistence during this important time period. Site occupation spans most of the Medieval Climatic Anomaly (1100-650 calBP), making its investigation an excellent opportunity to understand and evaluate cultural developments during a time marked by prolonged droughts (Jones et al. 1999).

Figure 10.1. CA-SLO-2563 Looking Southeast with Point Arguello in Background.

### SITE DESCRIPTION

The deposit consists of a small (18 x 6 m) shallow shell midden extending only 60 cm below the surface. Revealed in the seacliff profile is a relatively homogenous midden composed of shells of rocky intertidal species, predominantly black turban snail, California mussel, and small red abalone. The deposit also contains fire-altered rock, flaked and ground stone tools, stone debitage, modified shell and bone, and bird, mammal, fish and reptile bone.

### SITE ENVIRONMENT

The site is situated on an isolated section of what was once a broad marine terrace; however, the remnant deposit is now surrounded by steep

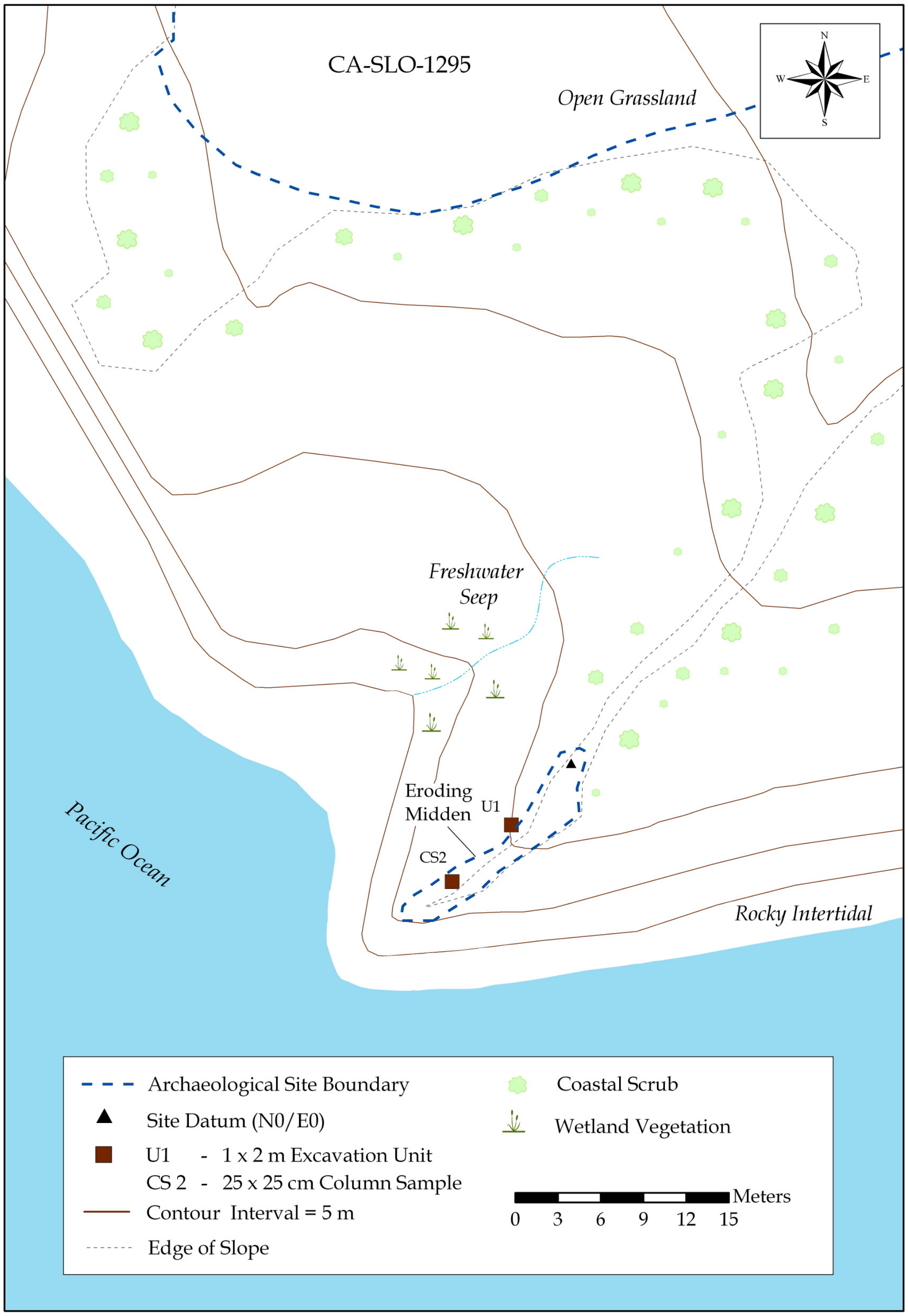


Figure 10.2. CA-SLO-2563 Site Map.

wave-cut cliffs that are rapidly eroding into the Pacific Ocean. CA-SLO-2563 is located about 15 m above sea level, with a small spring flowing from the sea cliff below the site. An unnamed seasonal creek also empties into the ocean 100 m north of the site. The spring is located in a ravine that has cut back from the sea cliff, exposing a midden profile and spilling cultural materials into the ravine.

Vegetation communities immediately on and adjacent to the site include coastal scrub, annual grassland, riparian, and chaparral. On and near the site are coffee berries, coastal sagebrush, poison oak, blackberries, lupine, willows, and annual grasses, with riparian annuals along the unnamed creek to the northwest. A productive stand of giant wild rye (*Leymus condensatus*) is located in the spring below the site. On-site vegetation is minimal, consisting of scattered coastal sage, coyote brush, and bush lupine.

## LOCAL ARCHAEOLOGICAL CONTEXT

The Ravine Site was recorded during surveys for this dissertation research. Two other sites are in the immediate vicinity. CA-SLO-1294 is located 300 m southeast, on the same marine terrace. The site appears to contain the same diversity of rocky intertidal shellfish as the Ravine Site, although a very small vestige of the site remains. A radiocarbon date from near the base of the 60-cm-thick deposit produced a date of 4360 – 4140 calBP (Dills 1990), suggesting that at least this portion of the site was occupied earlier than the Ravine Site. A second site, CA-SLO-1295, reported on in Chapter VII, is situated only 40 m north of the Ravine Site at the base of the ridge and across the open terrace. CA-SLO-1295 dates to the Early Period (5190-2860 calBP), contemporaneous with CA-SLO-1294. Collectively, these sites suggest human occupation of this marine terrace between 5100 and 690 calBP, with an occupational hiatus during the Middle Period around 3000 and 1000 calBP.

### SITE SOILS AND STRATIGRAPHY

The site is situated on a remnant of the uplifted Pleistocene Cambria marine terrace (Stokes and Garcia 2008). Soils at the terrace surface are mapped as Still-Elder series, in the Still gravelly sandy clay loam phase. These deep soils are characterized by well-drained sandy loam and gravelly sandy clay loam formed on alluvial fans and plains from sedimentary rocks (Ernstrom 1977:85, Sheet 4.). Immediately north of the site, on the steep hill slopes, soils are thin, corresponding to an area mapped as Gazos-Lodo clay (Ernstrom 1977:48, Sheet 4).

One excavation unit (2.0 x 0.5-1.0 m) and a column sample (0.25 x 0.25 cm) were placed in areas of the site that appeared to be relatively intact. A total volume of 0.7 $m^3$ was excavated. The stratigraphic profile of the unit and the sea cliff marine terrace were examined for structural integrity (Figure 10.3). The intact archaeological deposit is buried under five cm of colluvium

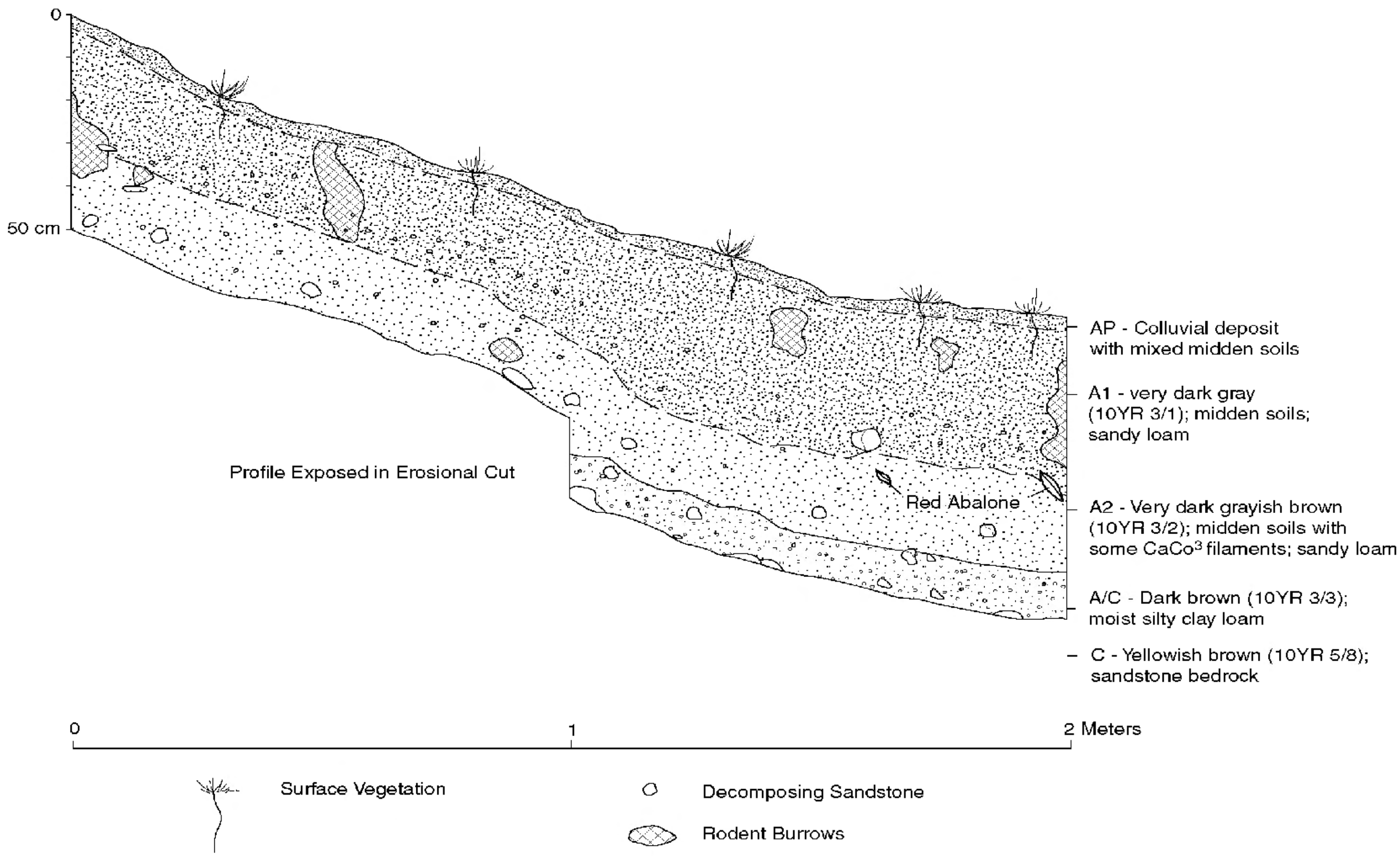


Figure 10.3. CA-SLO-2563 Excavation Unit 1 East Wall Soil Profile

mixed with midden. The upper deposit, between 5 and 40 cm in depth, is within an A-Horizon soil. It is a very dark gray shell midden (10 YR 3/1) composed of a friable sandy loam matrix containing sub-rounded to rounded pea-sized gravels. An indistinct boundary occurs at 40 cm, where an A2 transition to very dark grayish brown (10YR 3/2) sandy loam is encountered. This horizon continues to approximately 60 cm in depth. Cultural materials decrease in abundance within the A2 midden, and yellowish-brown sandstone pebbles become more common with depth. A distinct zone of accumulated calcium carbonate (CaCo3) filaments indicates leaching from the overlying shell deposits and stability in the deposit. The final level (60–70 cm) is a dark brown (10YR 3/3) moist silty clay loam containing only small pockets of midden. The C Horizon is defined by aeolian sands immediately above weathering yellowish-brown (10YR 5/8) sandstone bedrock with massive structure.

The vertical distribution of cultural remains corresponds rather closely with the soil horizons. The maximum density of artifacts and faunal remains occurs between 30 and 60 cm in depth, with highest counts in the 30–50 cm levels. This corresponds with the A1 Horizon (5–40 cm). Cultural remains decline steadily through the A2 Horizon (40-60 cm) and essentially end below the A/C Horizon.

One discrete feature was defined in the course of excavation, at 30-40 cm below datum. Feature 1 is a concentration of ground and battered stone, a Monterey chert core, and whole small red abalone shells in the southeast corner of the unit. Although fire-altered rock was part of the feature, only a small concentration of charcoal (9.42 g) was present, and no other evidence of burning was noted. The rocks were angular, between 5 and 15 cm long. No changes in faunal remains or in flaked stone tool type, density, or condition were observed.

## CHRONOLOGY

Excavations provided shell for radiocarbon assay but no temporally diagnostic artifacts or obsidian. Two radiocarbon dates were obtained from the site, both from single pieces of red abalone (Table 10.1). One was obtained from near the top of the excavation unit and a second from the lower level near the base. The two dates reflect a Middle/Late Transition occupation, ranging between 693 and 924 calBP. These dates, whose midpoints span only 231 years, correspond to about 65 cm of deposit.

Table 10.1. Radiocarbon Dates from CA-SLO-2563.

| Lab No. Beta- | Material | Unit | Depth cmbd | Measured Radiocarbon Age (BP) | Conventional Radiocarbon Age (BP.[a] | Calendar Age Range, 1 Sigma[b] |
|---|---|---|---|---|---|---|
| 251136 | *Haliotis rufescens* | 1 | 5 | 1060± 40 | 1470± 40 | 740 (690) 650 calBP<br>A.D. 1210 (1260)1300 |
| 249369 | *Haliotis rufescens* | 1 | 65 | 1420± 40 | 1818± 40 | 990 (920) 860 calBP<br>A.D. 960 (1030) 1090 |

Note:[a]Corrected $^{13}C/^{12}C$; [b]Calibrated using 325± 35 UC CALIB REV 5.0.1 (Stuiver et al. 2005), Rounded calendar ages include midpoint; cmbd - Centimeters below datum.

## CA-SLO-2563 ARTIFACTS

A small assemblage of flaked stone, ground and battered stone, bone tools, and shell tools was recovered from CA-SLO-2563 (Table 10.2). The artifacts provide evidence of a variety of manufacturing and processing activities.

### SHELL ARTIFACTS

Two abalone artifacts were recovered from the site. The first is a small (24.8 X 6.3 X 1.5 mm) ornamental pendant blank formed from the flat area of a *Haliotis cracherodii* shell (SLO2563-338; Figure 10.4a). The oval artifact was shaped by grinding along its periphery and has abrasion striations across the epidermis. The artifact found in the lowest level of the unit (60-70 cmbd). It is unclear if this specimen is a finished ornament or a pendant blank. King (1991a) identified a variety of Middle and Late period abalone ornament shapes and sizes that are similar to this artifact, with various perforation locations. The second artifact is a section of cut and abraded *Haliotis rufescens* shell (43.4 X 25.1 X12.0 mm) recovered from the 20-30 cm level (SLO2563-59). The artifact is crescent-shaped, comprising a section of outer rim of the whorl that is cut along both margins. Striations are present across the epidermis. Both of these artifacts appear to have been objects still being shaped for decorative use.

Table 10.2. Summary of CA-SLO-2563 Artifacts.

| ARTIFACT CLASS | TOTAL |
|---|---|
| **Flaked Stone** | |
| Simple flake tools | 2 |
| Core | 1 |
| Debitage | 209 |
| **Ground and Battered Stone** | |
| Millingslabs | 2 |
| Handstone | 1 |
| Miscellaneous handstones | 3 |
| Pitted stones | 6 |
| Battered cobbles | 4 |
| Miscellaneous groundstone | 1 |
| **Subtotal** | 17 |
| **Shell Artifacts** | |
| *Haliotis cracherodii* pendant/blank | 1 |
| *Haliotis rufescens* worked object | 1 |
| **Bone Tools** | 2 |
| **Asphaltum** | 1 |
| Total | 234 |
| Artifacts per cubic meter[a] | 302 |

Note: [a]Based on $0.776^3$ of excavated deposit.

### BONE ARTIFACTS

Two nondescript worked bone tools were recovered from the middle of the site deposit (Figure 10.4). Of these, one is a polished fragment of an indeterminate long bone from a large bird (SLO2563-284, Figure 10.4c). The second is an awl formed from the metacarpal of a large mammal, most likely deer (SLO2563-273, Figure 10.4b). It has clearly been shaped, with unpolished splinter facets and a polished tip.

### FLAKED STONE TOOLS AND DEBITAGE

As with most sites along the San Simeon Reef, the most common artifacts recovered from CA-SLO-2563 are Monterey chert debitage and tools.

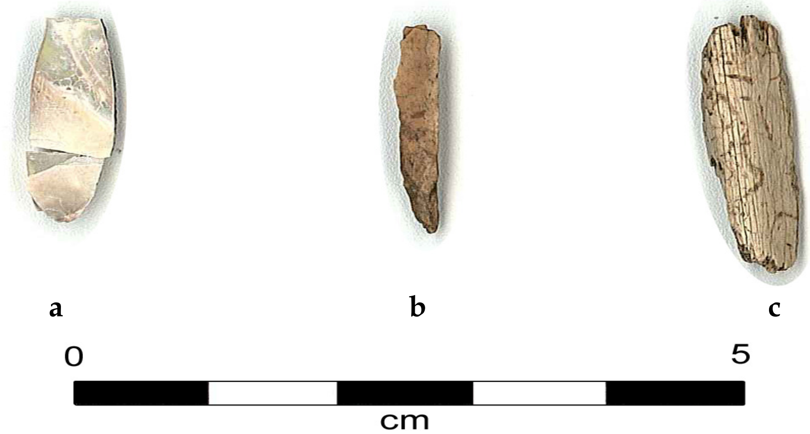


Figure 10.4. Bone Tools and Shell Artifact from CA-SLO-2563. a: *Haliotis rufescens* ornamental pendant blank; b-c: Bone tools.

Analysis of the small flaked stone collection resulted in identification of two simple flake tools with minor unifacial flaking, a core, and debitage reflecting a full range of tool manufacturing activities (Table 10.3).

The debitage collection is composed of 209 items, almost exclusively of the locally abundant Monterey chert (93% of the total). Franciscan chert and shale represent the remaining seven percent of the material. Technological analysis of 142 diagnostic flakes recovered from the 1/8-inch mesh screening of deposits from both unit and two column samples was conducted (Table 10.4). It is clear that both Monterey and Franciscan cherts were brought to the site in the early stages of reduction and then were further reduced to bifaces. Interior and pressure flakes are the most abundant flake classes represented (41% and 26%, respectively). Biface thinning (13%) and primary and core reduction activities (18%) account for more modest proportions. Both the debitage reduction sequence and density suggest that stone tool manufacture was not a primary site activity. Given the higher proportions of interior percussion flakes, occupants were focusing on the earlier stages of reduction rather than the production of bifacial tools from core or flake blanks. The biface thinning and pressure flakes, however, indicate that some production, finishing, and maintenance of Monterey and Franciscan chert bifacial tools also occurred on site.

Table 10.3. CA-SLO-2563 Flaked Stone Assemblage.

| Artifact | Monterey chert | Franciscan chert | Shale | Total |
|---|---|---|---|---|
| Simple flake tools | 2 | – | – | 2 |
| Core | 1 | – | – | 1 |
| Debitage | 194 | 14 | 1 | 209 |
| Total | 197 | 14 | 1 | 212 |

Table 10.4. CA-SLO-2563 Debitage Attributes.

| | Monterey chert | Franciscan chert | Shale | Total |
|---|---|---|---|---|
| Primary reduction | 6 | 1 | – | 7 |
| Secondary reduction | 17/1 | 1 | 1 | 19 |
| Core rejuvenation | 1 | 1 | – | 2 |
| Interior | 57/12 | 1/1 | – | 58 |
| Biface thinning | 17/1 | 2 | – | 19 |
| Pressure | 34 | 3 | – | 37 |
| Subtotal | 132/14 | 9/1 | 1 | 142 |
| Non-diagnostic | 62/7 | 5 | – | 67 |
| Total | 194/ 21 | 14/2 | 1 | 209/23 |

Note: Debitage analysis based on the unit excavations wet screened through 1/8-inch mesh; # /# -Total Number of Flakes/Number of Heat Altered Flakes

## GROUND AND BATTERED STONE

The ground and battered stone assemblage contains a small but diverse array of 17 artifacts, the largest proportion coming from Feature 1 and the 20-30 cm level. Included in the assemblage are two millingslabs, four handstones, six pitted stones, four battered cobbles, and one miscellaneous groundstone artifact (Table 10.2). The artifacts are of sandstone (n=14), mudstone (n=1), and greenstone (n=2) cobbles that could have been collected in the local area within the intertidal zone or the freshwater stream to the north.

Many of the ground and battered stone implements, particularly the handstones, battered cobbles, and pitted stones, appear to have had multiple uses. In particular, the handstones were reused as pitted stones for battering activities. This is common among pitted stones from all study sites and has been observed at other coastal sites. Two unique artifacts deserve mention. The first is an extensive end-battered and pitted cobble that demonstrates tool reuse (SLO2563-298: Figure 10.5a). The second is an irregularly shaped cobble showing a series of deep pits along a shallow natural depression in the rock, along with end battering (SLO2563-304: Figure 10.5b). Asphaltum residue on two of the tools indicates some use in preparing an adhesive or for caulking or waterproofing.

### PLANT REMAINS AND CHARCOAL

The seeds of three California native plants were identified in the deposit. One California goosefoot (*Chenopodium californicum*) and two bush lupine seeds were recovered from the excavation unit between 10 and 60 cm below datum. Although these seeds may reflect use of the local coastal prairie plant resources, they are not burnt and may be a natural occurrence.

A modest amount of wood charcoal is distributed throughout the deposit, but slightly higher proportions occur in the 10-50 cm depth. The most abundant charcoal, 11.37 g, was recovered in the 40-50 cm level.


Figure 10.5. Selected Ground and Battered Stone Artifacts from CA-SLO-2563.
a: End-battered pitted stone; b: End-battered and pitted cobble.

## SUBSISTENCE STRATEGIES

The most common materials recovered from CA-SLO-2563 were faunal remains, including marine shell and fish, mammal, bird, and reptile bone (Table 10.5). Although derived from a small volume of excavated deposit, the data presented here provide insights into the subsistence choices of site inhabitants during the approximately 230 years long occupation.

Table 10.5. Vertical Distribution of CA-SLO-2563 Faunal Remains by Weight.

| Unit 1 Depth (cm) | Shell | Fish Bone | Mammal, Bird, Reptile Bone |
|---|---|---|---|
| 0-10 | 149.48 | 0.04 | - |
| 10-20 | 660.71 | 2.64 | 0.68 |
| 20-30 | 1,432.69 | 4.44 | 0.43 |
| 30-40 | 2,431.29 | 4.18 | 2.06 |
| 40-50 | 2,317.19 | 4.48 | 1.23 |
| 50-60 | 1,938.38 | 4.59 | 4.47 |
| 60-70 | 804.38 | 2.61 | 0.21 |
| Total | 9,734.12 | 22.98 | 9.08 |

Notes: Excluded rodent bones. Data from 1 x 2-m excavation unit, 1/8-inch screen residuals; Weight in grams; Levels correspond to cm levels excavated below datum; Shell includes 691.87 grams from *Haliotis rufescens* from 0-10 and 20-70 cm levels.

## MAMMAL, BIRD, AND REPTILE BONE

A small sample of 239 bone elements weighing 12.96 g was identified (Table 10.6). As with most coastal middens, few of the mammal bones could be identified to genus or species level, i.e., only one element from a *Canis* spp. Bones of rodents are the most abundant (122 specimens or 35% of the identifiable collection). This is not surprising given the prevent krotovina in the unit sidewalls. Rodent bones are excluded in the dietary analysis.

Table 10.6. Identified Mammal, Bird, and Reptile Bone from CA-SLO-2563.

| COMMON NAME | TAXON | NISP | WEIGHT (G) |
|---|---|---|---|
| **Terrestrial mammals** | | | |
| Canis spp. | Dog/coyote | 1 | 0.21 |
| Medium carnivore | Mammalia | 1 | 0.20 |
| Medium-Large carnivore | Mammalia | 1 | 2.03 |
| Large mammal | Mammalia | 1 | 0.90 |
| Medium mammal | Mammalia | 22 | 1.65 |
| Small mammal | Mammalia | 1 | 0.01 |
| Mammal | Mammalia | 14 | 0.62 |
| Subtotal | | 41 | 5.62 |
| **Marine mammal** | | | |
| Medium | Unidentified | 3 | 3.06 |
| **Rodent** | | | |
| Rodent | Rodentia | 76 | 1.76 |
| California ground squirrel | *Spermophilus beecheyi* | 1 | 0.11 |
| Pocket gopher | *Thomomys bottae* | 45 | 1.33 |
| Subtotal | | 122 | 3.2 |
| **Birds** | | | |
| Small bird | Aves | 3 | 0.02 |
| Medium bird | Aves | 3 | 0.18 |
| Large bird | Aves | 1 | 0.07 |
| Subtotal | | 7 | 0.27 |
| **Reptiles** | | | |
| Pacific gopher snake | *Pituophis catenifer catenifer* | 2 | 0.02 |
| Snake | Serpentes | 4 | 0.18 |
| Subtotal | | 6 | 0.20 |
| Vertebrae | Vertebrata | 60 | 0.61 |
| **Total** | | 239 | 12.96 |

Note: NISP – number of identified specimens.

The collection can only be quantified regarding general classes. Within the broader classes, terrestrial mammals (72%) dominate the assemblage, with medium mammals comprising half of the elements, followed by birds (16%) and marine mammals (7%). Other categories are represented by minor numbers. Excluding the rodents, only eight of the 117 elements show signs of burning.

## MARINE FISH

A minimum of 78 taxa were identified within the 22.98 g of fish bone (n=596) (Table 10.7). The fish bone assemblage is derived from the unit and both column samples and was wet screened in the laboratory. Due to the low minimum number of individuals (MNI) values, the following discussion will be primarily based on NISP. By weight, the stratigraphic distribution of fishbone is relatively evenly distributed between 20 and 60 cm (Table 10.5). Almost half (240 of the 596 elements) show signs of burning, most being of pricklebacks.

Nineteen teleost taxa were identified to family, genus, or species. About 96 percent of the identified fishes inhabit nearshore waters above a rocky substrate (e.g., pricklebacks, rockfish, and cabezon). The remaining species are common to kelp forests (e.g., señorita), sandy surf/muddy bottoms (e.g., surfperches) and inshore/offshore locations (e.g., herrings and anchovy). All of the taxa could have been caught in rocky shore or kelp forest habitats using hook or gorge and line, spears, or nets; or by hand.

Similar to the taxa of the other southern San Simeon Reef fish assemblages, pricklebacks are the most abundant taxon, making up about 92 percent of the NISP and 21 percent of the weight of total identified fish. Rockfishes are the next most abundant species, making up 12 percent of the NISP and 10 percent of the weight. Kelp greenlings and cabezon closely

Table 10.7. Marine Fish Remains from CA-SLO-2563.

| Common Name | Taxon | Mesh size 1/8″ NISP | Mesh size 1/16″ NISP | Total NISP | MNI | Wt (g) |
|---|---|---|---|---|---|---|
| Inshore/Offshore Migrators | | | | | | |
| Herrings | Clupeidae | – | 4 | 4 | 4 | 0.02 |
| Northern anchovy | *Engraulis mordax* | 1 | 2 | 3 | 2 | 0.01 |
| Silversides | Atherinidae | 1 | 5 | 6 | 3 | 0.07 |
| Rocky Intertidal | | | | | | |
| Cabezon | *Scorpaenichthys marmoratus* | 9 | – | 9 | 6 | 1.01 |
| Clinids | Clinidae | 3 | 1 | 4 | 3 | 0.05 |
| Crevice kelpfish | *Gibbonsia montereyensis* | 1 | – | 1 | 1 | 0.14 |
| Croaker, drum or white seabass | *Sciaenidae* spp. | 1 | – | 1 | 1 | 0.02 |
| Kelpfish | *Gibbonsia* spp. | 2 | – | 2 | 2 | 0.14 |
| Kelp greenlings | *Hexagrammos decagrammus* | 9 | 3 | 12 | 5 | 0.44 |
| Monkeyface prickleback | *Cebidichthys violaceus* | 2 | – | 2 | 2 | 0.28 |
| Northern clingfish | *Gobiesox maeandricus* | 6 | – | 6 | 4 | 0.21 |
| Pricklebacks | Stichaeidae | 75 | 18 | 93 | 10 | 2.51 |
| Rockfishes | *Sebastes* spp. | 22 | 1 | 23 | 12 | 2.33 |
| Rock or black prickleback | *Xiphister* spp. | 51 | 34 | 85 | 10 | 2.02 |
| Scorpionfish or rockfish | Scorpaenidae spp. | 1 | – | 1 | 1 | 0.02 |
| Sculpins | Cottidae | 3 | 5 | 8 | 5 | 0.08 |
| Wooly sculpin | *Clinocottus* spp. | 3 | – | 3 | 1 | 0.02 |
| Kelp Beds | | | | | | |
| Señorita | *Oxyjulis californica* | 3 | – | 3 | 2 | 0.03 |
| Sandy Surf/Muddy Bottoms/Bays | | | | | | |
| Surfperches | Embiotocidae | 2 | – | 2 | 2 | 0.23 |
| Ray-Finned Fishes | Actinopterygii | 328 | | | | 13.31 |
| Totals | | 523 | 73 | 596 | 77 | 22.98 |

Note: Weights are in grams.

follow, with about six and five percent of the NISP and two and four percent of the weight, respectively. When MNI is considered, the ranking is the same: pricklebacks (n=22), rockfishes (n=12), kelp greenlings (n=12), and cabezon (n=9). All other taxa appear to make up minor amounts of the total fish sample in relatively equal proportions. The density of fish in the deposit, including all ray-finned fishes, is 778 bone elements per cubic meter of excavation.

### SHELLFISH

A total of 10,917.96 g of shell was recovered; of this total, 9734.12 g were recovered from the excavation unit and 1183.84 g from the two column samples. To investigate research questions surrounding ecology, subsistence and intensification two types of samples were collected and analyzed, as discussed in *Chapter VI: Archaeological Methods, Shellfish.*

Twenty-seven invertebrate species are represented in the assemblage from CA-SLO-2563 (Appendix A; Table A2). The midden deposit contains moderately dense shell (14,253.2 g/m$^3$), and similar to fish and mammal bone, the shell is evenly distributed between 20 and 60 cm below datum, with most concentrated in the 30 to 60 cm levels. As is true of most southern San Simeon Reef sites, black turban snail is the most common species, accounting for 56 percent of the total shell weight (Table 10.8). The second most abundant taxon is red abalone (22%) followed by limpets (9.4%), chiton (5.4%), crab (1.8%), and California mussel (1.6%). The remaining shell encompasses a range of larger, more economically important species such as red turban snails (1.5%), as well as a variety of smaller invertebrates such as brown turban snail (0.6%) and sea urchin (0.2%). Due to the site location, the rocky intertidal shellfish composition is expected. All of the identified species

Table 10.8. Contribution of Significant Shellfish Species from CA-SLO-2563.

| Common Name | Taxon | Total (g) | Total (%) |
|---|---|---|---|
| Black turban snail | *Tegula funebralis* | 666.32 | 56.3 |
| Red abalone | *Haliotis rufescens* | 270.71 | 22.9 |
| Limpet | *Collisella* spp. | 111.07 | 9.4 |
| Chiton | *Mopalia* spp. | 67.26 | 5.7 |
| Crab | Cancer | 21.13 | 1.8 |
| California mussel | *Mytilus californianus* | 18.49 | 1.6 |
| Red turban | *Lithopoma gibberosa*[a] | 18.03 | 1.5 |
| Brown turban snail | *Tegula brunnea* | 7.24 | 0.6 |
| Sea urchin | *S spp.* | 1.68 | 0.2 |
| Black abalone | *Haliotis cracherodii* | 1.35 | 0.1 |
| Slipper shell | *Crepidula* spp. | 0.56 | 0.0 |
| Total | | 1183.84 | 100 |

Note: Shell samples are based on two column samples screen through 1/8-inch mesh, a total of 0.0662 $M^3$; Weight in grams; % - proportion of site shell assemblage; S – *Stonglyocentrotus*; [a]*Lithopoma gibberosa* was formerly classified as *Astrea gibberosa*.

occur in the intertidal habitats: California mussel, barnacle, tegula, limpet, and the chitons are typically found in the mid-to-high-intertidal zone; the mid-to-low intertidal zone is populated by black abalone; and red abalone and sea urchin tend to concentrate in the low intertidal zone (Rickets and Calvin 1968; Coan et al. 2000). The small predatory snail species identified in the assemblage are probably not economically significant and were collected inadvertently during harvesting of the targeted shellfish to which they were attached.

Variations in the importance of different shellfish species over the course of site occupation are minimal, resulting largely from the short amount of time that elapsed over the course of midden accumulation. The distribution of red abalone is the only distinct difference noted in the midden composition. Red abalone is concentrated in the 30 to 50 cm portion of the deposit. California mussel is a minor species throughout the deposit and is only 1.5 percent of the shell assemblage. The only difference between the upper and lower portions of the deposits is the amount of shellfish present. The upper three levels contain between 150 and 1,400 g of shell per level, the middle of the deposit contains around 2,300 g, and the lowest levels only about 800 g.  However, the shell collection, much like the other faunal categories, represents a small sample from a restricted portion of the site that may be near its margin as site deposits have been destroyed by erosion.

### CALIFORNIA MUSSEL AND RED ABALONE SIZE-FREQUENCY DATA

As with the other three sites, in addition to species identifications and shell quantification, all complete and nearly complete mussel and abalone shells were segregated to evaluate their size at the time of harvesting.

#### RED ABALONE

A total of 32 red abalone shells was analyzed from CA-SLO-2563 (Table 10.9). Red abalone lengths ranged from 2 to 14 cm, with an average of approximately 8.1 cm. The data demonstrate that the highest class frequency is 10-11 cm, 25 percent of the red abalones. The data also suggest that foragers collected both juvenile and adult red abalones over the course of site occupation.  Over the approximately 230 years of site occupation, there is a slight increase in abalone shell size over time, although the small sample class size may bias the 12.25 cm length estimate.

Table 10.9. Red Abalone Lengths and Frequencies from CA-SLO-2563.

| SIZE CLASS (CM) | FREQUENCY WITHIN AGE PROFILE | PERCENT |
|---|---|---|
| 0-2 | 1 | 3 |
| 2-3 | 2 | 6 |
| 3-4 | 3 | 9 |
| 4-5 | 1 | 3 |
| 5-6 | 1 | 3 |
| 6-7 | 2 | 6 |
| 7-8 | 4 | 13 |
| 8-9 | 2 | 6 |
| 9-10 | 4 | 13 |
| 10-11 | 8 | 25 |
| 11-12 | 1 | 3 |
| 12-13 | 1 | 3 |
| 13-14 | 2 | 6 |
| Total | 32 | 100 |
| UNIT LEVEL (CM) | FREQUENCY (AVERAGE SIZE CM) | PERCENT |
| 0-10 | 0 | 0 |
| 10-20 | 0 | 0 |
| 20-30 | 4 (12.25) | 23 |
| 30-40 | 11 (7.9) | 34 |
| 40-50 | 8 (7.5) | 25 |
| 50-60 | 7 (7.0) | 22 |
| 60-70 | 2 (6.5) | 6 |
| Total | 32 | 100 |

### CALIFORNIA MUSSEL

Only 10 measurable shells were identified and analyzed (Table 10.11). Such a small sample size and should be used with caution. California mussel shells ranged between 1 and 6 cm, averaging 3.5 cm. Although no mussel collecting strategies can be inferred, it is interesting that the general size of the shells is small over the duration of site occupation.

Table 10.10. California Mussel Lengths and Frequencies from CA-SLO-2563.

| MUSSEL SIZE CLASS (CM) | 0-2 | 2-3 | 3-4 | 4-5 | 5-6 | Total |
|---|---|---|---|---|---|---|
| Frequency within age profile | 2 | 4 | 2 | 1 | 1 | 10 |
| Percent | 20 | 40 | 20 | 10 | 10 | 100 |

Number of Mussel Shells Per Unit Level.

| UNIT LEVEL (CM) | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | Total |
|---|---|---|---|---|---|---|---|
| Frequency | 0 | 0 | 1 | 7 | 1 | 1 | 10 |
| Percent | 0 | 0 | 10 | 70 | 10 | 10 | 100 |

## DIETARY RECONSTRUCTION

When the relationship between key dietary resources is illustrated by calculating the density of NISP and weight per cubic volume of excavation, additional trends are recognized (Table 10.11). The faunal remains suggest that site occupants targeted shellfish and fish, while important terrestrial resources such as rabbit and deer were only minor dietary constituents. Marine mammals, birds, and reptiles are also present in low frequencies. The relative importance of shellfish is demonstrated by the ratio of shellfish weight to terrestrial mammal bone, i.e., 1081:1. Based on these data, it is clear that occupants focused almost exclusively on the littoral environment.

To estimate the relative importance of various faunal classes, the significance of each animal category was calculated using the meat weight multipliers (Table 10.12). This method provides a valuable relative index that allows for a greater understanding of this assemblage, and identification of

Table 10.11. Bone and Shell Densities from CA-SLO-2563.

| FAUNAL CLASS | DENSITIES PER CUBIC METER |
|---|---|
| Shellfish (g) | 14,253 |
| Terrestrial mammal (NISP/g) | 53.5/7.3 |
| Marine mammal (NISP/g) | 3.9/ 4.0 |
| Bird (NISP) | 9.1/0.4 |
| Reptile (NISP) | 7.8 |
| Fish (NISP/g) | 778/30.0 |

Note: Terrestrial bone includes unidentified class size and identified species; g – gram; NISP – number of identified specimens.

Table 10.12. CA-SLO-2563 Estimated Dietary Reconstruction Based on Meat Weight.

| TAXON | BONE/SHELL WEIGHT (G) | MEAT WEIGHT (G) | PERCENT (MEAT WEIGHT) |
|---|---|---|---|
| Terrestrial mammals | 5.62 | 28.86 | 0.25 |
| Marine mammals | 3.06 | 74.6 | 0.65 |
| Birds | 0.20 | 0.36 | 0 |
| Reptiles | 0.27 | 0.10 | 0 |
| Marine fish | 22.98 | 634.98 | 5.60 |
| Shellfish | 11,609.83 | 10,664.6 | 93.50 |
| Total | 11,641.96 | 11,403.5 | 100 |

Notes: Appendix D provides data for meat weight reconstructions.

relative changes in the diet over time. Dietary reconstruction using the weight method suggests that shellfish, primarily black turban snail and red abalone, were the most important component of the diet (93.5% of overall meat yield). Marine fish from rocky intertidal environments contributed roughly 5.6 percent of the overall meat yields; marine and terrestrial mammals less than one percent; and birds and reptiles only minor contributions.

Collectively, the data suggest that CA-SLO-2563 occupants relied most on shellfish from the rocky substrates and to a lesser extent on fish from rocky intertidal, nearshore, and kelp forest habitats. These findings are consistent with dietary reconstructions pertaining to the other study site occupations.

### SYNTHESIS

CA-SLO-2563, the Ravine Site, is a small coastal midden with a discrete Middle/Late Transition Period component dating between about 920 and 690 calBP. The site many have been occupied once for a short period of approximately 200 year interval, or multiple discrete episodes. This is the first excavated site pertaining to this important time period along the southern San Simon Reef, and investigation of the last remaining vestige of the deposit offers new insights into a poorly understood portion of prehistory.

The site is a seasonal or multi-seasonal residential location where people focused almost exclusively on the collection and consumption of shellfish from the rocky intertidal zone, but they also fished in the kelp forest and near-shore waters. Most species within the site assemblage could have been captured with hook-and-line technology or by club or hand in the shallow intertidal waters, with the smaller migratory fish procured with nets. The shellfish assemblage, in particular the low frequency and small size of California mussel and the importance of black turban snail throughout time, is consistent with findings at the other study sites.

Hunting terrestrial game and sea mammals does not appear to have been important overall diet. A low frequency of deer bones is a characteristic also observed at Late Period CA-SLO-71 located north of the site, and at the Middle/Late Transition Coon Creek site (CA-SLO-9) to the south.

The artifact assemblage includes a variety of battered and ground stone, particularly pitted stones that probably were used to process shellfish. Flaked stone tools and debitage reflect the production, finishing, and maintenance of Monterey chert bifacial tools at the site. The two simple flake tools provide evidence of more delicate tasks such as cutting and scraping. Although site occupants focused on fishing, besides the bone tools there is an absence of other fishing-related tackle such as notched net weights and circular shell fishhooks. Based on the short period of occupation (approximately 230 years), the shallow deposit, and the character of the artifact assemblage, it appears that the site was used on a short-term basis by limited numbers of people, perhaps small family bands.

# CHAPTER XI: MIDDLE TO LATE HOLOCENE MARINE ADAPATIONS ALONG THE SOUTHERN SAN SIMEON REEF

The Middle to Late Holocene was a time of pronounced cultural and environmental change in North America, including exponential population growth, increased cultural complexity, and intensified subsistence. This chapter presents a comparative analysis of the four sites excavated along the open coast of the southern San Simeon Reef and set the stage for addressing the research questions outlined in Chapter V. I examine changes in the types and densities of artifacts associated with technology and subsistence, as well as variations in categories of faunal remains and settlement patterns, and the role of interregional exchange. In particular, I focus on temporal trends in marine fisheries and shellfish collecting. Data on fishing, the changing mean sizes of California mussel and red abalone − species consistently harvested over this 5000-year interval − and patterns in black turban snail and California mussel collecting provide important insights on intertidal ecology and human resource use. This chapter provides new information on the southern San Simeon Reef and incorporates the data to build on and refine existing interpretations of the regional archaeological record. Comparisons of artifacts and dietary remains with those from other sites in the area reconstruct how littoral adaptations changed over time in a localized area of the central California Coast.

## EVIDENCE OF MARINE AND TERRESTRIAL ENVIRONMENTAL CHANGE

Changes in landform and nearshore habitats are important considerations in understanding patterns of marine adaptations. Two specific aspects of environmental change, seawater temperature and precipitation, may have had fundamental effects on the distribution and abundance of food resources along the San Simeon Reef and along central California coast. Sea water temperature affects species distribution and productivity of shellfish, marine fish, and sea mammal populations; and precipitation influences the distribution and productivity of terrestrial mammals and plant foods. Air temperature also affects the productivity of terrestrial resources.

### SEA LEVEL CHANGE

During the Early Holocene, rising sea levels inundated many coastal lowlands and canyons along the California coastline, forming the small estuarine bay to the north at San Simeon Creek and the expansive Estero Bay to the south. When the study sites along the southern San Simeon Reef were first occupied (around 5000 calBP), sea level rise had slowed dramatically; but, the coastline remained in a state of constant instability. Despite sea level stabilization of abound 6000 to 5000 years ago (Inman 1983), may coastal bays and lagoons decreased in productivity as they filled with sediments and were reduced in size, were periodically cut off from the oceanic circulation, or disappeared entirely (Erlandson 1997; Masters 2006). Along the open coastline, coastal terraces continued to be lost to shoreline transgression caused by gradual coastal erosion. Nonetheless, the consistent occurrence of shellfish and fish common in rocky intertidal and nearshore habitats throughout the periods of site occupation along the southern San Simeon Reef reflects the stability of taxa procured by occupants of around 10,000 years.

### CLIMATE CHANGE AND WATER TEMPERATURE

During the last 3000-years episodes of marine cooling may coincide with cool and dry terrestrial conditions. The Late Holocene is hypothesized to have been punctuated by two pervasive intervals of drought. The first occurred between about 1100 and 900 calBP, and the second between 800 and 650 calBP (Stine 1994). These periods of reduced rainfall, referred to collectively as the Medieval Climatic Anomaly, resulted in decreased marine resource productivity along the whole California coast and disrupted human populations along the central California Coast (Jones et al. 1999).

A record of Holocene marine water temperature fluctuations for the central California Coast is currently being developed; however, many aspects of the water temperature record are still poorly understood. Recent research on sea-surface temperature intervals along the north coast of San Luis Obispo (Jones et al. 2008c) and the Santa Barbara Channel (Kennett 2005; Kennett et al. 2007:352-353) provides significant insights. Pertaining to the Middle

Holocene, Kennett (2005) and Kennett et al. (2007) found that Santa Barbara Channel sea water temperatures were cooler than present at the onset of this interval, between 6300 and 5900 calBP. About the time the Early Period sites of the San Simeon Reef were occupied, around 5200 calBP, water temperatures became very warm and remained so until 3800 calBP. Afterwards, the water temperatures fluctuated between cooler and warmer than present.

Based on a recent analysis of oxygen isotopic measurements from archaeological shell samples, Jones et al. (2008a) found that average sea-surface temperatures vary though time. These results suggest that between 2000 and 700 calBP sea surface water temperatures were ~1 °C cooler than present and fairly stable; between 700 and 500 calBP there was greater seasonal variation with extremes above and below historic levels; and between 500 and 300 calBP the temperature was 2–3 °C cooler than today (Jones and Kennett 1999, Table 11.1).

Table 11.1. Seasonal Sea-Surface Temperature Ranges for Middle to Late Period Sites.

| Season | Middle Period | Middle/Late Transition | Middle/Late Transition | Late-Historic Period | Modern |
|---|---|---|---|---|---|
| | SLO-267 | MNT-1233 | SLO-9 | MNT-1223,1227 | |
| Spring | ≤10.75 | ≤12.25 | ≤12.4 | ≤ 9.2 | ≤ 11.1 |
| Early Summer | 10.75-12.75 | 12.25-15.55 | 12.4-14.0 | 9.2-11.0 | 11.1-12.3 |
| Late Summer/ Early Fall | ≥12.75 | ≥15.55 | ≥14.0 | ≥11.0 | ≥12.3 |
| Winter | 10.75-12.75 | 12.25-15.55 | 12.4-14.0 | 9.2-11.0 | 11.1-12.3 |

Note: Ranges are in °C; Table data adapted from Jones et al. (2008:2291, Table 4).

## Population Fluctuations

In light of the paleoenvironmental trends over the course of site occupation, it is important to evaluate the possible links between apparent cultural change and events in the natural environment. Population growth (or decline) is now considered to be crucial in understanding subsistence change and economic intensification. While data on subsistence change in the archaeological record are relatively abundant, changes in population density are difficult to asses based on the limited consideration of the subject and the low number of radiocarbon-dated site components in the San Simeon Reef area. Population density is estimated here based on the frequencies of radiocarbon dated deposits and ethnohistoric information. For the purposes of this research, a site component is defined as a 200-year interval of occupation at a site. If the number of radiocarbon dates were reported for each site, those with a larger number of dates would exaggerate the population size during the intervals pertaining to the dates. Some sites have three of more dated components, but most have only one or two. Figure 11.1 presents the frequency distribution of 148 radiocarbon dates pertaining to 40 San Simeon Reef sites.

As is true for many regions throughout California, there are a relatively small number of sites dating to the Millingstone Period (10,000 to

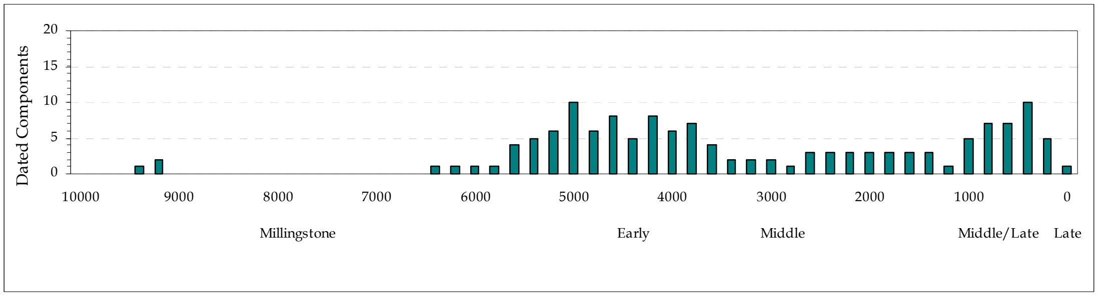


Figure 11.1. Distribution of Radiocarbon Dated San Simeon Reef Site Components (200-year intervals).

5500 calBP) along the San Simon Reef, suggesting that population densities remained very low from the time of the first documented occupation. Although sites date to the early parts of this interval, between 9300 and 8900 calBP, there appears to be an occupational hiatus along the north coast, with no sites dated between about 8800 to 6300 calBP. Large trans-Holocene site CA-SLO-369 also does not date to this interval and may have been abandoned. CA-SLO-383, located along the San Simeon Creek estuary is the only site along the San Simeon Reef known to date to this interval (6360-5050 calBP; Hines 1986). This apparently very low population density may have been brought on by the drought conditions associated with the Altithermal. In the Vandenberg region population increases during this interval, which is argued to have had favorable (relatively cool and wet) environmental conditions (Glassow 1996:102,132). Another possibility is that sites located along the shoreline have eroded into the ocean. By around 6400 calBP the

Millingstone Period apparently came to an end, or if it continued it did not leave a substantial trace.

The Early Period (5500-3000 calBP) is marked by increased radiocarbon frequencies. After 5700 calBP the number of archaeological sites increases significantly throughout the region, with occupations in both estuary settings and along the open coast such as within the San Simeon Reef region. Although this trend and associated technological changes may be the result of a migration (Harrison 1964; Lathrop and Troike 1984; Rogers 1929; Warren 1968), there is limited archaeological evidence for a population replacement (Erlandson 1997; Glassow 1997).

The Middle Period (3000 to 1000 calBP) has lower radiocarbon date frequencies, with only six dated components, suggesting a population decline in the San Simeon Reef area. However, residential bases appear to be loci of population aggregation, evidenced by a low frequency of large midden deposits, e.g., CA-SLO-276, in comparison to Early and Late Period sites. The decline in radiocarbon dated components is noticeable between 1200 and 1400 calBP (Figure 11.1). The distinct decline in radiocarbon dates is similar in other regions of California, such as the Vandenberg region, and suggests that this period of warm weather may correlate with lower population along the San Simeon Reef.

Population continues to remain low during the Middle/Late Transition Period (1000 to 700 calBP), with only six known sites in this region. Coinciding with this period is the Medieval Climatic Anomaly, between approximately 1100 and 650 calBP, marked by unusual and prolonged droughts and low terrestrial productivity through much of North America (Graumlich 1993; Stine 1994). While this interval may well have affected population density and settlement systems along the central coast, reflected in the limited number of excavated sites dating to this interval, we have yet to identify the nature of cultural change associated with these unfavorable climatic conditions.

Evidence of Late Period (700 calBP to Historic) population density is more tangible due to mission record information pertaining to adjacent regions along with frequencies of radiocarbon-dated components. Human population density does not appear to be particularly high during the Late Period, although the frequency of radiocarbon-dated deposits increases to 18. This does not appear to be a result of higher population density, but rather a result of shifting settlement patterns. Late Period settlement patterns reflect a more mobile strategy that left traces at a number of smaller sites with shallower deposits. Milliken and Johnson (2005) suggested that the pre-mission population along the San Simeon Reef is rather low, about 300 people or a regional population distribution of 1.6 people per square mile.

Comparatively, to the north along the San Francisco Bay, population estimates are around 5.5 persons per square mile (Milliken 1991:34-36), and to the south between Malibu and Point Arguello, between 8.0 and 10.0 persons per square mile (Brown 1967:79; Cook 1976).

Although this summary cannot address fine-grained details of population fluctuation, certain characteristics of change in population density are noteworthy. First, it appears that human populations in the San Simeon Reef area did not uniformly increase gradually over the course of prehistory. There were periods of decline and rebound, with a general trend towards increasing population in the Middle and Late Holocene that still remains relatively low. Second, populations never reached the higher population densities observed in the regions occupied by the Chumash along the Santa Barbara Channel or the Ohlone of the San Francisco Bay area at the time of European contact. Finally, in light of this review of climate fluctuations and populations, it appears that lower population density correlates with periods of drought, which may occur during cool or warm conditions, and warm sea surface temperatures which depress marine productivity. Most pronounced is the 2500-year interval between about 8800 and 6300 calBP with no radiocarbon dates. The second interval is the environmental deterioration associated with the Medieval Climatic Anomaly, when droughts caused changes in settlement, diet, exchange, and social relationships.

## Hunting Culture Technological Continuity and Artifact Diversity

Despite the relatively low excavation volumes at the study sites, an adequate number of formed tools were recovered to identify various subsistence and technological activities. Archaeologists have long recognized that artifact diversity must compensate for sample size; the larger a collection, the greater probability that rare artifact types will be recovered. Despite the relatively small size of the artifact assemblages from the study sites, some idea of the most common site activities may be derived from them. Artifact diversity and density from my study sites and others from northern San Simeon Reef area show considerable variation (Tables 11.2 and 11.3). This variation provides evidence of how the local populations adapted temporally and spatially to specific environments and changes in these habitats.

Artifact assemblages from CA-SLO-1295, -1622, -1677, and -2563 contain a variety of tool types that represent residential activities by social groups. Flaked stone tools reflect hunting and butchering activities (e.g., projectile points, bifaces), as well as processing or manufacturing various types of material (e.g., flake tools, drills). Fishing activities are reflected in the presence of bone tools and a notched/grooved net sinker at CA-SLO-1622. Processing tasks (e.g., shellfish, mammals) are reflected by choppers/ hammerstones, pitted cobbles, and multi-functional ground stone tools with

Table 11.2. Early Period Artifact Assemblages from Morro Bay and the San Simeon Reef.

| | Morro Bay | ------- Northern San Simeon Reef------- | | | --------------------Southern San Simeon Reef------------------ | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Artifact Class | SLO-165 | SLO-175 | SLO-265 | SLO-273/H, 274 | SLO-369 | SLO-1295 | SLO-1622[a] | SLO-1677[a] | Total |
| Projectile Points | 22 | 23 | 1 | 8 | 2 | 0 | 6 | 2 | 64 |
| Bifaces | 108 | 38 | 66 | 117 | 2 | 7 | 16 | 10 | 366 |
| Flake Tools | 99 | 57 | 11 | 30 | 4 | 21 | 57 | 57 | 336 |
| Formed Flake Tools | 0 | 0 | 9 | 0 | 3 | 1 | 5 | 1 | 19 |
| Drills | 5 | 1 | 1 | 3 | 0 | 2 | 3 | 1 | 16 |
| Reamers | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| Core Tools | 0 | 0 | 2 | 0 | 1 | 10 | 10 | 15 | 38 |
| Choppers | 23 | 2 | 0 | 12 | 5 | 1 | 3 | 0 | 45 |
| Hammerstones | 31 | 0 | 0 | 2 | 10 | 1 | 5 | 2 | 51 |
| Handstones/Millingslabs | 12 | 4 | 2 | 7 | 13 | 11 | 11 | 9 | 69 |
| Pestles/Mortars | 9 | 1 | 1 | 1 | 0 | 2 | 3 | 1 | 18 |
| Notched/Grooved Stones | 3 | 15 | 0 | 1 | 0 | 0 | 1 | 0 | 20 |
| Pitted Stones | 0 | 15 | 3 | 8 | 13 | 29 | 63 | 40 | 171 |
| Misc Ground Stone | 0 | 0 | 11 | 2 | 49 | 6 | 0 | 2 | 70 |
| Battered Cobles | 0 | 0 | 5 | 2 | 0 | 1 | 8 | 2 | 18 |
| Bone Tools | 21 | 3 | 0 | 6 | 6 | 6 | 4 | 3 | 49 |
| Shellfish Hooks/Blanks | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shell Beads | 33 | 3 | 0 | 27 | 8 | 2 | 2 | 8 | 75 |
| Other Shell Artifact | 8 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 13 |
| Total Artifacts | 374 | 162 | 0 | 222 | 116 | 102 | 201 | 155 | 1332 |
| Artifact Classes | 12 | 11 | 11 | 14 | 11 | 15 | 17 | 15 | |
| Excavation Volume | 72.9 | 5.8 | 2.1 | 6.1 | 0.2 | 2.2 | 0.81 | 1.6 | |
| Milling Tool Total | 21 | 5 | 0 | 8 | 13 | 13 | 13 | 10 | 70 |
| Point/Biface Total | 130 | 61 | 0 | 125 | 4 | 7 | 21 | 12 | 356 |
| Total | 151 | 66 | 0 | 133 | 17 | 20 | 34 | 22 | 426 |

Note- [a] Includes 1995 salvage collection; Artifact data from Hildebrandt et al. 2002 (SLO- 273/H, -274), 2007 (SLO-265); Jones and Waugh 1995 (SLO-175); Mikkelsen et al. 2000 (SLO-165); Parker 2004(SLO-369).

Table 11.3. Middle, Middle/Late Transition, and Late Period Artifact Assemblages from the San Simeon Reef.

| | ------------------------------ North San Simeon Reef------------------------- | | | | | | -------Southern San Simeon Reef------ | | |
|---|---|---|---|---|---|---|---|---|---|
| | ----------------- Middle Period -------------- | | | | Middle - Middle/Late Transition | Middle/Late Transition | Middle/Late Transition | Late Period | |
| Artifact Class | SLO-267 | SLO-266 | SLO-268 | SLO-1259 | SLO-179 | SLO-273/H | SLO-2563 | SLO-71 | SLO-115 |
| Projectile Points | 35 | 2 | - | 10 | 18 | 4 | - | 1 | - |
| Bifaces | 557 | 27 | 14 | 27 | 92 | 72 | - | 7 | 2 |
| Flake Tools | 24 | 24 | 23 | 26 | 20 | 19 | 2 | 8 | 10 |
| Formed Flake Tools | 0 | - | - | - | - | - | - | 23 | 16 |
| Drills | 0 | - | - | - | 3 | 3 | - | 4 | 5 |
| Reamers | 0 | - | - | - | - | | - | 7 | 2 |
| Core Tools/ Hammerstone | 19 | 2 | 5 | - | 13 | 6 | - | 10 | 15 |
| Choppers | 0 | - | - | - | - | - | - | 1 | 6 |
| Handstones/Millingslabs | 0 | 4 | 6 | - | 1 | 5 | 3 | 6 | 5 |
| Pestles/Mortars | 17 | 1 | - | - | 3 | 1 | - | - | - |
| Notched/Grooved Stones | 11 | - | - | 2 | 5 | 1 | - | - | - |
| Pitted Stones | 258 | - | - | 13 | 17 | 4 | 6 | 3 | 3 |
| Misc Ground Stone | 0 | - | - | - | - | - | 4 | 20 | 13 |
| Battered Cobles | 0 | - | - | - | - | - | 4 | 2 | 2 |
| Bone Tools | 25 | - | - | - | 22 | 3 | 2 | 4 | 2 |
| Shellfish Hooks/Blanks | 4 | - | - | - | 5 | - | - | 1 | - |
| Shell Beads | 17 | - | - | - | 23 | 5 | - | 9 | - |
| Other Shell Artifact | 0 | - | - | - | - | - | 1 | 3 | - |
| Total Artifacts | 967 | 60 | 48 | 78 | 222 | 123 | 22 | 109 | 81 |
| Artifact Classes | 10 | 6 | 3 | 5 | 12 | 11 | 7 | 16 | 12 |
| Excavation Volume | 89.0 | 7.88 | 10.16 | 6.4 | 10.3 | 4.4 | 0.77 | 1.3 | 1.0 |
| Milling Tool Total | 17 | 4 | 6 | 37 | 110 | 6 | 3 | 6 | 5 |
| Point/Biface Total | 592 | 29 | 14 | 0 | 4 | 76 | 0 | 8 | 2 |
| Total | 609 | 33 | 20 | 37 | 114 | 82 | 3 | 14 | 7 |

Note: Bouey and Basgall 1991 (SLO-266,- 268); Jones and Ferneau 2002a (SLO-179, -267); Jones and Waugh 1995 (SLO-1295); Hildebrandt et al. 2002 (SLO-273/H); Joslin 2006 (SLO-71, -115).

pitting, battering, and asphaltum. Plant processing activities are represented by millingslabs, bowl mortars, and handstones. Shell beads and modified shell artifacts are present in small numbers.

The density of artifacts at a site is a general reflection of how intensively, and for how long, people performed various activities. Artifact data from the four study sites, when combined with two nearby Late Period sites (Joslin 2006), reflect general trends over a 5000-year time span (Table 11.3). Analysis of formal artifacts, excluding debitage, suggests a slight increase in artifact density and diversity through time. Artifact totals from the remnant deposit at CA-SLO-2563 may not be representative of the site, as we excavated within the last vestige of the eastern extent of the site. Artifact density from a robust sample (34.3 $m^3$) at Middle/Late Transition site Coon Creek, CA-SLO-9, however, is only 4.9 artifacts per cubic meter.

The study area artifact assemblages are consistent with the large collections from Arroyo de los Chinos (CA-SLO-273/H and 274) and CA-SLO-267 and seem to reflect the presence of both residential and short-term residential or seasonal bases along the San Simeon Reef. According to Jones and Ferneau (2002a) Early, Middle, and Middle/Late Transition Period assemblages along the San Simeon Reef all have a similar suite of artifacts: Contracting-stemmed points, mortars and pestles, handstones and millingslabs, and pitted stones. Table 11.2 suggests these Early and

MiddlePeriod sites show a clear trend towards hunting, with high proportions of projectile points and bifaces. This pattern does not conform to my study sites were shellfish collecting is dominant. Spatially, however, some variations in the southern San Simeon Reef artifacts assemblages are apparent.

**MILLING EQUIPMENT**

First, although residential artifacts and dietary remains are present at all San Simeon Reef sites, milling gear along the north coast is not a large component of the overall assemblage even if excavation volume was large (Hildebrandt et al. 2002). Mortars and pestles, if present, are in very small numbers, less that one percent of the total site assemblage. The paucity of these implements suggests that small seeds, forbs, tubers, and acorns were not important to the diet along the open coast, or that mortars and pestles have a much longer use life and may be curated.

Each of the my study sites contains milling implements, however, including well formed manos, millingslabs, pestles, and bowl mortars from the Early Period sites (CA-SLO-1295, -1622, and -1677). Ground and battered stone collections at the study sites have relatively large numbers of milling artifacts: 26 percent at CA-SLO-1295, 28 percent at SLO-1622, 17 percent at SLO-1677, and 18 percent at SLO-2563. This pattern is more clearly illustrated by comparing the relative abundance of formal milling tools with that of bifaces and projectile points (Table 11.2). Although not present in as high frequencies as along the Goleta Slough on the Santa Barbara Channel (e.g., 49% at SBA-53) the proportion of milling equipment is more closely matched with Morro Bay sites (e.g., 14% at SLO-165) than with the north coast sites, which average around 3 percent (Hildebrandt et al. 2002:98). These data indicate that plant resources appear to be of greater dietary significance to occupants along the southern San Simeon Reef than to people living farther north along the open coast.

Assuming that seed-bearing plants, bulbs, and acorns were locally available in both of these environments, as they are today, the small amount of milling equipment at north coast sites is perplexing. The Early Period study sites are located in coastal prairies, with fresh water sources and riparian vegetation immediately adjacent. CA-SLO-1622 and SLO-1677 are also located at the edge of Monterey pine forests with an understory of oaks. Conversely, the north coast sites are situated in coastal prairies. This pattern may indicate that the density and diversity of plant resources in the study area was more conducive to processing vegetable materials. Mikkelsen et al. (2000) hypothesize that in estuary settings, rich sources of protein and limited carbohydrates necessitated the intensification of plant foods. This is supported by inter-regional variability in the initiation of mortar-pestle technology across the state. The first use of mortar and pestles occurs along the central coast around 5500 calBP, and at variable later times across California (Basgall 1987; Glassow 1996). Hildebrandt et al. (2002:99), following Basgall (1987:44-45), suggest differentiation in the abundance of these tools along the San Simeon Reef supports the hypothesis that labor-intensive acorn processing first occurred in places where resource imbalances were brought on by increased population size and density.

**PITTED STONES**

Another pattern is apparent in the distribution of pitted stones. Although Jones and Ferneau (2002) and Hildebrandt et al. (2002) identified pitted stones as common to the northern San Simeon Reef, the artifact type is considerably more frequent in southern San Simeon Reef sites (Table 11.4). These ubiquitous artifacts are the largest class of artifacts in the ground and battered stones collections, between 35 and 69 percent. When controlled for excavation volume, the study sites have between nine and 13 pitted stones

Table 11.4. Pitted Stone Frequencies in San Simeon Reef Sites.

| | ----Southern San Simeon Reef---- | | | | ---Northern San Simeon Reef--- | | |
|---|---|---|---|---|---|---|---|
| CA-SLO- | 1295 | 1622 | 1677 | 2563 | 265 | 267 | 273/H, 274 |
| **Density Data** | | | | | | | |
| Shellfish (kg/m$^3$) | 85.8 | 16.2 | 71.2 | 14.3 | 50.2 | 38.8 | 296.7 |
| Pitted stones (#/m$^3$) | 13.2 | 9.9 | 13.1 | 7.8 | 1.4 | 2.8 | 1.3 |
| **Significant Shellfish in Assemblage** | | | | | | | |
| California mussel | 45.9% | 8.8% | 10.5% | 1.6% | 90.5% | 84.9% | 80% |
| Black turban snail | 42.4% | 25.7% | 39.9% | 56.3% | 5.5% | 8.9% | 10% |
| Red abalone | 0.4% | 47.1% | 33.3% | 22.9% | 0.8% | - | 1.8% |

Note: CA-SLO-265 counts are Early Period component only.

per cubic meter of excavation. Conversely, sites along the north coast have only one or two pitted stones per cubic meter. Shell density in the San Simeon Reef sites does not appear to correlate with the number of pitted stones. Arroyo de los Chinos sites (CA-SLO-273/ and -274/H) have 252.7 kg of shell per cubic meter and CA-SLO-265 has 50.2 kg per cubic meter (Hildebrandt et al. 2002, 2007). Conversely the four study sites have between 14.3 (CA-SLO-2563) and 81.5 (CA-SLO-1295) kg of shell per cubic meter. The greatest distinction is in the shellfish species, with California mussel accounting for between 80 and 90 percent of the taxa in the northern sites. My study sites, in contrast, have higher proportions of black turban snail (between 25% and 56%) and red abalone (24% and 47%), and only minor amounts of California mussel (between 8% and 10%). Pitted stones seem likely to be an expedient, multi-purpose tool that related to extracting flesh from the small turban snails.

### FLAKED STONE TECHNOLOGICAL ORGANIZATION

Previous archaeological studies have documented a pattern of flaked stone technological continuity throughout the Early to Middle/Late periods along the San Simeon Reef (Jones and Ferneau 2002a). It is therefore not surprising that the study-site flaked stone tool and debitage assemblages largely mirror one another in terms of material selection and reduction strategies, but with some interesting variations. All of the assemblages are dominated by the locally available Monterey chert, with Franciscan chert, obsidian, and quartzite are present as minor contributors. Typologically, two projectile point forms are represented in the CA-SLO-1622 and SLO-1677 collections—Contracting-stemmed and Large side-notched points.

Clearly, site occupants targeted the nearby sources of Monterey chert cobbles, as reflected in the relatively high abundance of cores, cobble tools, core tools, and primary reduction debris. Cobbles were apparently collected in abundance from the nearby eroding sea terrace, within the rocky intertidal zone, or along the adjacent creek banks. The relatively small amount of Franciscan chert was apparently transported to the sites as later-stage tool forms, while the rare obsidian artifacts likely reflect the resharpening of valued and curated tools.

Projectile points are often manufactured of the higher quality Franciscan chert (i.e., 83% at CA-SLO-1622 and 50% at SLO-1677), while expedient flake tools are frequently made of Monterey chert. Imported tools brought from the interior apparently were discarded and replaced with ones of local material. Compared to other tool classes bifaces are rather uncommon in the collection; late stage bifaces are rare. Those in the assemblage are early-stage preforms with discard due primarily to manufacture and material flaws. The lack of bifaces conflicts with the debitage profile, which indicates that late-stage pressure and edge-working were dominant, along with core reduction. This pattern suggests that bifaces were initially manufactured on-site from local Monterey chert beach cobbles, and finished/maintained for use off site, where they were discarded.

In the flaked stone assemblages from CA-SLO-1622 and SLO-1677, cores and core tools both outnumber bifaces by approximately two to one. This pattern has been noted at quarry/lithic workshops to the north of the San Simeon Reef and viewed as the byproduct of the initial reduction of cobbles to produce relatively homogenous material for transport, with a limited range of resource processing on-site (Hildebrandt et al. 2007).

Also of interest is the large number of pressure flakes relative to the low amount of bifacial thinning flakes and finished bifaces. The lack of biface thinning flakes may be in part due to their greater length-to-thickness ratio, making them the most susceptible to fracture during manufacture and post-depositional events, leading to their exclusion from analysis. Simple flake and core tools together possess many of the same functional traits as more costly bifaces. Given the low risk associated with tool failure—i.e., they were easily replaced—it is not surprising that the bulk of tools recovered are simple and expedient. The abundance of late-stage bifacial tool debitage suggests that more refined tools were produced on site and taken away when the site inhabitants moved on.

## Subsistence and Littoral Ecology

The four study sites produced faunal assemblages with a variety of shellfish, marine fish, sea and terrestrial mammal, reptile, and bird remains. Data collected from these subsistence remains provide an opportunity to investigate temporal and spatial patterns in the use of various food resources in local environments. When combined with data from Late Period sites CA-SLO-71 and SLO-115 faunal collections, located nearby on the same marine terrace, long-term patterns in subsistence change may be considered.

In the following section, data on the distribution and abundance of various animal taxa at each site is first summarized to set the foundation for further discussions of subsistence change. Based on the high density of shellfish and the greater number of identifiable fish bones compared to other faunal categories, a focus will be on these classes. I then consider each of the major dietary categories, using overall densities of faunal remains by NISP, MNI, and weight to examine changes in the specific taxa identified in each sample. Finally, I will integrate these data into a picture of dietary change through 5000 years of Native American occupation along the southern San Simeon Reef.

Between 31 and 87 shellfish, fish, mammals, bird, and reptile taxa were identified at the six sites, including my four current study sites and two Late Period sites I studied previously (Table 11.5). Although in many regions there

Table 11.5. Taxonomic Richness in Southern San Simeon Reef Sites.

| SLO- | Age calBP | Shellfish | Fish | Terrestrial Mammal | Marine Mammal[1] | Bird[1] | Reptile | Total |
|---|---|---|---|---|---|---|---|---|
| 1295 | 5190-2860 | 40 | 9 | 3 | 2 | 2 | 1 | 57 |
| 1622 | 4660-3760 | 37 | 11 | 2 | 1 | 3 | 1 | 55 |
| 1677 | 4910-3640 | 44 | 16 | 3 | 3 | 3 | 3 | 72 |
| 2563 | 920-690 | 27 | 19 | 1 | 1 | 3 | 1 | 52 |
| 115 | 670-470 | 21 | 5 | 1 | 1 | 1 | 2 | 31 |
| 71 | 610-480 | 45 | 24 | 6 | 5 | 3 | 4 | 87 |

Note: [1]Counts for SLO-1295, 1622, 1677, 2563 are identified taxa, size class only; Sample sizes: SLO-1296 (2.11m$^3$), SLO-1622 (0.81 m$^3$), SLO-1677 (1.62 m$^3$), SLO-2563 (1.36 m$^3$), SLO-115 (1.05 m$^3$), SLO-71 (1.27 m$^3$).

is a general trend towards increasingly rich faunal assemblages throughout the Holocene, it is difficult to identify such a pattern with the current data. Even with a small sample size, it is clear that CA-SLO-71 has a rich faunal assemblage with a wide diet breadth. A variety of factors influence the density, abundance, and richness of faunal remains and artifacts in archaeological sites (Grayson 1984; Schiffer 1987), but one of the most important is sample size. Several studies along the central California Coast and on the northern Channel Islands have used these types of data to document changes in human subsistence (Glassow 1996; Jones 2003; Jones and Ferneau 2002a; Braje 2007; Erlandson et al. 2005; Rick 2007; Rick et al. 2008) and human impacts on local environments (Jones et al. 2008c).

### Dietary Reconstruction

The dietary contribution of various fauna classes was estimated by quantifying bone and shell weights and converting them to meat weight values for each major category of faunal remains (Table 11.6). This approach to dietary reconstruction is used in conjunction with NISP frequencies, as the high fragmentation of terrestrial and marine mammal remains produced low NISP and MNI values. The estimates are not intended to reflect the diet in absolute terms, just the relative importance of faunal categories. The data for the dietary analysis come from all excavation units and the column samples.

Table 11.6. Percentages of Dietary Contribution Based on Meat and Bone/Shell Weight.

| Site | Shellfish Meat | Shellfish Shell | Fish Meat | Fish Bone | Terrestrial Mammal Meat | Terrestrial Mammal Bone | Marine Mammal Meat | Marine Mammal Bone |
|---|---|---|---|---|---|---|---|---|
| **Early Period** | | | | | | | | |
| SLO-1295 | 99 | 99 | 0.1 | 0 | 0.98 | 0 | 0.2 | 0 |
| SLO-1622 | 96 | 99 | 1.1 | 0.2 | 2.6 | 0.8 | 0.3 | 0.1 |
| SLO-1677 | 96 | 99 | 1.1 | 0.4 | 3 | 0.2 | 0.3 | 0 |
| **Middle/Late** | | | | | | | | |
| SLO-2563 | 94 | 99 | 6 | 0.2 | 0.3 | 0.04 | 0.7 | 0.2 |
| **Late Period** | | | | | | | | |
| SLO-115 | 9 | 80 | 32 | 7 | 8 | 10 | 3 | 0.9 |
| SLO-71 | 8 | 78 | 47 | 10 | 9 | 8 | 35 | 3 |

## SHELLFISH

Marine invertebrates are the most abundant faunal material recovered in all the excavated middens. The estimated meat weight percentages presented in Table 11. 6 reveal that at all four study sites the greatest proportions of animal protein to the diet was contributed by shellfish. Variation in the importance of the shellfish species is apparent (Table 11.7) and shows distinct patterns in individual shellfish taxa. All sites have

Table 11.7. Most Abundant Shellfish as Percent of Total Shell Weight.

| Site and Age | Black turban | California mussel | Red abalone | Red turban | Chiton | Crab |
|---|---|---|---|---|---|---|
| **Early Period** | | | | | | |
| SLO-1295 | 42.4 | 45.9 | 0.4 | 0.8 | 3.3 | 1.8 |
| SLO-1622 | 25.7 | 8.8 | 47.1 | 5.5 | 4.8 | 1.0 |
| SLO-1677 | 39.9 | 10.5 | 33.3 | 6.0 | 3.7 | 1.3 |
| **Middle/Late** | | | | | | |
| SLO-2563 | 56.3 | 1.6 | 22.9 | 1.5 | 5.7 | 1.8 |
| **Late Period** | | | | | | |
| SLO-115 | 38.8 | 16.9 | - | - | 8.6 | 2.8 |
| SLO-71 | 47.0 | 7.7 | 4.7 | 0.5 | 8.4 | 7.9 |

Note: Shell sample is based on column sample weight in grams and includes all major common dietary contributors.

relatively high proportions of the small black turban snail; an interesting trend that will be further considered later in this chapter. California mussel, an important dietary contributor in central coast sites, is only significant at CA-SLO-1295 and otherwise of minor importance, between only 2 and 11 percent.

**MARINE FISH**

Although the meat and bone weights suggest minor contributions from fish, the percentages suggest a very late increase in fishing in intertidal and nearshore waters. Data from Early Period sites shows only about one percent of the meat diet is from marine fish, increasing to six percent during the Middle/Late Transition, and by the Late Period increasing again to between 32 and 47 percent. This is a consistent pattern across California, including the Vandenberg region to the south, although there have been few data to support this along the northern coast of San Luis Obispo. Because their vertebrae or centra are well preserved, numbers of identifiable fish bone are larger than is the case with other vertebrate faunal categories. As a result, a greater number of fish species could be identified, resulting in a clearer picture of the development of fishing technologies over time. The increasing reliance on marine fish will be discussed in greater detail and placed in a regional context later in this chapter.

### LAND AND MARINE MAMMALS

Meat and bone weight densities as well as NISP suggest that both land and marine mammals are of relatively low importance to the overall diet for all the study sites except CA-SLO-71 (Table 11.6, 11.8). This may be a consequence of the small sample sizes at the sites; moreover, when the bones of land and marine mammals are recovered, they are highly fragmented, making taxonomic identification to genus or species impossible. Terrestrial mammals appear to be less than one percent of the overall diet at the four earlier study sites, with a maximum at CA-SLO-1622 with 2.6 percent. The two Late Period sites, however, do suggest a greater emphasis on terrestrial game, around 8 to 9 percent. The numbers of marine mammals are in even lower frequencies, with all of the sites at less than one percent. In Table 11.8 land and marine mammal bone was placed into general categories along with deer and rabbits, species common to most sites. Medium terrestrial mammals have the highest frequencies at all sites. At Early Period sites the percentages of all bone categories are higher than at any of the later site components, and large land mammal, likely reflecting deer, have the highest percentages. Deer are common in small numbers throughout the course of occupation of the San Simeon Reef, occurring in counts almost equal with rabbits by the Late Period. At no point do sea mammals overshadow land mammals; however, they do increase in numbers at Late Period site CA-SLO-71, i.e., 35% of meat yield. These data are largely consistent with those produced by Jones and Ferneau (2002a), who found minimal use of marine mammals during the Early Period but a steady increase over time. A much larger sample would be necessary for a greater degree of confidence in evaluating the significance of terrestrial and marine mammals in the diet.

Table 11.8. Terrestrial and Marine Mammal and Bird Remains Based on NISP.

| | ------- Early Period ------- | | | Middle/ Late | ----- Late ----- | | |
|---|---|---|---|---|---|---|---|
| | SLO-1295 | SLO-1622 | SLO-1677 | SLO-2563 | SLO-71 | SLO-115 | Total |
| **Terrestrial Mammals** | | | | | | | |
| Brush rabbit | 6 | 5 | 1 | 0 | 13 | 1 | 26 |
| Deer | 11 | 5 | 6 | 0 | 10 | 0 | 32 |
| Large mammal | 98 | 357 | 420 | 1 | 120 | 2 | 998 |
| Medium mammal | 123 | 156 | 1,418 | 22 | 736 | 55 | 2,510 |
| Small mammal | 14 | 125 | 96 | 1 | 58 | 7 | 301 |
| **Marine Mammals** | | | | | | | |
| Large | 3 | 0 | 2 | 0 | 15 | 0 | 20 |
| Medium | 5 | 15 | 5 | 3 | 11 | 0 | 39 |
| **Birds** | 12 | 30 | 48 | 7 | 100 | 7 | 204 |
| TOTAL | 272 | 693 | 1,996 | 34 | 1,063 | 72 | 4,130 |

### BIRDS

The remains of small, medium, and large birds were found in small numbers throughout the study sites. Again, the small delicate bones of birds fragment easily and made it difficult to classify beyond the general categories. Their minor bone and meat weights suggest birds were not an important element in the diet of site occupants, consistently less than one percent of all collections. Bird bone does have a noticeable presence during the Late Period, their numbers increasing to twice the highest Early Period numbers and accounting for 43 percent of the non-fish collection at CA-SLO-71.

### PLANTS

As discussed earlier in this chapter, the importance of plants is reflected in the higher than anticipated numbers of milling equipment. The presence of milling slabs, handstones, and manos associated with processing hard seeds from grasses and annuals, and mortars and pestles presumably associated with milling acorns suggest plant foods contributed significantly to the diet. All of the study sites are situated in plant-rich coastal prairies, with riparian vegetation and immediately adjacent freshwater sources. Monterey Pine forests and oaks are located near the two sites in the UC Reserve, so access to acorns and pine nuts was within minimal walking distance. Based on the ground stone assemblage, the collection of seeds and consumption of food products were important subsistence activities at these sites beginning about 5000 calBP. However, there is no way to determine how important these plant foods were in comparison to shellfish and mammals, particularly with the lack of discrete cultural features containing quantities of plant macrofossils.

### SUBSISTENCE CHANGE

The patterns in faunal remains described above when combined with comparative ratio and density data, reveal several interesting changes over time in the use of subsistence resources by site inhabitants (Table 11.9). To understand long-term dietary changes between the Middle and Late Holocene, it is important to set the context for understanding the Early

Table 11.9. Bone and Shell Densities from Study Sites.

| | --------Early Period-------- | | | Middle/Late Transition | ----Late Period---- | |
|---|---|---|---|---|---|---|
| FAUNAL CLASS | SLO-1295 | SLO-1622 | SLO-1677 | SLO-2563 | SLO-115 | SLO-71 |
| **Density per cubic meter** | | | | | | |
| Shellfish (g) | 85,823 | 16,231 | 71,232 | 14,253 | 927 | 15,579 |
| Terrestrial mammal (NISP/g) | 170/33 | 3,641/144 | 1,936/103 | 54/7 | 1/124 | 22/750 |
| Marine mammal (NISP) | 4.2 | 18 | 30 | 3.9 | 4.8 | 38 |
| Bird (NISP) | 6.3 | 37 | 27 | 9 | 6 | 79 |
| Fish (NISP/g) | 60 /3 | 995/22 | 1,009/29 | 778/30 | 319/6 | 7,101/152 |
| **Comparative Data** | | | | | | |
| Fish: Shellfish (g) | 1:28,607 | 1:738 | 1:2,499 | 1:475 | 1:102.4 | 1:167.7 |
| Fish: Mammal (g) | 1:11 | 1:6.7 | 1:3.8 | 2.7:1 | 1.09:1 | 1.47:1 |
| Fish: Terrestrial mammal (NISP) | 1:2.8 | 1:3.7 | 1:1.9 | 14:1 | 10.8:1 | 4.4:1 |
| Tegula: Abalone (g) | 96:1 | 1:1.8 | 1.2:1 | 2.4:1 | - | 10:1 |
| Tegula: Mussel (g) | 1.1:1 | 2.9:1 | 3.8:1 | 36:1 | 2.3:1 | 6.1:1 |

Note: Terrestrial bone includes unidentified class size and identified species; g – gram; NISP – number of identified specimens.

Holocene adaptations along the southern San Simeon Reef. Dating to between about 9700 and 8600 cal BP, two Lodge Hill sites (CA-SLO-177 and SLO-369) have the only evidence for Early Holocene occupation in the study area. Based on a review of excavation reports with a wide range of sampling strategies, site occupants appear to have had a dietary focus typical of Millingstone populations—small seeds and shellfish (Erlandson 1991, 1994). At CA-SLO-369, rocky intertidal shellfish (dominated by mussel, tegula, and barnacle), medium and large terrestrial mammals, and marine birds were the primary dietary contributors (Parker 2004). Although the importance of seed collecting and milling cannot be determined on the basis of currently available data, these activities were clearly occurring on site, as indicated by the large numbers of well-shaped manos recovered.

Occupation along the north coast of San Luis Obispo between 5500 and around 700 calBP is associated with a relatively uniform subsistence organization marked by a slight increase in the use of marine resources from the Early Period through the Middle/Late Transition (Jones and Ferneau 2002a). However, as the sample of excavated sites increases, spatial and temporal variations in marine and territorial resources are becoming apparent.

Previous investigations at Early Period (5500–3000 calBP) sites revealed an increase in the dietary importance of mammals and fish relative to shellfish. Although more intensive use of plant resources is reflected by the introduction of mortar and pestle technology, along the northern San Simeon Reef milling equipment is not abundant in excavated deposits.

Shellfish was the dominant subsistence activity collecting at the Early Period study sites (CA-SLO-1295, -1622, -1677), accounting for about 96 to 99 percent of the meat and shell weight (Table 11.6). The same three species, black turban snail, red abalone, and California mussel, dominate the shellfish assemblages, although the proportions vary from site to site (Table 11.7). This is not particularly surprising at the red abalone middens, but the densest shell is at CA-SLO-1295, a midden composed primarily of California mussel and black turban snail (85.8 $kg/m^3$).

By comparison, hunting game and birds, along with fishing, contributed minor amounts of protein to the diet, at least in the portions of the sites I excavated. Hunting terrestrial game appears to have focused on deer and rabbit, and marine mammals are nearly absent from the study sites, with only four to 30 unidentifiable fragments per cubic meter (Table 11.9). Projectile points at CA-SLO-1622 and SLO-1677 and the presence of large and medium mammals indicate that hunting was practiced. However, the very small numbers of land and marine mammal bones and projectile points at CA-SLO-1295 is intriguing, particularly when compared to contemporaneous sites that have very large numbers of points (Table 11.2).

Explanations for the absence of points may be a product of the spatial contexts of gender specific tasks. Cross-culturally (Jochim 1988) and in California (Glassow 1996:130; Jones 1996; Walker and Erlandson 1986) male and female hunter and gathers participated in significantly different subsistence-settlement systems, although overlapping to some degree while at residential sites. The large quantities of shellfish and ground and battered stone and the paucity of terrestrial and marine mammal bones at CA-SLO-1295 may reflect the longer periods of time men spent at hunting camps rather than at residential sites. Women and children, being more sedentary, would have focused subsistence activities on intertidal resources, shellfish and fish from tide pools, and plant remains. Although the importance of plants cannot be determined based on current data, it is clear that seeds, nuts, tubers, and acorns were a subsistence focus, complementing the marine resource protein.

Marine fish remains are present in small quantities at CA-SLO-1622 and –1677 and are almost absent from CA-SLO-1295, the earliest occupied study site (5190-2860 calBP). An analysis of the ratio of fishbone counts to shellfish weights is revealing (Table 11.9). As expected, frequencies of fish remains are very low at CA-SLO-1295 (60 elements/$m^3$), but do increase in importance at CA-SLO-1622 and -1677 (995 and 1,009 elements/$m^3$). However, the importance of fish remains low, especially when compared to

Early Period components of the northern San Simeon Reef at Arroyo de los Chinos (CA-SLO-273/274H), where fish bones are present in large quantities, approximately 9,720 elements per cubic meter (Hildebrandt et al. 2002).

The current research did not identify a Middle Period (3000–1000 calBP) occupation along the southern San Simeon Reef, and there is a paucity of sites that date to this interval in the Cambria area, making comparisons difficult. Therefore, a brief overview of findings from Middle Period deposits to the north is provided. These sites reveal continuity with the Early Period, but Jones and Ferneau (2002a:194) suggested that an increase in the use of marine resources occurred, specifically mussel (81.9%) and fish (15.1%), which is indicative of a limited amount of subsistence intensification. Based on bone densities at the Piedras Blancas site (CA-SLO-267), a deposit that spans the Middle Period, MNI calculations suggest marine fish were a significant proportion of the diet. Mammal and bird remains are dominated by terrestrial species, which constitute 88.3 percent of the assemblage, while marine mammals and birds are represented by only a minor number of bones.

After the end of the Middle Period and into the Middle/Late Transition (1000–700 calBP), the focus on marine resources continues. The CA-SLO-2563 faunal assemblage suggests a relatively balanced economy in which fish from rocky intertidal, nearshore, and kelp forest habitats and shellfish from the rocky substrates composed most of the diet. Black turban snail (56%) and red abalone (23%) dominate the shell assemblage, with California mussel of minor importance (1.6%). As expected, fishing increases after the Early Period, indicated by a decline in the abundance of shellfish relative to fish remains and an increase in the abundance of fish relative to mammal bone, particularly terrestrial mammal (Table 11.9). Along the northern portion of the San Simeon Reef at Arroyo de los Chinos, the Middle/Late Transition component at CA-SLO-273/H contains evidence of a decrease in the importance of shellfish from the Early Period, (Hildebrandt et al. 2002:99). The reduction in shellfish dependence coincides with a marked increase in the importance of fish, especially inshore/offshore migrators such as anchovies and sardines.

Hunting terrestrial game and sea mammals does not appear to be an important contribution to the overall diet. The small quantities of deer bone are a characteristic also observed at Late Period site CA-SLO-71 and Middle/Late Transition Coon Creek (CA-SLO-9) to the south. This stands in contrast to the Middle to Middle/Late Transition Piedras Blancas site (CA-SLO-267), where terrestrial mammal bones comprise 86 percent of the collection and marine mammal bones comprise 12 percent (Jones and Ferneau 2002a:164). The minimal importance of deer is a product of drought-affected terrestrial environments, which forced foragers to shift to more on diversified or broad-spectrum subsistence practices that included small terrestrial prey and marine resources (Codding et al. 2009; Joslin 2006). These trends are consistent with data from CA-SLO-179 (Pico Creek Site), which shows a decrease in the importance of deer and a general pattern of intensified use of marine fish, coinciding with a rise in the frequency of shore birds and sea otters (Jones and Ferneau 2002a:219). At Arroyo de los Chinos, consistent with data from other Middle and Middle/Late Transition sites, terrestrial mammals were more important than marine mammals, with slightly more dependence on deer than rabbits (Hildebrandt et al. 2002:99).

Subsistence during the Late Period (700 calBP – Spanish contact) departs in significant ways from earlier time intervals. Changes in proportional dependence of different categories of food resources appear to occur at the onset of the Late Period. Most dramatic, fishing became significantly more important. Fish bone densities increase from 60 elements per cubic meter at the earliest occupied study site (CA-SLO-1295) to 7,100 elements per cubic meter at CA-SLO-71. Data from the Late Period locus at Piedras Blancas (CA-SLO-267) reflects the same dramatic transition from earlier times, with an increase in the importance of rocky intertidal fish (Bouey and Basgall 1991:116). A wide range of fish from a variety of habitats appears to be one of the primary subsistence foci at many San Simeon Creek sites (Gibson 1979a, 1992a; Hines 1986). To the south in the Vandenberg region, Late Period sites also show an increase in the importance of nearshore fish (Glassow 1996:135). At CA-SLO-71 and -115 this trend coincides with a decrease in the importance of shellfish relative to other foods.

Also noticeable is the striking shift to more intensive use of marine mammals, which may be related to site locations near the rocky off-shore haulouts. A much larger sample would be necessary for a greater degree of confidence in evaluating the significance of terrestrial and marine mammals in the diet.

It appears that the subsistence trajectories set in motion during the Middle and Middle/Late Transition continued through time. The expansion of overall diet breadth from the Middle and Middle/Late Transition periods to the Late Period is evident in the relative importance of faunal categories (Table 11.9). This trajectory entails an increase in the importance of food sources that appear minor during earlier times, such as bird and reptiles; these animals become noticeably more important during the Late Period. For example, at CA-SLO-71 identified bird remains include shore birds, a red-throated loon and a cormorant, and a relatively high proportion of bird bones in the total assemblage, suggesting that these marine-oriented birds may have been targeted. Diachronic changes in faunal classes as well as species composition support models of resource intensification and signal important changes in social organization.

## Middle to Late Holocene Southern San Simeon Reef California Mussel and Red Abalone Shell Lengths

At each of the study sites measurements of California mussel shell and red abalone shells were collected to compare the size distribution of the shells with other archaeological samples and living populations. The shells of California mussel and red abalone were chosen as indices of human predation because they are highly ranked resources relatively common in San Simeon Reef middens and allow for inter-site comparisons. Because they were harvested during all periods of occupation along the San Simeon Reef, it is possible to measure size changes through time. Although shellfish growth rates are influenced by a number of ecological factors such as wave action, upwelling, water temperatures, disease, predators (e.g., otters and sea stars), the mean size of many shellfish is also reduced by intensive human harvesting. Intertidal shellfish are particularly vulnerable to impacts from prehistoric collectors because they are sessile, located in predictable habitats, and require little technology to harvest (Erlandson et al. 2008).

### California Mussels

California mussels are typically the most abundant rocky open coast species in shellfish assemblages in California and as a result have received much attention regarding their significance in the prehistoric diet (e.g., Bettinger et al. 1997; Erlandson et al. 2008; Jones 1996; Jones and Richman 1995; Whitaker 2008a, 2008b).

Using White's (1989) shell template 4,892 shell measurements were acquired from study site collections and 231 from two Late Period sites (Joslin 2006). The mean mussel shell sizes are relatively low throughout the temporal sequence, with averages ranging between 2.5 and 3.3 cm, with no general decline from the Middle to Late Holocene (Table 11.10; Figure 11.2). At all of the study sites, shell size measurements have highest frequencies between 1 and 4 cm long (95%). There is not decline in mussel shell size over the course of site occupations, instead mussel sizes appear to remain small with some larger measurements that oscillate randomly. Only Early Period sites CA-SLO-1295 and SLO–1677 have measurements of over 7 cm. Based on the available data, there is a slight increase in average mussel size during the Late Period, although the sample size from these sites is small. The data suggests that sites occupants were harvesting relatively small mussels of similar size throughout the past 5000 years of occupation along the southern San Simeon Reef. The small size suggests sustained and intensive harvesting or natural regional variations in water temperature, marine productivity, or other natural cycles.

Table 11.10. California Mussel Size Data from Six Southern San Simeon Reef Sites.

| | --------Early Period------ | | | Middle/ Late | Late Period | | |
|---|---|---|---|---|---|---|---|
| Size Class (cm) | SLO-1295 | SLO-1622 | SLO-1677 | SLO-2563 | SLO-115 | SLO-71 | Total |
| 0-2 | 1,365 | 1 | 207 | 2 | 6 | 49 | 1,630 |
| 2-3 | 1,602 | 1 | 257 | 4 | 8 | 52 | 1,924 |
| 3-4 | 907 | 1 | 234 | 2 | - | 76 | 1,220 |
| 4-5 | 109 | - | 94 | 1 | - | 35 | 239 |
| 5-6 | 26 | - | 36 | 1 | - | 4 | 67 |
| 6-7 | 10 | - | 11 | - | - | 2 | 23 |
| 7-8 | 3 | - | 10 | - | - | - | 13 |
| 8-9 | 3 | - | 4 | - | - | - | 7 |
| 9-10 | - | - | 1 | - | - | - | 1 |
| TOTAL | 4,025 | 3 | 854 | 10 | 13 | 218 | 5,123 |
| Mean size | 2.5 | 2.5 | 3 | 3 | 2.6 | 3.3 | |

Note-Mean is based on midpoint in mussel class size.

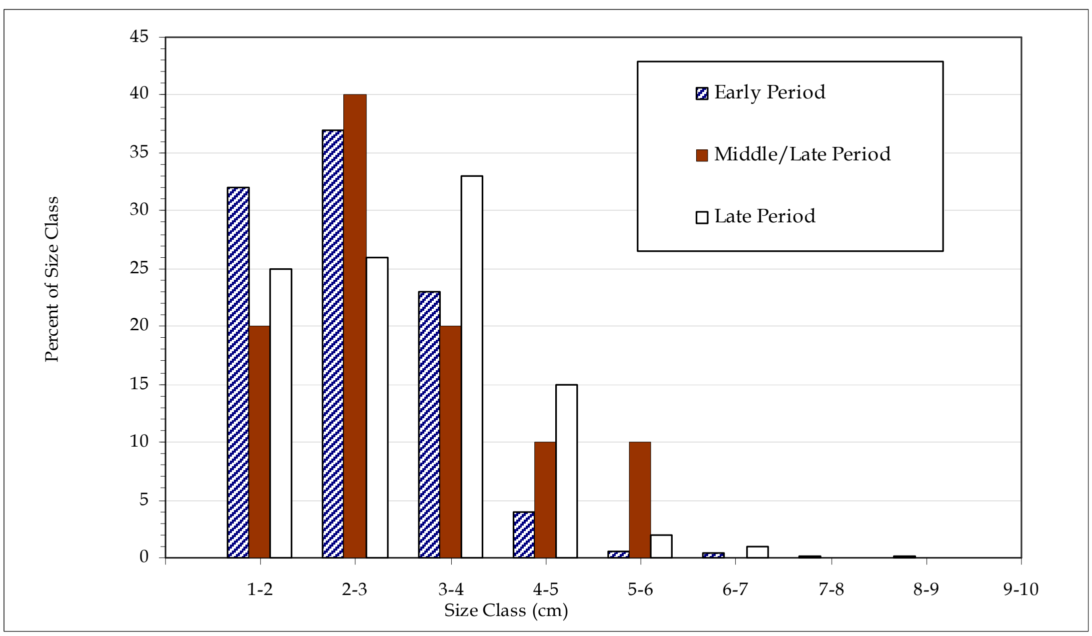


Figure 11.2. California Mussel Length Frequencies from Six Southern San Simeon Reef Early, Middle/Late Transition, and Late Period Sites.

## RED ABALONE

Measurements from 306 complete or nearly complete red abalone shells were also collected from the site deposits to compare with modern shell sizes and archaeological specimens from sites along the San Simeon Reef. Shell size was determined by measuring the maximum shell length to gauge the nature of human impact on this important resource.

Red abalone is the largest of California's marine snails, reaching lengths of around 8 to 9 cm in six years and may grow as large as 30 cm. When accessible in the intertidal zone the species provides a significant protein contribution to the diet. Although the species prefers cooler subtidal habitats, red abalones can be found in the intertidal zone where sea surface temperatures are cooler and may have been more accessible during cool sea surface temperature intervals over the Holocene. Compared with other shellfish species, the slow growth patterns of the red abalone make them more susceptible to impacts from human and sea otter predation, as it takes several years for them to attain maximum size (Bouey and Basgall 1991; Erlandson et al. 2008). Environmental variables, particularly intervals of warm and cool sea surface temperatures, affecting species abundance may also account for conditions under which abalone abundance, growth rates, and mean size should decline or increase.

A total of 306 red abalone shells was measured, 274 from the three Early Period deposits and 32 for the Middle/Late Transition deposit (Table 11.11, Figure 11.3). Only five shells were recovered from CA-SLO-71, a sample used with reservation. It is expected that red abalone would largest size when human populations first collected them. The patterns that emerge from this analysis conform to the general expectations of optimal foraging principles. However, other trends in the data are less predictable and require additional ecological information.

Data from the Middle Holocene red abalone middens, CA-SLO-1677 (4910–3640 calBP) and CA-SLO-1622 (4660–3760 calBP), show that occupants were harvesting relatively large abalones. At CA-SLO-1677 over 60 percent of the measured shells are large adults over 10 cm, with the mean shell length of 11.6 cm. The highest class frequencies are between 8 and 18 cm, accounting for 71 percent of the abalones. Almost all of the shells appear in the initial occupation of the site, around 5000 calBP, with 95 percent of the abalones within the 50 to 100 cm levels. CA-SLO-1622 has a similar pattern, with a slightly lower mean of 9.8. At both sites, the shell length data also suggests the largest red abalone shells were recovered during the earliest site occupation. Measurements from these deposits suggest that people were collecting larger red abalone shells from shellfish beds that had not been heavily preyed on by humans or sea otters (*Enhydra lutris)*.

Table 11.11. Red Abalone Lengths and Frequencies from Study Sites.

| | Early | | | | | | Middle/Late | | Late | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SLO-1295 | | SLO-1622 | | SLO-1677 | | SLO-2563 | | SLO-71 | |
| Size (cm) | No. | % | No. | % | No. | % | No. | % | No. | % |
| 0-2 | 3 | 12 | 0 | - | 3 | 1 | 1 | 3 | 0 | - |
| 2-3 | 8 | 32 | 0 | - | 2 | <1 | 2 | 6 | 0 | - |
| 3-4 | 4 | 16 | 2 | 6 | 2 | <1 | 3 | 9 | 0 | - |
| 4-5 | 3 | 12 | 3 | 9 | 7 | 2 | 1 | 3 | 0 | - |
| 5-6 | 2 | 8 | 1 | 3 | 10 | 5 | 1 | 3 | 0 | - |
| 6-7 | 3 | 12 | 3 | 9 | 17 | 8 | 2 | 6 | 0 | - |
| 7-8 | 1 | 4 | 3 | 9 | 10 | 5 | 4 | 13 | 2 | 40 |
| 8-9 | 0 | - | 2 | 6 | 17 | 8 | 2 | 6 | 1 | 20 |
| 9-10 | 0 | - | 3 | 9 | 13 | 6 | 4 | 13 | 2 | 40 |
| 10-11 | 1 | 4 | 2 | 6 | 14 | 6 | 8 | 25 | - | - |
| 11-12 | - | - | 4 | 13 | 19 | 9 | 1 | 3 | - | - |
| 12-13 | - | - | 0 | - | 14 | 6 | 1 | 3 | - | - |
| 13-14 | - | - | 4 | 13 | 19 | 9 | 2 | 6 | - | - |
| 14-15 | - | - | 2 | 6 | 13 | 6 | - | - | - | - |
| 15-16 | - | - | 0 | - | 20 | 9 | - | - | - | - |
| 16-17 | - | - | 2 | 6 | 14 | 6 | - | - | - | - |
| 17-18 | - | - | 1 | 3 | 14 | 6 | - | - | - | - |
| 18-19 | - | - | - | - | 1 | <1 | - | - | - | - |
| 19-20 | - | - | - | - | 2 | <1 | - | - | - | - |
| 20-21 | - | - | - | - | 4 | 2 | - | - | - | - |
| 21-22 | - | - | - | - | 2 | <1 | - | - | - | - |
| TOTAL | 25 | | 32 | | 217 | | 32 | | 5 | |
| Mean | 4.0 | | 9.8 | | 11.6 | | 8.1 | | 8.5 | |

Note-Mean is based on midpoint in abalone class size; No red abalones were recovered from SLO-115.

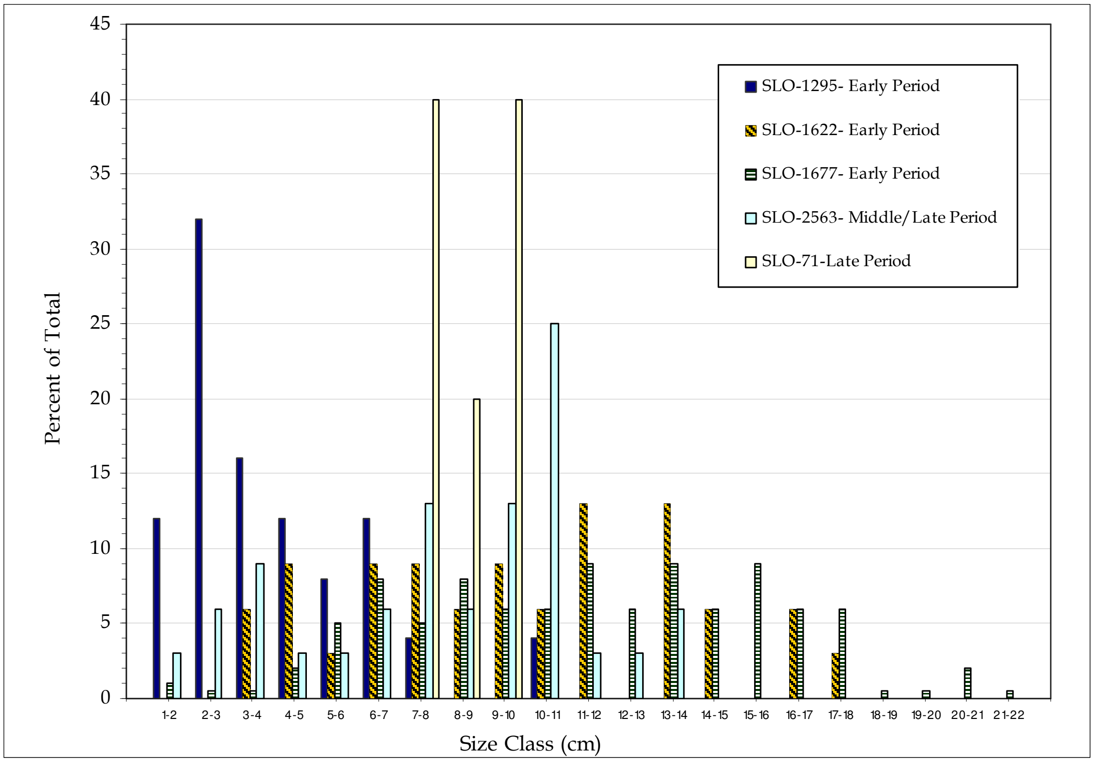


Figure 11.3. Red Abalone Frequencies from Southern San Simeon Reef Early, Middle/Late Transition, and Late Period Sites.

Most surprising are the results from the earliest occupation at CA-SLO-1295 (5190-2860 calBP). Red abalone lengths from the site ranged from 2 to 11 cm throughout the deposit, an average shell of only about 4 cm. The majority of abalone shells (92%) are small, between only 1 to 7 cm. The lengths reported by Jones and Ferneau (2002a:189) at Middle Period site CA-SLO-276 also show high frequencies of small individuals, which the authors attribute to increased human exploitation of abalone populations. These data suggest that earlier foragers previously over-harvested red abalone and that they never recovered, or that large marine predators (e.g., cabezon who feed on young individuals) or sea otters, unchecked by low human hunting, depressed the population.

Red abalone lengths from Middle/Late Transition CA-SLO-2563 (920 – 690 calBP) ranged from 2 to 14 cm, with an average of approximately 8.1 cm. The size class with the highest frequency is 10-11 cm, which includes 25 percent of the red abalones. Although the mean abalone size decreased from the time of red abalone middens, lengths are twice the size compared to those from the adjacent CA-SLO-1295. One explanation for this pattern is that greater upwelling and decreased sea water temperatures occurred between 1000 and 700 BP (Kennett 2005; Kennett and Kennett 2000). These conditions would have encouraged red abalone to occupy locations in the mid to upper intertidal in greater numbers, and therefore they would have been more accessible to foragers. Two other Middle/Late Transition deposits, CA-SLO-267, in northern San Simeon Reef area, and CA-SLO-9, south of Morro Bay, have the similar size profiles, with mean shell sizes between 8 and 10 cm.

At Late Period site CA-SLO-71, (610−480 calBP) the small sample ranges in size between 7 and 10 cm, with a mean shell length of 8.5 cm. When the Late Period abalone profile is compared to that of Early Period CA-SLO-1677, a site in the same environment and only 600 m northwest, the results are particularly striking. Both the small size of the red abalone and the low frequencies in the CA-SLO-71 deposit suggest that harvesting of this high-ranking but slow-growing species declined over time. Although the reduction in abalone size may be the result of prehistoric human harvesting, other factors such as predation by sea otters (bones of which also appear in the CA-SLO-71 site deposit and not in the other five sites) should not be discounted. Ecological observations suggest that dense aggregations of large red abalones are unlikely where substantial numbers of sea otters are found (Erlandson et al. 2005; 2008).

To further explore red abalone collecting practices along San Simeon Reef, archaeological data is compared to modern red abalone populations from Hopkins Marine Life Refuge where sea otters are present but human harvesting is prohibited (Figure 11.4, Hines and Pearse 1982; Codding et al. 2009). The Hines and Pearse (1982) samples include live red abalone populations not subjected to human or otter overharvesting (referred to as "live") and a second that represents empty shells of abalone that were consumed by sea otters. Their research revealed that within the location where sea otters lived, live abalones and empty abalone shells resulting primarily from predation by sea otters averaged 7.5 and 9 cm in length, respectively. Conversely, locations outside the range of sea otters, live abalones were over twice as large (i.e., averaging 18 cm) and were numerous outside crevices, when protected from human predation (Hines and Pearse 1982:1547, 1555). This is consistent with historic ecological data that demonstrates as sea otter populations expanded their range, red abalone populations that are abundant and accessible to human foragers are also unlikely to coexist with otter populations (Erlandson et al. 2008; McLean 1962)

When compared with the simulated live abalone population, shells from the red abalone midden sites are similar to the live population with a slightly smaller shell size class, but have a higher percent of larger shells over 18 cm (Figure 11.4). The comparison between the sea otter-predated shells and the archaeological samples shows the red abalone midden sizes are larger than the sizes preyed upon by otters. These data suggest that during the Early Period populations were collecting abundant and large abalones in habitats where sea otters populations were locally depressed, perhaps by hunters, or

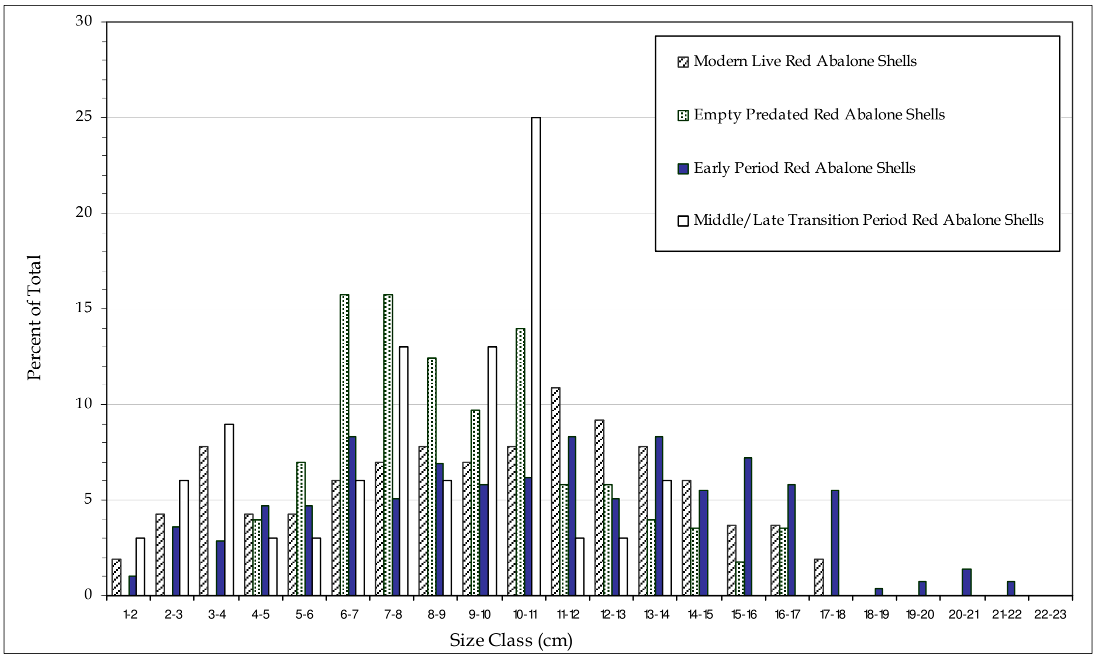


Figure 11.4 Red Abalone Size Frequency Data from Southern San Simeon Reef Early and Middle/Late Transition Sites Compared with Modern Populations (Hines and Pearse 1982: 1551, Figure 3). Note: Modern live shell and empty predated (presumably eaten by sea otters) shell data from Hopkins Marine Life Refuge (1973-1981).

the harvesting strategy, supported by low human populations and settlement mobility, was selective enough to limit economic intensification on abalones.

The Middle/Late Transition data show all of the size measurements between 1 and 11 cm are higher than live red abalone populations, and then the shell class size drop significantly. The depression of larger sized red abalone during the Middle/Late Transition, suggests possible unsustainable, intensive collecting by human harvesters. The Middle/Late Transition data show a dramatic increase in shell size frequency (between 9 and 11 cm) while the sea otter predated red abalone shells decreases in frequency. There is, however, a marked decrease in archaeological derived size measurements over 14 cm suggesting that sea otters may have been competing with local human harvesters.

The red abalone data demonstrate a decline in shell size and frequency from the Middle to Late Holocene (Figure 11.5). Over the course of this 5000-years, the size decline may be related to environmental changes associated with the appearance and disappearance of red abalone midden sites in both Cambria and the northern Channel Islands (Glassow 1993). The use of larger red abalone shells during the Late Holocene for fishhooks and pendants and in trade may also contribute to the reduction in shell sizes over time.

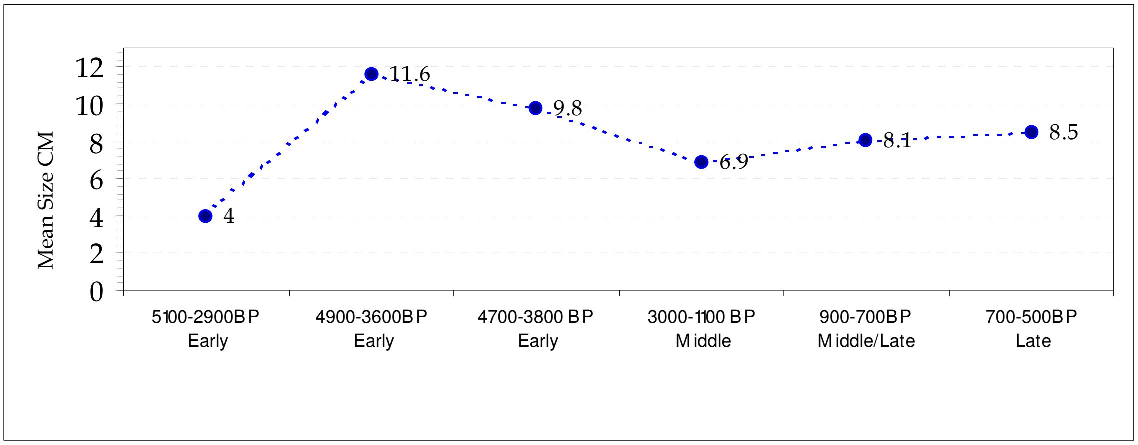


Figure 11.5. Average Size of Red Abalone at the Time of Harvesting from San Simeon Reef Sites. (Middle Period Data is derived from CA-SLO-267 (Jones and Ferneau 2002a.)

Overall, the shellfish data suggest that human collecting strategies altered local red abalone populations over the course of occupation. Impacts on the littoral environment may have been mediated by mobile settlement patterns, a widening of diet breadth, increased technological investment, and increased reliance on marine fish or terrestrial and marine mammals. Shellfish data from the study sites and the paleoclimatic data suggest that intervals of low population, and decreased populations (during and after the Medieval Climatic Anomaly) are marked by larger abalone sizes. The small average size of red abalone during the initial occupation Early Period at CA-SLO-1295, 5100 calBP, is surprising and must in part be due to higher sea otter populations or reduced marine productivity that restricted habitat for ablone. These intervals appear to coincide with periods of productive marine environments favorable to shellfish, including cooler sea surface temperatures just prior to site occupation that allowed abalone to live higher within the intertidal zone, which would have made them less costly to collect. However, by the Late Period these strategies may have become difficult as human population growth, although relatively low in the region, and increased territorial circumscription limited access to resources. The same species of rocky intertidal shellfish were collected over the whole span of occupation, with evidence for the reduction of size and frequencies of important resources suggesting changes in harvesting strategies and a decrease in the importance of shellfish by the Late Period.

## SOUTHERN SAN SIMEON REEF BLACK TURBAN SNAIL MIDDENS: INTENSIFICATION OR SPATIAL VARIATION IN INTERTIDAL ECOLOGY?

The dominance of small black turban snails in southern San Simeon Reef middens challenges our assumptions of intensification and expectations of optimal foraging theory models, which posit that the larger vertebrates and shellfish are the highest ranked (Ugan 2005:75). Black turban snail middens have recently been the subject of research in the Point Conception area (Glassow and Gregory 2000; Perry 2004), on San Miguel Island (Braje and Erlandson 2009), and on San Clemente Island (Raab et al. 2009). Focusing on their small size, researchers have interpreted the addition of black turban snails to the diet as evidence of increased population densities, an increase in diet breath, intensification, or ecological circumstances in the local intertidal zones. During earlier research, I observed a temporal and spatial reliance on black turban snail along the southern San Simeon Reef (Joslin 2006: 284-292). While tegula harvesting can be explained by a widening of diet breath, in some areas their abundance and ease of collection may have made them a high-ranked resources and ecological variation in these two shellfish species must first be considered. Collected data are used here with additional samples, and recent intertidal ecological research at the UC Reserve, to understand the inclusion of these small shellfish into the diet.

Shellfish assemblages along the coastline north to Big Sur and south of the

San Simeon Reef (Cayucos) suggests that black turban snails are ranked first or second in southern San Simeon Reef sites, in the Cambria/Lodge Hill vicinity (Table 11.12, Figure 11.6). California mussel comprises between 7 and 20 percent of shell assemblages, except for the Early Period component at CA-SLO-1295 where it is equal to black turban snails, 45.9 percent, and at CA-SLO-177 where it represents 78 percent (J. Rudolph 1985). Black turban snails are the dominant species both above and below the red abalone midden at CA-SLO-1622.

Sampling strategies may account for the difference in black turban snail and California mussel frequencies at CA-SLO-177. The CA-SLO-177 analysis is based on 1/4-inch mesh, which may have biased the sample by retaining only larger species of shell and under-representing highly fragmented black turban snail shells.

Continuing north along the open terrace, the reliance upon California mussel is more pronounced. Consistently, California mussel is an important dietary contributor from the Piedras Blancas area through the rugged Big Sur Coast, spanning the last 6400 years of prehistoric coastal occupation. Early through Late period shellfish assemblages have consistently large proportions of California mussel, between 90.5 and 85.1 percent, and small proportions of black turban snail, around 7.6 percent (Table 11.12). In these mussel-dominated, open coast assemblages are secondary and sometimes

Table 11.12. The Significance of Black Turban Snail and California Mussel in Northern Central California Coast Sites.

| Locality | Temporal Component | Primary Shellfish Contributor | Black Turban % | California Mussel % | Reference |
|---|---|---|---|---|---|
| **CAYUCOS** | | | | | |
| SLO-1914 | Late | Barnacle | 27.3 | 20.0 | Farrell et al. 2004 |
| **CAMBRIA/LODGE HILL** | | | | | |
| SLO-1295 | Early | Mussel | 42.4 | 45.9 | Reported here |
| SLO-1622 | Early | Red Abalone | 25.7 | 8.8 | Reported here |
| SLO-1677 | Early | Blk Turban | 39.9 | 10.5 | Reported here |
| SLO-177[a] | Early | Mussel | 5.0 | 78.0 | J. Rudolph 1985 |
| SLO-762 | Early | Blk Turban | 57.4 | 11.5 | Breschini & Haversat 1993 |
| SLO-2563 | Middle/Late | Blk Turban | 56.3 | 1.6 | Reported here |
| SLO-71 | Late | Blk Turban | 47.0 | 7.7 | Joslin 2006 |
| SLO-115 | Late | Blk Turban | 38.8 | 16.9 | Joslin 2006 |
| **SAN SIMEON CREEK** | | | | | |
| SLO-383 | Early | Blk Turban | 43.3 | 27.6 | Hines 1986 |
| SLO-187 | Late | Blk Turban | 14.6 | 10.9 | Hines 1986 |
| SLO-186 | Late | Mussel | 27.5 | 37.2 | Hines 1986 |
| SLO-221 | Late | Mussel | 9.3 | 53.0 | Gibson 1992 |
| SLO-1373 | Late | Mussel | 9.3 | 53.0 | Gibson 1992 |
| **PIEDRAS BLANCAS** | | | | | |
| SLO-175 | Early | Mussel | 7.8 | 80.5 | Jones and Waugh 1995 |
| SLO-265 | Early | Mussel | 5.5 | 90.5 | Hildebrandt et al. 2007 |
| SLO-274 | Early | Mussel | 7.7 | 82.5 | Hildebrandt et al. 2002 |
| SLO-179 | Middle and Middle/Late | Mussel | 5.2 | 85.1 | Jones and Ferneau 2002 |
| SLO-267 | Middle | Mussel | 8.9 | 84.9 | Jones and Ferneau 2002 |
| SLO-273/H | Middle/Late | Mussel | 7.7 | 82.5 | Hildebrandt et al. 2002 |
| SLO-267 | Late | Mussel | 8.3 | 35.1 | Bouey and Basgall 1991 |
| SLO-826 | Late | Mussel | 6.2 | 69.1 | Hildebrandt et al. 2007 |
| **BIG SUR** | | | | | |
| MNT-238 | Middle | Mussel | 0.4 | 89.0 | Mikkelsen et al. 2004 |
| MNT-1942 | Late | Mussel | 4.0 | 82.5 | Wohlgemuth et al. 2002 |

Note: Mussel- California Mussel; Blk Turban-Black Turban; [a]SLO-177 sample based on ¼-inch mesh screen.

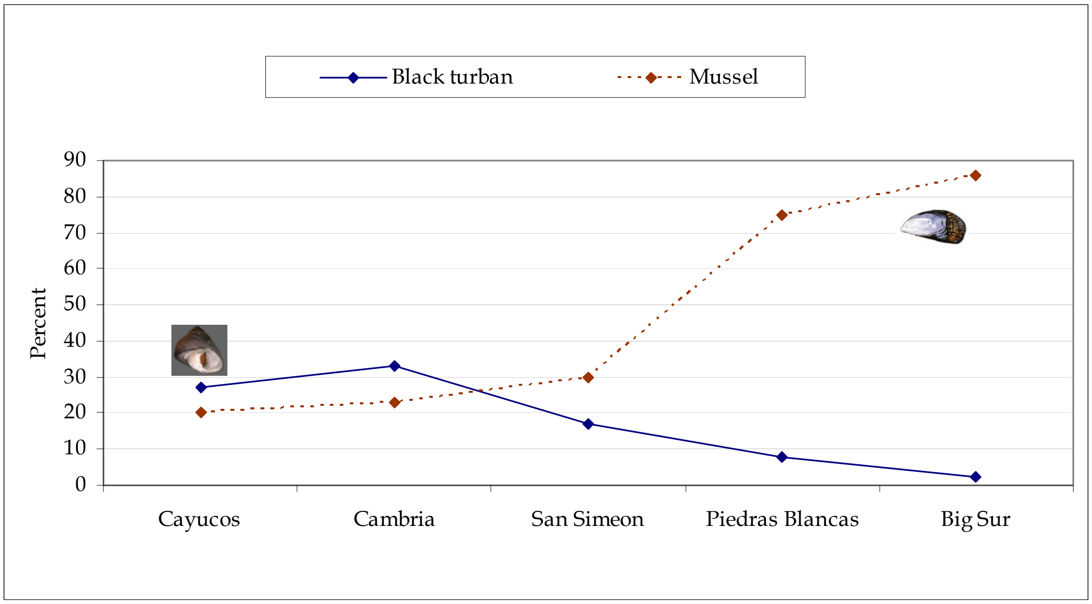

Figure 11.6. Relative Frequency of Black Turban Snail and California Mussels from Select San Simeon Reef and Big Sur Sites.

tertiary representations of black turban snail and barnacle. The extensive mussel-bed communities along the open northern San Simeon Reef and southern Monterey County coasts contrasts to the southern San Simeon Reef, where black turban snails are much more abundant.

One of the best means for interpreting these observations is to look at the data collected on mussel sizes. Data from measured California mussel show that during a 5000-year time span, mussel shell size at sites in northern San Luis Obispo County averaged between 2.5 and 3.3 cm in length (a difference of only 8 mm) with a range in length from ≤ 2 to 10 cm. The small size of these mussels is particularly striking compared to their typical maximum length of up to 20.0 cm along the California coastline (Morris et al. 1980:360).

To investigate the small size of mussel shells and paucity of productive beds occurring throughout prehistory in the San Simeon Reef, I compared the data on the mean mussel size to the Big Sur region (Figure 11.7). The Big Sur data set, from over a dozen discrete temporal components, reveal a mean mussel shell size between 3.0 to 5.0 cm persisted between 6500 and 150 calBP. Continuing south along the northern San Luis Obispo Coast, the size of mussel over time, however, suggests a smaller size throughout prehistoric occupation. The range of California mussel size is between 2.6 and 3.1 cm, a difference of only 5 mm, and the mean mussel length does not decrease dramatically over time. Data from both regions also suggest that mussels declined slightly in size during the Middle/Late Transition and recovered again during the Late Period. Although many researchers attribute these small sizes to humans over-collecting marine shellfish using an intensive shell stripping strategy (Hildebrandt et al. 2002:99; Jones and Ferneau 2002a:222; Jones and Richman 1995:51; White 1989), non-cultural explanations must also be considered (Erlandson and Rick 2008).

The reliance on black turban snails throughout the San Simeon Reef occupations requires consideration. Based on their small size and low meat (0.365) and protein (0.203) yields, the snail is often ranked below other

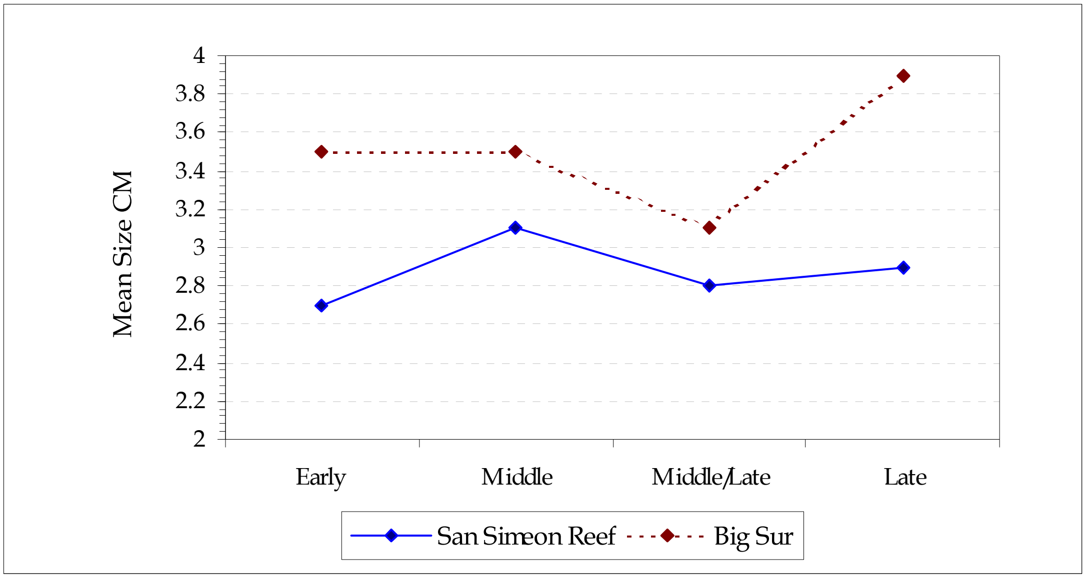


Figure 11.7. Mean Size of California Mussels from San Simeon Reef and Big Sur Sites.

available large species such as mussel, abalone, and giant chiton (conversion ratios from Erlandson 1994:59). They grow to a maximum size of 30 mm, with a rapid growth rate compared to abalones, 20 mm of growth within the first six years. I hypothesize that, in the absence of the "higher-ranking" species (i.e., California mussel) black turban snails found in compact clusters on rocks in the mid and upper intertidal, enabling low-cost procurement, may have been an appealing commodity.

During rocky intertidal surveys along southern San Simeon Reef over the last seven years, I observed only immature mussels clustered in small beds approximately 30 to 50 cm in diameter (Figure 11.8). The mussel beds are oriented east, or away from the tidal surges, with byssal threads directly

Figure 11.8. California Mussels Bed and Sea Moss (*Endocladia muricata*).

attached to the rock substrate in protected locations. The maximum observed mussel length measured was 7.3 cm, with the majority of shells consistently less than 5.5 cm. Similar results were reached by a marine biologists who observed the average thickness of mussel beds along the Cambria Coastline measuring only 2.0 cm deep (Blanchette and Gaines 2007:273, Figure 5). Conversely, black turban snail was locally abundant on most rock surfaces and ranged from small immature individuals to large adults with sizes up to 3.5 cm in diameter. This same situation was also observed in contemporary intertidal Purisma Point communities (Glassow and Gregory 2000; Perry 2004). To elaborate on these observations, I conducted an intertidal survey of the rocky intertidal zone within the same bedrock formation from Point Estero to Cambria, with similar results.

Whether particular marine conditions are suitable for shellfish depends on interrelated environmental characteristics such as geologic composition of the substrate, shoreline topography, and intensity of wave action (Engle 1994:15; Ricketts et al. 1985:450), as well as competition for habitat by other shellfish and macrophytes (algae and surfgrass) (Blanchette and Gaines 2007; Blanchette et al. 2007). First, an analysis of geological maps reveals that the underlying geology of the length of the southern San Simeon Reef is a Cretaceous sandstone, a fine-grained Feldspathic graywacke (Hall 1974). These sandstones have a higher proportion of feldspar which weather easily, breaking down into clay minerals. This geologic unit is also the parent material in the San Simeon Creek vicinity. To the north along the northern San Simeon Reef and Big Sur Coast, where mussels are larger and were a more significant dietary contributor, the geology consists of folded and faulted metamorphic rocks with higher proportions of more stable serpentines. These findings suggest that California mussels may be unable to attach to form productive beds along the southern San Simeon Reef.

Recent studies on diversity and abundance of algal and shellfish communities in the rocky intertidal zone adjacent to the study sites provide significant data to interpret these observations (Blanchette and Gaines 2007; Blanchette et al. 2007). Namely, there are several factors in the ecological stability, distribution, and abundance of key invertebrate species through time. Blanchette et al. (2006) investigated differences in temperature, upwelling, and wave exposure north and south of Point Conception to look at the recruitment and abundance of mussels as underlying causes of large–scale differences in community structure.

First, the authors determined that elevated wave exposures on the Cambria Coastline have displaced the entire mussel intertidal zone upward in areas with south-southwest coastal orientation. This wave action also dislodges mussels from rocks and damages their byssal threads during storm episodes. The Cambria area is also exposed to large ocean swells and storms generated in the North Pacific, whereas the rocky intertidal zones south of Point Conception are relatively protected from heavy wave action (O'Reilly and Guza 1993). Second, compared to the weak, seasonal upwelling and warmer water temperatures characteristic of the region south and east of Point Conception, the Cambria area has strong upwelling and cooler waters. Additionally, along the San Simeon Reef coastline, sea stars (*Pisaster ochraceus*) the primary predator of California mussel, are more abundant and may also limit their abundance (Blanchette and Gaines 2007:275).

Finally, perhaps most compelling obervation is the dominance of macrophytes (algae and surfgrass) in the intertidal along the southern San Simeon Reef. Multiple taxa, such as surf grass (*Phyllospadix spp*.), sea palm (*P. palmaeformis),* and spindle-shaped rockweed *(Pelvetia fastigiata*), compete with mussels for suitable rock surfaces for attachment. However, particularly intrusive in its effect on the variation in size and spatial cover of mussel beds is sea moss, (*Endocladia muricata*) a species marine biologists essentially term a "weed." As Figure 11.8 depicts, *Endocladia* forms dark bands along the upper shoreline, essentially constricting the area available for the attachment of the byssal threads of mussels. Blanchette and Gaines (2007:277) proposed that cold, nutrient-rich waters enhance the growth of macrophytes and strongly influence the structure of the entire intertidal community.

California mussels, due to several behavioral characteristics, are more heavily impacted by environmental agents than are gastropods such as black turban snails. Mussels have a tendency to aggregate in dense colonies in which individuals attach their byssal threads to other mussels rather than to bedrock substrate (Dayton 1971:358). Therefore, mature mussel beds with multiple layers are less stable than where mussels are not as dense and have a higher proportion of byssal thread attachments to rock surfaces (Perry 2004:94). Along with the unstable geologic conditions, storms would break off surfaces, removing mussel clusters, and/or killing off entire mussel beds (Engle 1994:19; Harger and Landenberger 1971:197). Once the beds are disturbed and the underlying substrate is exposed, their reestablishment is a relatively slow process (Jones and Richman 1995:40; Suchanek 1981).

In contrast to California mussel, several ecological and behavioral characteristics reduce the likelihood of black turban snails being dislodged during storm episodes (Perry 2004:94-95). Black turban snail habitats are situated in protected places in the rocky intertidal zone, such as sheltered crevices or on the sides of boulders, rather than exposed on upper rock surfaces where mussels attach (Ricketts et al. 1985:38). The small vertical size and compact shape also provide more stability in heavy wave conditions. Perry (2004:95) suggested that black turban snails are a mobile species that may gradually move to protected locations. As a result of habitat selection, size and shape, and mobility black turban snails therefore have an advantage over California mussel with respect to surviving strong wave action.

If the contemporary distribution of black turban snails and California mussel are an indication of prehistoric intertidal environments, the preference for black turban snails by southern San Simeon Reef site occupants may be due to local ecology rather than resource intensification. Exploitation of small shellfish species such as black turban snails in local environments suggests we have to adopt a more nuanced and ecological explanation of diachronic trends in shellfish collecting. Interpreting the archaeological record has to include detailed knowledge of biodiversity, ecology, and the characteristics of and ecological constraints on prey species over a variety of geographical and temporal scales. When considering littoral foraging strategies human impacts on marine resources, environmental changes, and ecological constrains must be considered along with cultural explanation (Erlandson and Rick 2008).

## SOUTHERN SAN SIMEON REEF RED ABALONE MIDDENS

> Once there was a famine year, a bad year. For three years there was no rain and food. They ate bleached bones pounded in the mortar, and acorn mush made of manzanitas. There were no deer and no meat; it was a great famine. The poor people ate alfilerillo seeds. On old women killed and roasted and ate her son; was very hungry. Then her bother came and killed her with three arrows because she had eaten her child. They did not bury her but left her to be eaten by the coyotes. It was a great famine. But the people who lived on the shore did not die because they ate abalones (Maria Ocarpia in Mason 1918:120).

Around 5700 calBP an increase in the number of occupation sites along the north coast of San Luis Obispo County coincides with the occurrence of red abalone middens distinctive to the southern San Simeon Reef (Figure 11.9). The middens contain unusually large numbers of complete or nearly whole red abalone (*Haliotis rufescens*) shells in stratum or discrete lens. Despite the high visibility of abalone shells, the shell of other species (i.e., black turban snails along the San Simeon Reef), fish and mammal bones, and a diversity of artifacts are also in these middens. This unique site type is often associated with the Northern Channel Islands (Braje et al. 2009; Glassow 1993a, 1993b, 2000). Red abalone middens are known to occur along the central coast, but have not been a focus of research, although they have the potential to add to our understanding of cultural and environmental change.

Red abalone middens have been a subject of researchers interested in

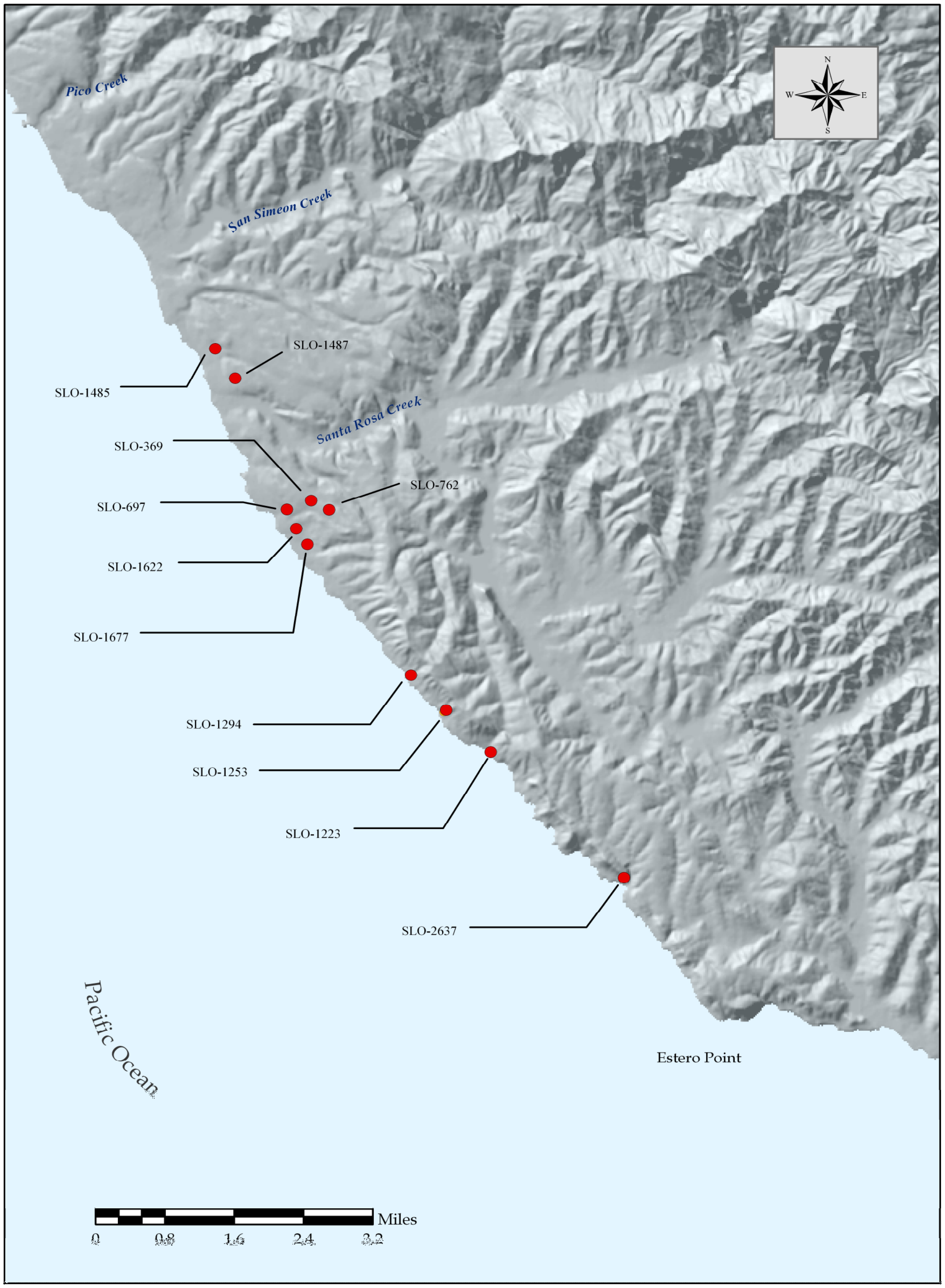


Figure 11.9. Southern San Simeon Reef Red Abalone Middens.

their environment, ecology, and economic implications (Braje et al. 2007, 2009; Erlandson et al. 2005; Glassow et al. 2008; Hubbs 1967; Orr 1968; Sharp 2000). Braje et al. (2009:911) define red abalone middens as sites that contain at least 5 percent abalone shell by mass of shellfish remains. Examined here is information from the two red abalone middens; CA-SLO-1622 with red abalone at 16 percent of shell the weight and SLO-1677 with 20 percent. Data from these sites is used in conjunction with existing site information from sites along San Simeon Reef to explore their role in Middle Holocene development of subsistence and settlement systems.

The two red abalone middens considered here have distinctive characteristics indicative of significant differences in adaptation from that of the initial Middle Holocene or Early Period. CA-SLO-1622 is an 80 cm thick cultural deposit with a red abalone lens spanning between 40 and 70 cm, and CA-SLO-1677 is a one meter thick deposit with an impressive red abalone midden between 45 and 95 cm. Although red abalone shells are present in shellfish assemblages throughout prehistoric occupation along the San Simeon Reef, variation in their frequency and size in these middens is distinctive. Occupants at CA-SLO-1677 harvested relatively large individuals, with over 60 percent of the shells classified as adults (Figure 11.10). Almost all of the shells, 95 percent, appear in the initial occupation of the site around 5000 calBP. A similar situation was found at CA-SLO-1622, where the

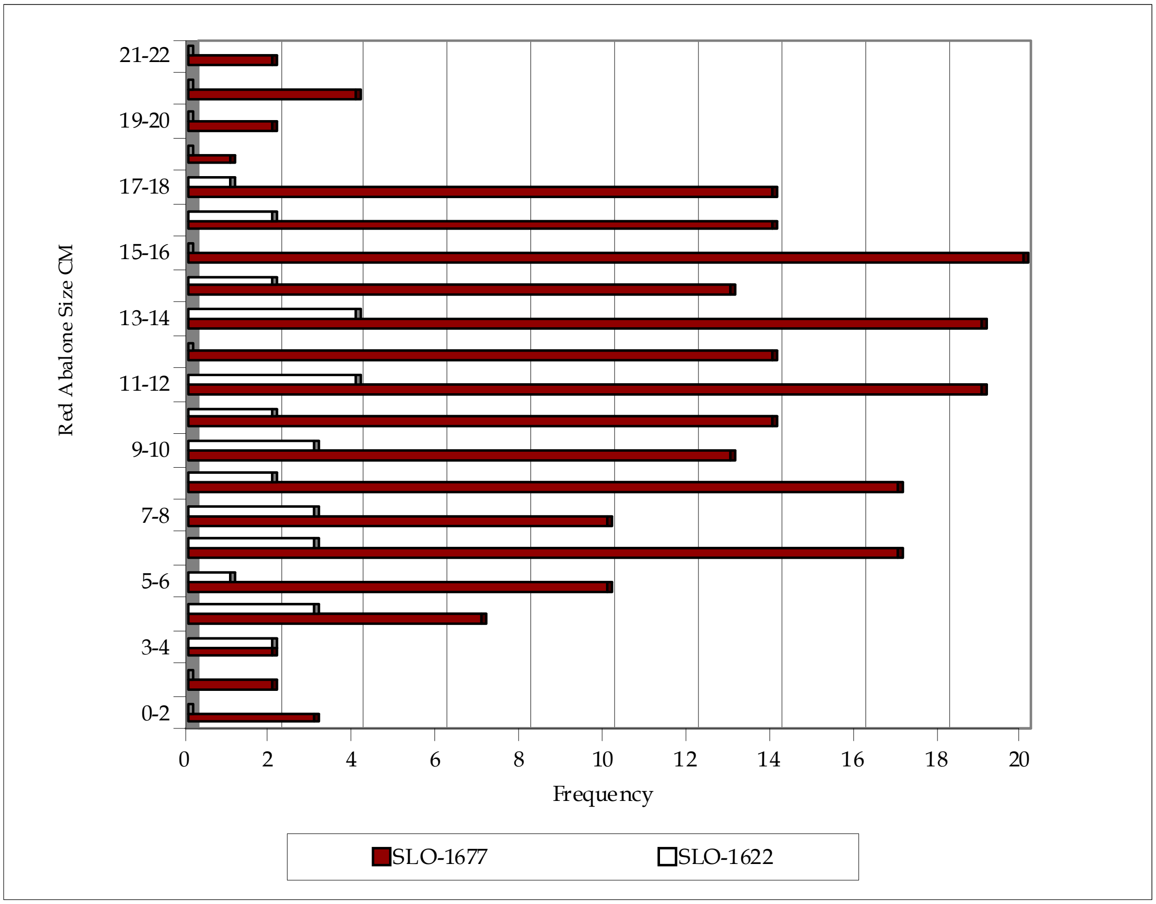


Figure 11.10. CA-SLO-1622 and CA-SLO-1677 Red Abalone Length Measurements.

red abalone midden was developed during the earliest occupation around 4700 calBP and the average shell size is 9.8 cm. The size data suggest that people were collecting larger red abalone from shellfish beds in a littoral environment that had not been heavily preyed on by humans or sea otters.

Focusing on the stratigraphic distribution of shellfish species provides interesting insights on the local intertidal and subtidal communities and temporal changes in the use of invertebrates. Although the shellfish assemblages of red abalone middens contain the same composition of rocky intertidal and subtidal invertebrates as seen in later deposits, the species change in relative proportion. At both red abalone middens, below and above the dense abalones, the shell taxa are more diverse, with black turban snail is the most important species, followed by California mussel, and red abalone is of minor dietary importance. Chiton species and owl limpets (*Lottia gigantea*) – having cold-water, lower intertidal affiliations – are also present throughout the deposit, although their size is much larger in the red abalone midden. If red abalone shells were excluded, the assemblage would resemble later assemblages, suggesting stability in the composition of local intertidal habitat. Variation in red abalone appears to be the only shellfish species that changes in abundance.

Given the focus on shellfish harvesting and a reliance on small samples, researchers have tended to concentrate on the study of faunal remains in red abalone middens and have often overlooked the artifact assemblage. Many researchers have therefore interpreted the sites as highly specialized collecting and processing sites and not residential bases (e.g., Kennett 2005:226). Although fragmented and whole shell are the principal midden constituents, the diversity of artifacts and faunal remains suggest domestic activities associated with a short-term or multi-seasonal residential base at CA-SLO-1622 and a residential base at CA-SLO-1677. At CA-SLO-1677, the high density of red abalone implies that shellfish were of prime importance to the diet, and the artifact assemblage supports this. A very large number of pitted stones, handstones, and battered stones and abundant expedient flake tools to process meat were recovered. All of the pitted stones and the cobble tool at CA-SLO-1622 were collected in association with the red abalone midden. At CA-SLO-1677, 83 percent of the ground and battered stone and all of the pitted stones are from the red abalone midden. Although abalone pry bars are often formed from hardwoods and sea mammal ribs, small wedge-shaped handstones may have been used. The continued importance of hunting gear (projectile points and bifaces) as well as fishing tackle (net weight) suggest site occupants relied on a variety of resources beyond shellfish. Similar to other Early Period flaked stone assemblages along the San Simeon Reef, the lithic collection is robust, with greater proportions of interior Franciscan chert and imported obsidian than the Late Holocene sites.

In the southern San Simeon Reef area, at least eleven red abalone middens have been identified, with radiocarbon dates between 5470 and 3000 calBP, mostly falling between 5200 and 3500 calBP (Table 11.13). Significantly, 10 of the sites were initially occupied around 5000 calBP, with the earliest date around 5390 calBP (CA-SLO-2637). Information on many of these sites is limited to site record data with a small number of radiocarbon dates, but general trends are evident. These sites are associated with a dramatic increase in the number of archaeological sites occupied along the San Simeon Reef, suggesting an increasing population occupying a wider variety of locations than before. To the north on the Monterey Peninsula, dense deposits of whole red abalone dating to the Late Period (e.g., CA-MNT-170) are interpreted as specialized sites where abalone were apparently harvested en masse, shelled, dried, and transported inland for later consumption (Breschini and Haversat 1991). The only other known red abalone midden along the central coast region is within a deeply stratified trans-Holocene residential site (CA-SLO-585) located to the south along the open coastline in Diablo Canyon (Greenwood 1972). This red abalone midden is located between 80 and 100 cm below the surface, and dates to around 7760 and 5230

Table 11.13. Southern San Simeon Reef Red Abalone Midden Radiocarbon Dates.

| Site Location | Landform | Lab Number | Provenience | Calibrated Date 1 Sigma Range | Reference |
|---|---|---|---|---|---|
| **SLO-369** | | | | | |
| Cambria | Hillslope | UCR-791 | Unit 2, 40cm | 3180(2990)2800 BP | Gibson 1979 |
| | | UCR-792 | Unit 2, 54 cm | 4500(4290)4080 BP | Gibson 1979 |
| | | Beta-155105 | Unit A, 60cm | 5280(5180)5070 BP | Parker 2002 |
| **SLO-697** | | | | | |
| Cambria | Hillslope | UCR-794 | Unit 3, 35 cm | 5520(5320)5120 BP | Gibson 1979 |
| **SLO-762** | | | | | |
| Cambria | M. Terrace | Beta-62287 | E Trench, 80 cm | 3570(3480)3380 BP | Sawyer 1993 |
| | | Beta-65727 | Backdirt pile | 5010(4910)4820 BP | Breschini and Haversat 1993 |
| | | Beta-65728 | Backdirt pile | 5030(4930)4830 BP | Breschini and Haversat 1993 |
| | | Beta-62288 | E Trench, 50 cm | 5170(5030)4890 BP | Sawyer 1993 |
| **SLO-1223** | | | | | |
| Estero Point | M. Terrace | WSU-3917 | SC, 1.5 m[a] | 4840(4710)4570 BP | WSU 1989 |
| | | WSU-3918 | SC, 2.1 m[a] | 4960(4790)4620 BP | WSU 1989 |
| **SLO-1253** | | | | | |
| Estero Point | M. Terrace | WSU-3946 | SC, 1.5 m[a] | 5080 (4930)4780 BP | WSU 1989 |
| **SLO-1294** | | | | | |
| Estero Point | M. Terrace | Beta-41781 | SC, 50-60 cm[a] | 4360(4250)4140 BP | Beta 1990 |
| **SLO-1485** | | | | | |
| Cambria | M. Terrace | Beta-53114 | SC, 5 cm BS | 5130(4500)4860 BP | Beta 1992 |
| **SLO-1487** | | | | | |
| Cambria | M. Terrace | Beta-53115 | SC, 5 cm BS | 4590(4720)4840 BP | Beta 1992 |
| **SLO-1622** | | | | | |
| Cambria | M. Terrace | Beta-186772 | Unit 2, 35 cm | 3860(3760)3670 BP | Reported here |
| | | Beta-87628 | T2, 55 cm | 4260(4180)4090 BP | Beta 1996 |
| | | Beta-87627 | T2, 30 cm | 4530(4450)4390 BP | Beta 1996 |
| | | Beta-186773 | Unit 2, 73 cm | 4780(4660)4550 BP | Reported here |
| **SLO-1677** | | | | | |
| Cambria | M. Terrace | Beta-186774 | Unit 2, 44 cm | 3750(3640)3540 BP | Reported here |
| | | Beta-186775 | Unit 65, cm | 5000(4910)4830 BP | Reported here |
| | | Beta-87629 | Unit T2, 80 cm | 4220(4090)3960 BP | Beta 1996 |
| | | Beta-87630 | Unit T2, 80 cm | 4140(4080)4010 BP | Beta 1996 |
| **SLO-2637** | | | | | |
| Estero Point | M. Terrace | Beta-275276 | SC,90 cm[a] | 5470(5390)5310 BP | Reported here |

Notes: All dates from *Haliotis rufescens;* M. Terrace –Marine Terrace; Measured and conventional date summarized in Appendix B Table B2; Calibrated using 325± 35 UC CALIB REV 5.0.2 (Stuiver and Reimer 2005) rounded calendar ages include midpoint; SC-Surface Collected; [a]Collected from sea cliff wall.

calBP (Jones et al. 2009). Although the earliest date is almost 2000 years earlier than the Southern San Simeon Reef sites, the 20 cm-thick red abalone midden appears to be above the earliest date and may indeed date to the same age. Currently more than 30 red abalone middens on Santa Cruz, Santa Rosa, and San Miguel Islands have been dated between approximately 8000 to 3500 calBP (Braje 2007; Glassow 2002, 2005; Glassow et al. 2008; Rick et al. 2006; Sharp 2000; Vellanoweth et al. 2006). The San Simeon Reef red abalone middens, therefore, occur at least 2000 years later than those on the Northern Channel Islands.

Spatially, the distribution of red abalone middens is discrete, situated along the open coastline between Point Estero and Cambria (Figure 11.9). All of these sites are buried under alluvial and colluvial deposits, only identified if erosion has exposed them along the edge of the sea cliff (Figures 11.12 and 11.13). Nine of the eleven identified red abalone middens are situated along the edge of the marine terrace and exhibit a pavement-like appearance because of the closely packed red abalone shells, and two are on hillslopes above coastal bluffs. All of the midden deposits are consistently between 40 and 90 cm below surface. Similar to the Santa Cruz Island red abalone middens (Glassow 2005), the strata are typically less than a meter thick, generally between 20 to 50 cm thick with no earlier midden deposited directly below, and any deposits that occur above date to much later in time. The two

Figure 11.11. CA-SLO-1223 Looking South Exposed in Terrace Edge. (1988 Photograph by Charles Dills. This site has since been destroyed by shoreline erosion.)

Figure 11.12. CA-SLO-1223 Red Abalone Midden Profile in Terrace Edge. (1988 Photograph by Charles Dills.)

exceptions are Lodge Hill sites CA-SLO-369 and SLO-697 that have earlier deposits dating to 9800 calBP.

There are also distinctions in size between the smaller red abalone midden sites along the open coastline to the north and south—around 50 m in diameter—and the Lodge Hill/Reserve sites, which are over 100 m in diameter. This contrast between numerous small sites and a few larger sites suggests a difference in their place within a settlement system. The larger Lodge Hill sites and CA-SLO-1677 appear to have served as principal residential bases where populations spent more time, and from which task-specific groups foraged. A newly identified red abalone midden in the sheltered Gold Rush Bay (CA-SLO-2637), just north of Point Estero, also appears to be a more intensively occupied site. These larger sites may have been used by more frequently due to more locally abundant and diverse resources, reliable fresh water, and level topography. The abundance of small sites at regular intervals implies that smaller social groups were very mobile during at least portions of the year, frequently moving from one site to another along the coast.

On the Northern Channel Islands multiple hypotheses have been proposed to account for the distribution and characteristics of red abalone middens (Table 11.14). Additionally, they may be the product an expansion of a new ethnic group into the region or feasting events.

Table 11.14. Hypotheses for the Occurrence of Red Abalone Middens.

| Hypotheses | Reference |
|---|---|
| • Movement of red abalones into the intertidal zone during periods of cooler sea surface temperatures | Glassow (1993) |
| • Viral epidemic or coastline alteration | Salls (1992) |
| • Subtidal diving by Native People | Salls (1991), Sharp (2000) |
| • Specialized shellfish processing sites | Kennett (2005) |
| • Use of localized upwelling zones by human foragers | Sharp (2000) |
| • Overexploitation of California mussel, requiring shift in collection practices | Vellanoweth et al. (2006) |
| • Low sea otter populations | Erlandson et al. (2005) |

Along the southern San Simeon Reef, there appears to be a change in intertidal and subtidal habitat that triggered an adaptive response leading to the sudden appearance of this unique site type. Although it is important to consider these competing hypotheses, multiple lines of evidence suggest surface seawater temperatures were cool in the Santa Barbara Channel around 5900, before local foragers focused on red abalone (Kennett 2005:66). Fluctuations in sea water temperatures may have caused the red abalones to move from subtidal to intertidal habitats, making them more accessible (Glassow 1993) or at least high enough in the subtidal zone that they could have been collected by shallow diving or wading. About the time the southern San Simeon Reef sites were occupied, however, water sea surface temperatures in the Santa Barbara Channel became very warm, around 5200 calBP, and remained so until 3800 calBP (Kennett et al. 2007). It is plausible that cooler waters preceding this interval continued until the southern San Simeon Reef red abalone middens were occupied. Compared to the weak, seasonal upwelling and warmer water temperatures south and east of Point Conception, the Cambria area has strong upwelling and cooler waters that may also affect the abundance of red abalone (Blanchette et al. 2006). This also suggest that the appearance of red abalone middens may not be directly tied to millennial-scale changes in sea surface temperatures (Glassow 1993b) and might be better explained by infrequent Middle Holocene ENSO activity (Kennett et al. 2007) and cultural changes in shellfish collecting that included expanding their diet to include subtidal red abalone (Braje et al. 2007).

With lower water temperatures cooler subtidal shellfish species—red abalone, red (*Lithopoma gibberosa)* and brown (*Tegula brunnea*) turbans—would have become prevalent in intertidal zones when water temperatures were cooler. Compelling evidence supporting this hypothesis is the higher proportion of the cool-water gastropod red turban in all Southern San Simeon Reef red abalone middens. After the time of the red abalone middens, red turban is absent in shellfish assemblages and the brown turbans are minor dietary contributors. Despite evidence of apparently cooler water temperature, the continued emphasis on rockfishes and pricklebacks, species common throughout time, does not suggest drastic changes in intertidal or subtidal environments.

Arguments based on optimal foraging theories would suggest southern San Simeon Reef red abalone middens are the result of intensive collecting of the highest-ranking resources. However, this cannot alone account for the sudden appearance of a subsistence focus on a species, if found subtidal, that would be potentially more expensive to procure. Human occupation of the Cambria area dates back to at least 9800 calBP (Lodge Hill), and in these earliest deposits, abalone occurs but is not economically important, and red and brown turbans are absent. Due to their dispersed distribution in lower intertidal and subtidal zones red turban, would have been more labor-intensive to procure than mussels and other clustered species found in the upper reaches of the intertidal zone. Additionally, the low dependence on minor taxa both during and after this interval does not suggest intensive collecting strategies or ecological imbalance.

Further investigation of these sites, and contemporaneous sites along the southern San Simeon Reef, will provide insights into the role of sea surface temperature fluctuations on red abalone collecting during the onset of the Middle Holocene. It is likely that ecological adaptations were not constant through the roughly 2400-year interval when red abalone middens were created along the southern San Simeon Reef. As fine-grained chronological information from additional sites and paleoenvironmental data (i.e., higher resolution local Holocene sea surface temperature curves) develop, subsistence variations at specific sites and changes through time will allow many of the outstanding questions to be addressed.

## SOUTHERN SAN SIMEON REEF MARINE FISHERIES

Fishing is a subsistence activity that fishers-hunters-gatherers in which engaged that depended upon a complex range of cultural and environmental variables than changed over time. One of the most iconic examples of an elaborate and effective fishing economy is that of the Chumash along the Santa Barbara Channel to the south, who by the Middle Period maintained a subsistence economy focused on the exploitation of both near shore and pelagic fisheries. The diaries of early Spanish explorers document the extraordinary capabilities of Chumash fishers, and archaeological evidence supports the ethnohistoric record, as fish remains are abundant in even the earliest strata at Daisy Cave (Rick et al. 2001), becoming nearly ubiquitous in midden deposits dating to the late prehistoric period (Rick 2007). In the Vandenberg region, the Purisimeño also increased fishing efforts through time, although shore-caught fish were more important than along the channel (Glassow 1996). Along the Big Sur Coast, evidence suggests that fishing, including small taxa such as herrings and anchovies, were part of the Late Period diet at a level not previously known (Jones 2003:221; Wohlgemuth et al. 2002).

Compared to the maritime cultures of the Santa Barbara Channel, adaptations along the San Simeon Reef appear to be more littoral—staying closer to shore and using tule balsas. Although marine adaptation in this region spans at least 10,000 years, occupants apparently made less use of boats compared to along the Santa Barbara Channel. A comparison between fishing strategies of these regions is of considerable interest in determining the impact of watercraft on the development of fishing along the Pacific Coast of North America.

Regarding the San Simeon Reef, the ethnographic literature suggests that a terrestrial verse marine dichotomy existed between the southern interior Salinan and the coastal Playano. Mason (1912:123) noted that:

> Throughout most of western California a difference was noticed and recorded by the earlier travelers between the fishing people on the coast and the hunting people inland. The latter are generally credited with being larger, better built, and more courageous. While the shore people undoubtedly hunted game and the inland group made journeys to the ocean for seafood, yet one were primarily fishers and the other hunters.

This statement is consistent with local populations being a maritime-oriented group that relied on fish but also obtained inland resources and for at least part of the year. In explicating the nature of subsistence and settlement organization, it is important to know the specific fishing methods, which were largely determined by resource characteristics.

## TEMPORAL CHANGES IN MARINE FISHERIES

Dietary reconstructions suggest that a decrease in the significance of shellfish during the Late Holocene culminates in a dramatic increase in the importance of marine fish in the Late Period, a general trend in many coastal economies. In contrast, local researchers have hypothesized that the role of fish increased slightly through time along the central California Coast (Jones and Ferneau 2002a). A comprehensive syntheses of local fisheries is difficult due to the varied excavation techniques utilized (e.g., screening strategies not conducive to recovering bones of small fish species), with only a limited number of sites along the San Simeon Reef that are associated with comparable data. Data from the Early and Middle/Late Transition collections presented here, and fish bone assemblages pertaining to the Middle Period (Jones and Ferneau 2002a), Middle/Late Transition (Hildebrandt et al. 2002), and Late Period (Joslin 2006) are now available to evaluate changes in marine fisheries over the past 5000 years.

These fish assemblages show a clear diachronic trend towards an increase in fishing along the southern San Simeon Reef (Table 11.15 and Figure 11.13). Data from sites in similar rocky intertidal settings, Early through Middle/Late Transition Period assemblages show similar relationships between smaller migratory fish and other species. By the Late Period, fish bone density increases over three times, and assemblages contain

Table 11.15 Absolute Frequencies and Relative Percentages of Fish Bone from San Simeon Reef Sites.

| | Time Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Early | | Middle | | Middle/Late | | | | Late | |
| | SLO-1295, -1622, -1677 | | SLO-267 | | SLO-273/H | | SLO-2563 | | SLO-71 | |
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Inshore/Offshore Migrators | 2 | <1 | 219 | 12 | 538 | 26 | 13 | 2 | 1,665 | 52 |
| Other Fish | 2,552 | 99 | 1,567 | 88 | 1,555 | 74 | 583 | 98 | 1,518 | 48 |
| Fish Bone/m$^3$ | 553[a] | | 2,128 | | 2,113 | | 778 | | 7,100 | |

Note: No.-Total number of elements per cubic meter; Inshore/Offshore Migrators includes Herrings, Pacific Sardine, Northern Anchovy, Smelt, Silversides; Other fish includes all other identified species at each site; Comparative data is from SLO-267 and SLO-273/H (Hildebrandt et al. 2002; Jones and Ferneau 2002a); Includes average from site specific SLO-1295 (60/m$^3$), -1622 (995/m$^3$ ), -1677 (1009/m$^3$ ).

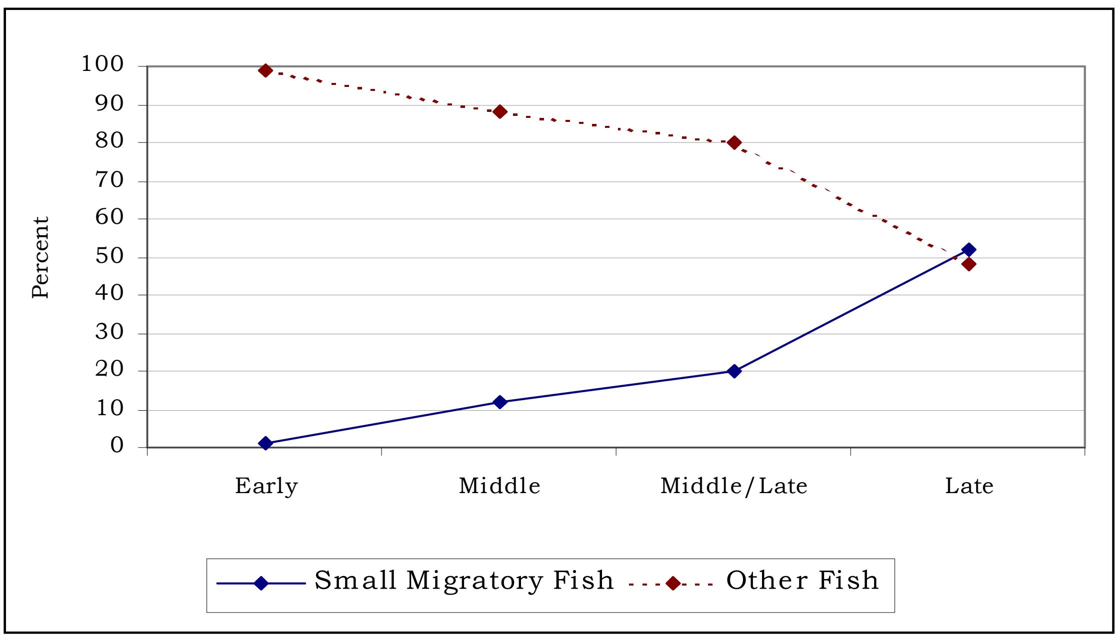


Figure 11.13. Relative Percentage of Small Migratory and Other Fish Bone from San Simeon Reef Sites. (Based on data presented in Table 11.13.)

almost equal proportions of small inshore/offshore migratory species and all other fishes. This intensified focus on fish may have resulted from increasing pressure on terrestrial and intertidal resources. Alternatively, CA-SLO-71 may have such high proportions of fish remains due to the site's location or function and may not be representative of Late Period sites generally.

A comparison of Early through Middle/Late Period sites in the same environment reflects similar profiles between smaller inshore/offshore migratory species. However, by the Late Period fish bone assemblages contain almost equal proportions of elements from the small inshore/offshore species and medium bodied fishes such as the rockfish and cabezon.

Table 11.16 illustrates the number of elements (NISP) of different fish taxa identified to family, genus, or species. All of the sites are dominated by the same three fish taxa: pricklebacks, rockfishes, and cabezon. In the three Early Period sites, monkeyfaces and black and rock pricklebacks strongly dominate the assemblage followed by rockfish and cabezon. Although common in many central California's assemblages (Gobalet and Jones 1995), picklebacks are abundant along the Southern San Simeon Reef. Also present are relatively equal numbers of 10 small-medium sized rocky intertidal fish and only limited counts of small inshore/offshore fish and a single hound shark.

Table 11.16. Temporal Comparison of Southern San Simeon Reef Fish Species Based on NISP.

| | | --------------Early Period----------- | | | Middle/ Late | Late |
|---|---|---|---|---|---|---|
| | | SLO-1295 | SLO-1677 | SLO-1622 | SLO-2563 | SLO-71 |
| COMMON NAME | TAXON | | | | | |
| **INSHORE/OFFSHORE MIGRATORS** | | | | | | |
| Herrings | Clupeidae | – | – | – | 4 | 94 |
| Pacific Sardine | *Sardinops sagax* | – | – | – | – | 4 |
| Northern Anchovy | *Engraulis mordax* | – | – | – | 3 | 70 |
| Smelt | Osmeridae | – | – | – | – | 11 |
| Silversides | Atherinidae | 1 | 1 | – | 6 | 89 |
| **ROCKY INTERTIDAL** | | | | | | |
| Cabezon | *Scorpaenichthys marmoratus* | 10 | 43 | 10 | 9 | 72 |
| Gobies | Gobiidae | – | – | – | – | 5 |
| Clinids | Clinidae | 2 | 8 | 5 | 4 | 42 |
| Crevice Kelpfish | *Gibbonsia montereyensis* | – | – | – | 1 | – |
| Croaker, Drum or White Seabass | *Sciaenidae* spp. | – | – | – | 1 | – |
| Pile Perch | *Rhacochilus vacca* | – | 3 | 1 | – | 30 |
| Pricklebacks | Stichaeidae | 30 | 143 | 27 | 93 | 759 |
| Kelpfish | *Gibbonsia* spp. | – | 1 | – | 2 | – |
| Kelp Greenlings | *Hexagrammos decagrammus* | 3 | 5 | 1 | 12 | 15 |
| Monkeyface Prickleback | *Cebidichthys violaceus* | – | 1 | – | 2 | 34 |
| Northern Clingfish | *Gobiesox maeandricus* | 2 | 6 | 1 | 6 | 1 |
| Rockfishes | *Sebastes* spp. | 10 | 49 | 19 | 23 | 158 |
| Rock or Black Prickleback | *Xiphister* spp. | 2 | 34 | 21 | 85 | 523 |
| Scorpionfish or Rockfish | Scorpaenidae spp. | – | – | – | 1 | – |
| Sculpins | Cottidae | – | – | 2 | 8 | 29 |
| Sea Bass | *Paralabrax* spp. | – | – | – | – | 1 |
| Wooly Sculpin | *Clinocottus* spp. | – | – | 3 | 3 | 1 |
| **KELP BEDS** | | | | | | |
| Giant Kelpfish | *Heterostichus rostatus* | 4 | 11 | 2 | – | 2 |
| Señorita | *Oxyjulis californica* | – | 1 | – | 3 | 53 |
| Striped Kelpfish | *Gibbonsia metzi* | – | – | – | – | 1 |
| **SANDY SURF/MUDDY BOTTOMS/BAYS** | | | | | | |
| Hound Sharks | Triakididae | – | 1 | – | – | – |
| Lingcod | *Ophioden elongates* | – | 7 | – | – | 3 |
| Surfperches | Embiotocidae | – | 2 | – | 2 | 88 |
| Ray-Finned Fishes | Actinopterygii | 47 | 1,319 | 713 | 328 | 6,857 |
| **TOTALS** | | **112** | **1,635** | **805** | **596** | **8,955** |

The Middle/Late Transition Period collection (CA-SLO-2563) also shows an increased focus on pricklebacks, followed by rockfish and cabezon. Compared to the Early Period sites, a greater diversity of species from multiple environments is present, such as surfperches. Notable is a slight increase in the number of inshore/offshore migrators, a pattern observed at the contemporaneous Arroyo del los Chinos site (CA-SLO-273/H), where migratory fish increase to 26 percent of the assemblage (Hildebrandt et al. 2002). At this site they are twice as abundant as at the nearby Middle Period site, CA-SLO-267 (Jones and Ferneau 2002a).

Significantly, during the Late Period at least 24 distinct taxa are represented in study site assemblages, almost double the number recovered from the earliest occupation.  These were obtained from a variety of marine habitats. Analyses of vertebral elements indicate pricklebacks, members of the Stichaeidae family that include monkeyfaces and black and rock pricklebacks, were the dominant taxa followed by rockfishes. Further illustrating a shift in fishing organization by the Late Period is the intensified focus on fishing for smaller species (silversides, herring, and surfperch). The species identified at Late Period CA-SLO-71 show an increase in the diversity of fishing habitats. The fish taxa represented in the assemblages show no dramatic differences over time.

The diachronic trend towards increased fishing is best reflected in the amount of fish bone per cubic meter of deposits. The density of fish elements remains relatively constant from sites along the northern San Simeon Reef, with the Early (2,448), Middle Period (2,128), and Middle/Late Transition (2,113) all around 2,000 bones per cubic meter. The southern San Simeon Reef sites have lower densities, with Early Period sites having only 553 bones per cubic meter and Middle/Late Transition sites having slightly higher counts, 778 per cubic meter. However, by the Late Period fish bone density exponentially increases to 7,000 bones per cubic meter.

**FISHING TECHNOLOGIES**

Nearshore fishes could have been obtained using a variety of technologies determined by species size, abundance, and habitat (Table 11.17.). The simplest technique was hand collection of fish trapped in intertidal pools such as prickleback. Along the rocky shoreline, wooden poles or spears could be used to procure fish from the shallows. Larger fish were probably captured from a wide variety of habitats with hook, bone gorges, or composite fishhooks attached to cordage line. San Simeon Reef circular fishhooks, mostly of abalone shell, are associated with changes in fishing practices beginning around 2500–2000 years ago. Small inshore/offshore migratory fish were probably procured with nets. These may include dip nets from watercraft or casting nets from shore. Sinkers, grooved or notched

Table 11.17. Important Fish Species and Potential Methods of Capture.

| Common Name | Habitats | Method of Capture: Seines, Nets | Method of Capture: Hook and Line | Method of Capture: Poke Pole / Spear | Seasonal Preference |
|---|---|---|---|---|---|
| Pacific Herrings | Pelagic nearshore, outer edge of kelp | ✔ | | | Residential |
| Pacific Sardine | Pelagic nearshore, outer edge of kelp | ✔ | | | Residential<br>Fall/nearshore |
| Northern Anchovy | Pelagic nearshore, outer edge of kelp | ✔ | | | Winter/offshore<br>Fall/near shore |
| Smelt | Pelagic nearshore, outer edge of kelp | ✔ | | | Residential |
| Silversides | Pelagic nearshore, outer edge of kelp | ✔ | | | Residential |
| Cabezon | Rocky nearshore, kelp beds | | ✔ | ✔ | Residential<br>Winter shallows |
| Clinids | Kelp beds | ✔ | ✔ | ✔ | Residential |
| Gobies | Rocky nearshore | | ✔ | ✔ | Residential |
| Pricklebacks | Rocky nearshore | | ✔ | ✔ | Residential |
| Kelp Greenlings | Rocky nearshore, kelp beds | | ✔ | ✔ | Residential |
| Lingcod | Rocky nearshore, kelp beds, sandy bottoms | | ✔ | ✔ | Residential<br>Summer shallows |
| Pile Perch | Rocky nearshore, kelp beds | | ✔ | ✔ | Late fall/early winter |
| Rockfishes | Rocky nearshore, kelp beds | | ✔ | ✔ | Residential |
| Sculpins | Rocky nearshore | | ✔ | ✔ | Residential |
| Giant Kelpfish | Kelp beds | | ✔ | ✔ | Residential |
| Señorita | Kelp beds | | ✔ | ✔ | Residential |
| Pacific Hake | Offshore | | ✔ | ✔ | Winter-spring |
| Surfperches | Kelp beds, rocky nearshore | | ✔ | ✔ | Residential |

Note: Habitat information from Love (1996), Pletka (2001), and Salls (1989).

stones such as the one recovered from CA-SLO-1622, were casually shaped artifacts attached to a net or line for added weight.

If fishing strategies were intensifying, fishing-associated artifacts should also increase in frequency over time. Analysis of fishing versus hunting-related tools from San Simeon Reef sites does not reveal a relative increase in the frequency of fishing-related artifacts in the Late Period (Joslin 2006). The fish species from the study sites appears to correlate with the refinements of fishing technologies. Based on the relative percentages of the artifact classes, fishing gear artifact frequencies peak during the Middle and Middle/Late Transition. Early Period artifacts include a net weight from CA-SLO-1622, which correlate with the abundance of species represented in the fish bone assemblage that would have been captured with hook and line. The Late Period assemblage shows a slight decrease in the abundance of projectile points and fishing gear, although there is an increase in bone tools and the use of the single shell fishhook. The higher frequencies of bone tools over time could reflect increasing use of net technologies, especially in light of the presence of small fish species. The paucity of net weights at CA-SLO-2563 and SLO-71 is perplexing, however, as the fish assemblages suggest more efficient netting technology was used.

Watercraft, in the form of dugout canoes and tule balsas, would have facilitated the exploitation of open ocean species. Mason (1912:130) noted that "the Playanos or fishing people of the coast must have had some variety of boat and probably made balsas of tule after the general California type." Based on experimental replication and use of tule balsas, the vessels had the advantage of being simple to build and quick to manufacture from dried reeds (Fagan 2004:9; Hudson and Blackburn 1979:333).

Although watercraft would have expanded the fishery environments available to local populations, larger, truly pelagic taxa were not captured (Tables 11.16 and 11.17). Of the variety of marine locations available to populations, nearshore and rocky intertidal waters are overwhelmingly favored. Giant kelpfish, Pacific hake, and señorita represent the only exclusively offshore species. The inshore/offshore migratory species, Pacific sardine and Pacific herring (family Clupeidae), topsmelt, jacksmelt and California grunion (family Atherinidae), were most likely procured beyond the kelp beds with fine-meshed nets and some form of watercraft. Although these species enter shallow waters occasionally, they usually congregate offshore in large schools.

The use of simple forms of watercraft along the central California Coast, although allowing access to a wider range of fisheries, is in striking contrast to the importance of offshore fisheries that plank canoes facilitated south of Point Conception. Sites along the San Simeon Reef reflect a relatively cohesive fish bone assemblage over time, one predominately focused on nearshore and intertidal waters with a rocky substrate and use of sandy bottom environments (Table 11.18). During the Late Period, assemblages show an increase in the diversity of fishing habitats, as well as more reliance on inshore/offshore migrators. Large pelagic taxa, such as albacore and swordfish, however, continue to be absent from the samples north of Point Conception.

The disparity between the two regions with regard to fisheries has been the subject of debate (Gobalet 1992, 2000). San Simeon Reef populations had the resources and technology to support the adoption of the plank canoes, but there were compelling reasons why they did not. Research on the origin and use of the plank canoe reveals that its primary function was to facilitate the transportation of people and resources between the mainland and the Channel Islands (Gamble 2002). The use of the plank canoe was

Table 11.18. Most Abundant Fish Taxa as Percent of Total NISP.

| Site | Age (calBP) | [a]Pricklebacks | Rockfishes | Cabezon | Surfperches |
|---|---|---|---|---|---|
| SLO-273/H-274 | 5560-2790 | 32 | 7 | 30 | 9 |
| SLO-1295 | 5190-2860 | 48 | 15 | 15 | 0 |
| SLO-265 | 5110-5090 | 20 | 19 | 9 | 28 |
| SLO-1677 | 4910-3640 | 56 | 16 | 14 | 1 |
| SLO-1622 | 4660-3760 | 52 | 21 | 11 | 0 |
| SLO-267 | 2970-700 | 33 | 30 | 5 | 10 |
| SLO-273/H-274 | 980-780 | 26 | 13 | 12 | 11 |
| SLO-2563 | 920-690 | 92 | 12 | 5 | 1 |
| SLO-115 | 670-470 | 46 | 33 | 20 | 2 |
| SLO-71 | 610-480 | 36 | 25 | 3 | 4 |
| Average | | 44 | 19 | 12 | 7 |

Note: [a]Pricklebacks include family Stichaeidae, and black, rock, and monkeyface.

not just for fishing for deep-water pelagic fish, but was important in facilitating the regional economic system. Along the San Simeon Reef there was no such motivation, as there was not a relationship with people living on offshore islands.

From a cultural ecological perspective, the low San Simeon Reef population density suggests that population pressure did not push the development of intensive offshore marine fishing and drive costly technological changes. At the Middle/Late Transition site Coon Creek site (CA-SLO-9), an increase in hook and line fishing suggests that fishermen were acquiring resources at a lower return rate (Codding and Jones 2007:142). The expensive of constructing plank canoes does not appear to offset the economic utility of offshore fishing, when other marine fishes were abundant adjacent to the sites. Finally, adopting new and more effective fishing gear and vessels might also be rejected if the technology conflicted with existing cultural patterns (Acheson 1981). For example, access to suitable launching locations may be limited by territorial boundaries, or a mobile settlement pattern may limit ownership and storage of large amounts of public resources. Furthermore, the knowledge of offshore environments would be limited, requiring new information on the species distribution and associated habitats (Morrill 1980:3). Continued research on inter- and intra-regional watercraft and fishing will undoubtedly provide meaningful comparisons.

## ORGANIZATION OF FISHING

As numerous studies of fishing societies have indicated, one of the most important reasons for targeting specific fishes is ecological. As Rick (2007:139) suggests, most of the variation in the significance of fish species to a group is a product of local fluctuations in the abundance of fishes or their habitats, season of availability, and the types of technology available for catching fish. The general characteristics of a fishery (seasonality, distribution, density, biological structure, and behavior) are major determinants of the social organizational requirements involved in fishing (Salls 2000:56). Distance from the residential base to the fishing location would be a major factor affecting most marine fisheries. The farther away a fishery ground is, the more difficult it becomes to obtain optimal returns from fishing forays (Cordell 1980:53). In fishing, estimation of time and energy expenditures must account for wind patterns, current, climatic variations, upwelling, season of abundance, and other oceanic influences (Salls 2000:56). Ethnographic research has clearly shown that fishermen attempt to maximize their catch by exploiting various environments (Acheson 1981; Kirch and Dye 1979). Based on fishing-related artifacts and bone assemblages from the study sites, many of the same fish were caught throughout the last 5000 years. The focus was on species that could be easily procured within the immediate vicinity of sites. Late Period fishing strategies appear to have expanded; however, and require consideration.

By the Late Period, occupants at CA-SLO-71 were catching a higher proportion of schooling fish, which comprise almost half of the fish assemblage. Coinciding with this increase in small migratory fish is the presence of thick fire-altered rock layers interspersed with Monterey pine wood charcoal that span the width of the site (Joslin 2006). The high density of burned rock (700 kg/$m^3$) and charcoal (1700 g/$m^3$) is not associated with discrete features, such as ovens or hearths, and does not occur in sites dated to earlier time intervals. Across California fire-altered rock was used for cooking a variety of subsistence remains (e.g., Glassow 2004; Lebow and Harro 1999; Pierce 1982; Waechter 2005; Wandsnider 1996). Because fire-altered rock, charcoal, and fish bone are all unusually abundant at CA-SLO-71 they may provide evidence of preparation of fish for storage and transport of fish to interior locations. Ethnohistorical information suggests that coal-roasting may have been practiced to process fish, with the larger fish gutted and flayed and placed over the coals and the smaller fish perhaps just draped over the heated rocks. Placing the fish on heated rocks would have the added benefit of avoiding direct contact with sand and dirt, increasing aeration, and decreasing grit and spoilage.

Cross-culturally, while netting is often more efficient than hook and line technology, large-scale netting fish from the ocean can only be accomplished by a collective group, and returns oftenshared between multiple individuals (Alvard and Nolan 2000; Bright and Milner 2002; Kirch 1982; Lupo and Schmitt 2002; Wilkie and Curran 1991). Such large-scale netting would require mass collecting to offset the cost of manufacturing and maintenance, a more optimal strategy for return rates (Bettinger et al. 2006; Ugan 2005), although small dip nets would also have been effective, without the large labor investment. Along the southern San Simeon Reef, the time spent searching would be minimal in the fall, when small inshore/offshore fish congregate in tight schools or bait-balls" just outside the kelp forest. A wide range of fish-processing techniques may have been used for immediate consumption, long or short-term storage, and transportation, including fish salting/brining, drying, broiling, and smoking, all of which may have required coordinated group efforts. With an increased and large-scale reliance on the seasonally abundant small migratory fish, pre-arranged organization of activity would require groups with ecological knowledge of habitats procured the fish from offshore waters (Lauer and Aswani 2009), while at the camp individuals would have been engaged in processing. An increased focus on storage can also involve increased group interaction, cooperation, and sharing (Bliege Bird and Bird 1997; Hawkes 1992).

## San Simeon Reef Settlement Context and Seasons of Occupation

Having established the subsistence base of populations who occupied the study sites and the temporal trends in resource use, I now consider the placement of sites within particular types of settlement system(s) that existed along the southern San Simeon Reef. Situating the research sites and their function(s) in relationship to other sites will help to elucidate broader patterns of land and resource use and changes in settlement organization through time. This task is challenging, as sites usually were occupied many separate times, and they may be used in different ways depending on their position relative to the overall settlement pattern. However, repetitive and longer periods of occupation at locations is more likely as people become more sedentary depending on the spatio-temporal variability of the environment.

### Millingstone

Important to understanding the settlement context of the study sites is knowledge of the nature of the system before 5000 calBP. Three Millingstone sites represent principal residential bases within a semi-sedentary adaptation (Table 11.19, Figures 11.14 and 15). They are located along the southern San Simeon Reef, two on the prominent Lodge Hill, and one along the San Simeon Estuary. The Lodge Hill sites (CA-SLO-177 and SLO-369) are

Table 11.19. San Simeon Reef Radiocarbon-Dated Millingstone and Early Period Sites.

| SITE | AGE | LOCALITY: LANDFORM | SITE TYPE |
|---|---|---|---|
| | | MILLINGSTONE | |
| SLO-177[a] | 9170-8940 calBP | Cambria: Hill Top/Flank | Residential Base |
| SLO-369[a] | 9330-8850 calBP | Cambria: Hillslope/Flank | Residential Base |
| SLO-383[a] | 6360-6120 calBP | San Simeon Creek: Marine Terrace | Residential Base |
| | | EARLY PERIOD | |
| SLO-72 | 4990-4850 calBP | San Simeon: Marine Terrace | Secondary Residential |
| SLO-116 | 3560-3390 calBP | San Simeon: Marine Terrace | Secondary Residential; Processing |
| SLO-175[a] | 4930-3570 calBP | San Simeon: Marine Terrace | Residential Base |
| SLO-177[a] | 3380-3110 calBP | Cambria: Hill Top | Residential Base |
| SLO-179[a] | 4610-4350 calBP | San Simeon: Upper Marine Terrace | Residential Base |
| SLO-265 | 5700-5110 calBP | Piedras Blancas: Marine Terrace | Secondary Residential /Procurement |
| SLO-273/H[a] | 3950-2800 calBP | Piedras Blancas: Upper Marine Terrace | Residential Base |
| SLO-274 [a] | 5720-2810 calBP | Piedras Blancas: Upper Marine Terrace | Residential Base |
| SLO-327 | 4800-4600 calBP | Estero Point: Marine Terrace | Residential Base |
| SLO-369[a] | 5780-4290 calBP | Cambria: Hillslope/Flank | Residential Base |
| SLO-383[a] | 5780-5050 calBP | San Simeon Creek: Marine Terrace | Residential Base |
| SLO-697 | 5320-4020 calBP | Cambria: Marine Terrace | Residential Base |
| SLO-762 | 5030-3480 calBP | Cambria: Marine Terrace | Residential Base |
| SLO-1223 | 4790-4710 calBP | Estero Point: Marine Terrace | Secondary Residential |
| SLO-1288 | 4360-4110 calBP | Estero Point: Pericoastal Valley | Residential Base |
| SLO-1253 | 5080-4780 calBP | Estero Point: Marine Terrace | Residential Base |
| SLO-1294 | 4360-4140 calBP | Estero Point: Marine Terrace | Secondary Residential |
| SLO-1295 | 5190-2860 calBP | Estero Point: Marine Terrace, Hillslope | Secondary Residential |
| SLO-1485 | 5130-4860 calBP | Cambria: Marine Terrace | Secondary Residential |
| SLO-1487 | 4590-4840 calBP | Cambria: Marine Terrace | Secondary Residential |
| SLO-1622 | 4660-3760 calBP | Cambria: Marine Terrace | Secondary Residential |
| SLO-1677 | 4910-3640 calBP | Cambria: Marine Terrace | Residential Base |
| SLO-2637 | 5470-5310 calBP | Estero Point: Marine Terrace | Residential Base |

Note:[a] Muticomponent site; Site types are defined in Chapter VI; Age refers to range of calibrated radiocarbon date midpoints; Appendix B, Table B1 includes data and references.


Figure 11.14. San Simeon Reef Millingstone and Early Period Site Distribution.

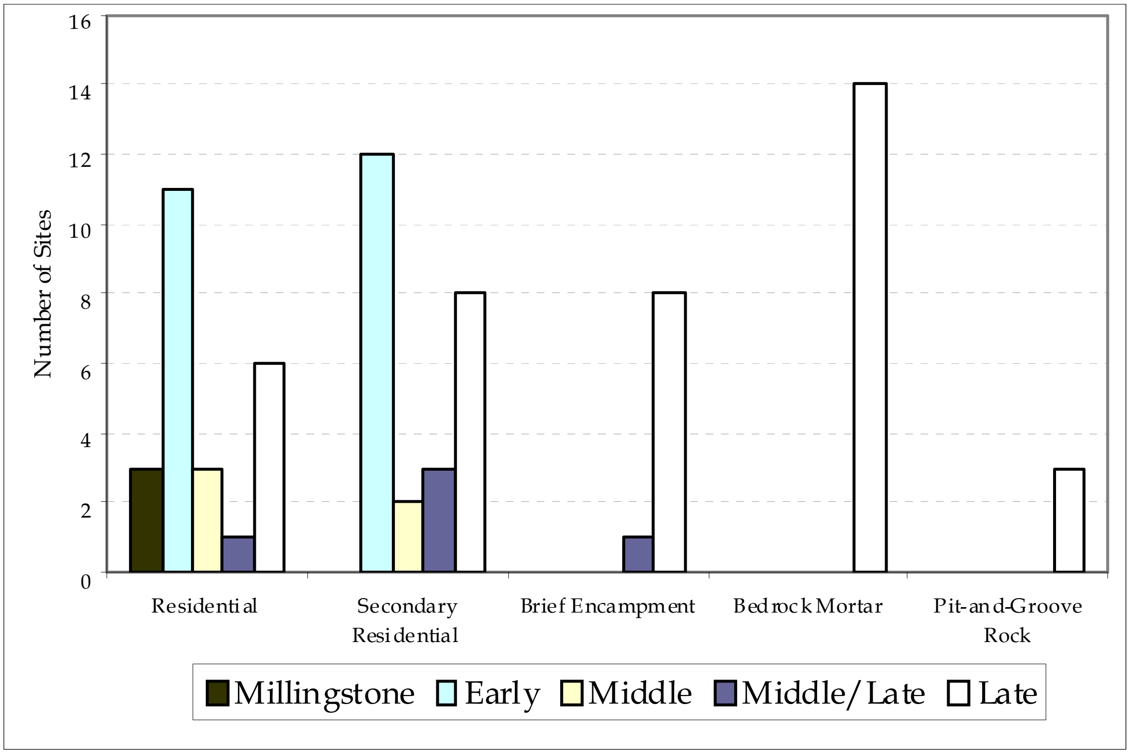


Figure 11.15. Summary of Site Types in San Simeon Reef Settlement Systems.

unique central places that were occupied over the course of at least 10,000 years, from the Millingstone Period until Spanish contact. A possible house floor and burials at CA-SLO-369 suggest a sedentary population that used the site as a residential base (Parker 2004). Consistent with a lifeway along the kelp highway (Erlandson et al. 2007), early occupants used all local environments, with a broad-spectrum adaptation and a distinct marine component (Jones et al. 2008c). However, as with other sites grouped into the Paleo-Coastal Tradition sites, such as Cross Creek and Diablo Canyon, there is a great deal of adaptive variability that implies different settlement system variants (Jones et al. 2008b). Although southern San Simeon Reef Millingstone people hunted deer and small game and collected plant materials, they appear to have been focused on the dense and diverse resources located along the open coastline, particularly at locations where rocky intertidal resources were available.

The current sample of sites suggests that the earliest populations preferred the sheltered environments and expansive viewsheds of the Cambria area Lodge Hill, as no Millingstone sites have been identified along the coastline to the north. However, depositional processes may have buried some Millingstone sites. Alternatively, it is possible that the low frequency of Millingstone sites found in outer coast settings, and their relative abundance in local estuary settings (i.e., Pismo Beach and Morro Bay) may simply be the result of differential preservation within these two habitat types. If most of the outer-coast sites were originally located immediately adjacent to the rocky inter-tidal zone, then most of them would have been eroded away during Holocene sea level rise and sea cliff retreat as such sites would have been located more than 3,000 m to the west and more than 25 m below the current sea level (Erlandson 2008; Hildebrandt et al. 2007:111).

**EARLY PERIOD**

Around 5700 calBP the number of occupied sites increased significantly along the San Simeon Reef, particularly along the open rocky intertidal coastline. The largest proportion of sites within the study area, twenty-three or 44 percent of the sites, have Early Period occupation deposits (Table 11.19, Figure 11.14). Because Early Period populations were oriented towards exploitation of marine resources, particularly shellfish, the sites are predominately located on marine terraces immediately adjacent to fresh water, with two located on Lodge Hill and one in a pericoastal valley. The settlement system during this between 5500 and 3000 calBP, appears to be a variant of a “collector” type of settlement system in Binfords’s terms. Primary residential and secondary residential bases are represented in almost equal proportions, 48 percent and 52 percent respectfully. Although a greater diversity of sites is obviously part of the larger settlement system, such as brief encampments and locations serving ideological purposes , not all types are represented among the study sites. Data from Early Period sites along the San Simeon Reef seem to reflect muti-seasonal use of the coast from fall through winter, use of the interior in the spring, and a return to the coast in summer (Jones and Ferneau 2002a).

An indicator of the site's role as a residential base is the number of artifact classes in the overall assemblage. Residential bases should contain a greater diversity of artifact categories than secondary, shorter-term residential or seasonal bases under the assumption that a broader range of activities takes place at the principal bases. Two Early Period study sites (CA-SLO-1295 and SLO-1622) have collections that appear to indicate briefer episodes of residential occupations. Although Early Period site CA-SLO-1677 appears to have the same density, when the abundance of beads, human remains, obsidian, and ornament blanks are considered, the site appears to be a residential base. It is clear that the red abalone middens, CA-SLO-1622 and SLO-1677, are not exclusively processing locations based on the diversity of artifacts and subsistence remains that suggest a wide range of activities.

Another indicator of a site's placement in the settlement system is the rate at which cultural remains accumulate. A residential base would be expected to have a high rate of accumulation due to the longer period during the annual cycle when the site was occupied as well as the greater intensity of food processing activities. This would ideally be reflected in the rate of accumulation of cultural remains per unit of time. Without the fine-grained site chronologies needed to ascertain accumulation rates, I have based this inference on the densities of certain classes of cultural remains per cubic meter of excavated deposit presented earlier in this chapter. The frequencies and densities of shellfish remains are key indicators, as they are products of a nearly ubiquitous subsistence activity. Shellfish densities at CA-SLO-1295 (85.8 kg/m$^3$) and SLO-1677 (71.2 kg/m$^3$) stand out from the other sites because of their exceptionally high volumes of shell. When the other classes of food remains are considered, it is clear that CA-SLO-1677 has generally higher densities of most categories and a high proportion of artifacts. Occupants at CA-SLO-1677 must have lived at this site for a longer period of time during an annual round than was the case at the surrounding sites. Additional data on inter-site variations in artifact diversity and information on season(s) of occupation would of course provide the necessary details to better understand the specific nature of these sites.

**MIDDLE PERIOD**

Populations along the north coast of San Luis Obispo appear to have congregated in large, primary residential settlements during the Middle Period (Jones and Ferneau 2002a). The five San Simeon Reef Middle Period sites include three residential bases and two secondary residential bases (Table 11.20, Figure 11.16). The sites are located along the open coastline on

Table 11.20. San Simeon Reef Radiocarbon-Dated Middle, Middle/Late Transition, and Late Period Sites.

| SITE | AGE | LOCALITY: LANDFORM | SITE TYPE |
|---|---|---|---|
| | | **MIDDLE PERIOD** | |
| SLO-77 | 2450-2380 calBP | Piedras Blancas: Marine Terrace | Secondary Residential |
| SLO-187[a] | 2580-1570 calBP | San Simeon Creek: Terrace | Residential Base |
| SLO-267[a] | 2970-1040 calBP | Piedras Blancas: Marine Terrace | Residential Base |
| SLO-369[a] | 2210-1010 calBP | Cambria: Hillslope/Flank | Residential Base |
| SLO-1218 | 2700-2430 calBP | Via Creek: Ridgetop | Secondary Residential |
| | | **MIDDLE/LATE TRANSITION** | |
| SLO-267[a] | 870-960 calBP | Piedras Blancas: Marine Terrace | Residential Base |
| SLO-273 | 1000-690 calBP | Piedras Blancas: Upper Marine Terrace | Secondary Residential |
| SLO-274[a] | 860-730 calBP | Piedras Blancas: Upper Marine Terrace | Brief Encampment |
| SLO-1290 | 1300-830 calBP | Estero Point: Marine Terrace | Secondary Residential |
| SLO-2563 | 920-690 calBP | Estero Point: Marine Terrace | Secondary Residential |
| | | **LATE PERIOD** | |
| SLO-71 | 612-480 calBP | Cambria: Marine Terrace | Residential |
| SLO-115 | 670-70 calBP | Cambria: Marine Terrace | Secondary Residential |
| SLO-175[a] | 490-300 calBP | San Simeon: Marine Terrace | Brief Encampment |
| SLO-178 | 390-110 calBP | Cambria: Hillslope/Flank | Residential Base |
| SLO-179[a] | 880-700 calBP | San Simeon: Upper Marine Terrace | Brief Encampment |
| SLO-184 | 230-0 calBP | Cambria: Marine Terrace | Secondary Residential /Procurement |
| SLO-186 | 620-30 calBP | San Simeon Creek: Upper Marine Terrace | Secondary Residential |
| SLO-187[a] | 890-670 calBP | San Simeon Creek: Upper Marine Terrace | Residential Base |
| SLO-221 | 250-210 calBP | San Simeon Creek: Upper Marine Terrace | Residential Base |
| SLO-267[a] | 740-330 calBP | Piedras Blancas: Marine Terrace | Secondary Residential /Procurement |
| SLO-369[a] | 1080-610 calBP | Cambria: Hillslope/Flank | Residential Base |
| SLO-460 | 290-60 calBP | Cambria: Marine Terrace | Secondary Residential |
| SLO-826 | 560-380 calBP | Piedras Blancas: Marine Terrace | Secondary Residential |
| SLO-1259[a] | 500-340 calBP | Piedras Blancas: Marine Terrace | Brief Encampment |
| SLO-1289 | 540-230 calBP | Estero Point: Marine Terrace | Secondary Residential |
| SLO-1373 | 630-200 calBP | San Simeon Creek: Marine Terrace | Residential Base |
| SLO-1437 | 540-380 calBP | Green Valley: Hillslope | Secondary Residential |

Note: [a] Muticomponent Site; Age refers to range of calibrated radiocarbon date midpoints; Appendix B Table B2 includes data and references.

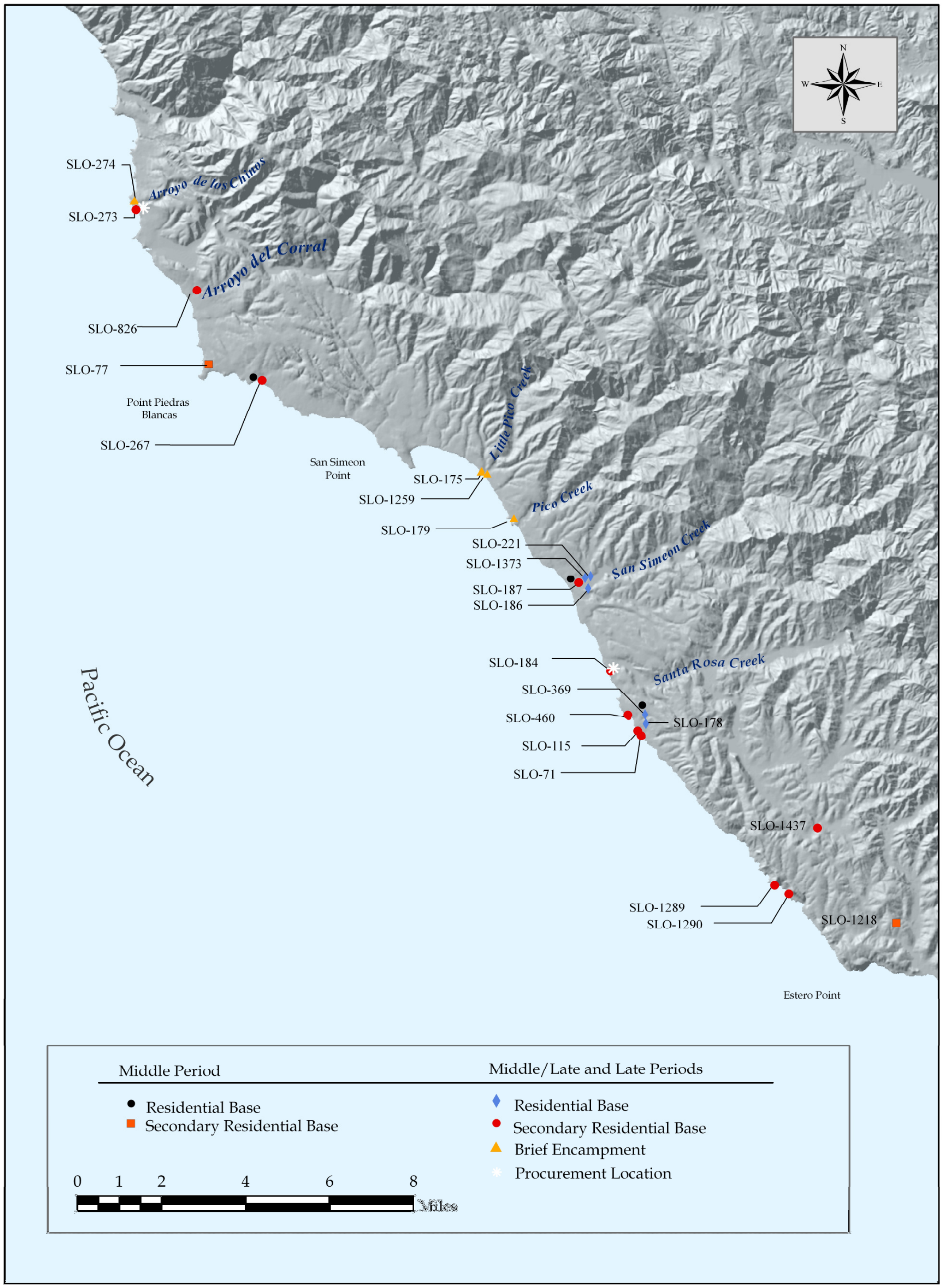


Figure 11.16. San Simeon Reef Middle, Middle/Late Transition, and Late Period Site Distribution.

marine terraces and on Lodge Hill, and one is situated next to pericoastal Via Creek. Based on the rich site collections, inter-site variability in task areas, and human burials, the primary residential sites suggest this interval is characterized by *collector*-type settlement systems (Binford 1980). Secondary sites contain rich, but shallow middens and a lower diversity and density of artifacts, reflecting a lower frequency of domestic activities suggestive of a shorter duration of occupation. These site types suggest that the local Middle Period settlement system was characterized by at least two types of functional sites: long-term and short-term residential bases similar to the situation in the interior of Big Sur (Jones 2003). Seasonality indicators at CA-SLO-267 show evidence of occupation from summer through winter, with a gap in occupation during the spring (Jones and Ferneau 2002a).

**MIDDLE/LATE TRANSITION**

The Middle/Late Transition was a time of highly visible culture change, marked by major shifts in behavior such as widespread site abandonment. This period coincided with the unfavorable drought conditions associated with the Medieval Climatic Anomaly that brought prolonged droughts and low terrestrial productivity throughout much of western North America (Graumlich 1993; Stine 1994). These broad-scale environmental trends had widespread effects on local human populations, and research in central California has offered compelling evidence for settlement disruption during the Middle-Late Transition (Codding and Jones 2007; Jones and Ferneau 2002a Jones et al. 1999, 2007).

Five sites along the San Simeon Reef date to this interval. They include one residential base, three secondary residential bases, and a brief encampment (Table 11.20, Figure 11.16). In general these deposits appear to be products of small, mobile populations, based on the relatively shallow deposits suggestive of neither a *forager* nor a *collector* pattern (Binford 1980). All of the sites are located on marine terraces immediately adjacent to rocky intertidal environments. As inferred from artifact assemblage diversity and a shallow deposit, CA-SLO-2563 is a secondary residential base that spans this period, 920-690 calBP. Although there are limited seasonal indicators, the presence of inshore/offshore migratory fish suggests at least a late summer and fall occupation. A subsistence shift to fishing and a decrease in the importance of large terrestrial vertebrates, abundant in earlier time intervals, suggest a change in social organization, similar to events occurring at the Coon Creek Site (CA-SLO-9, Codding and Jones 2007:144). These two sites show similar shifts from the Middle Period in artifact assemblages and subsistence pursuits. Such changes are generally consistent with foragers experiencing a change in their environment and confronting that change by altering their technology and subsistence strategies.

## Late Period

Settlement and subsistence during the Late Period departs in significant ways from that of earlier intervals (Joslin 2006). The currently available site sample suggests that the general distribution and composition of Late Period sites along the San Simeon Reef reflect an increasing emphasis on fishing and a greater diversity of marine resources exploited, therefore, an increase in coastal locations for settlement (Table 11.20, Figure 11.16). CA-SLO-71 and SLO-115 are indicative of secondary residential bases that were occupied for part of the annual round. CA-SLO-71, however, may be a more permanent base that was occupied for a short interval. The greater diversity of task-specific tools, suggesting a greater number of tasks were conducted on site, supports the inference that it was a permanent base. Late Period sites are predominately situated along the lowermost marine terrace and upper marine terraces, with several found on coastal hillslopes and flanks, as well as interior hillslope locations. Within the San Simeon Reef area, there are five well-developed residential bases or village sites, three at San Simeon Creek and two on Lodge Hill. San Simeon Creek has substantial deposits that span the Middle, Middle/Late Transition, and Protohistoric Periods. Surrounding the longer-term habitation sites are secondary residential bases, brief encampments, and processing locations or logistic sites. Based on seasonal indicators, CA-SLO-71 and SLO-115 would have been occupied late summer through winter, which is consistent with similar sites in northern San Simeon Reef and Big Sur (Jones 2003:185).

The southern San Simeon Reef Late Period subsistence-system does not appear to conform to either a *forager* or a *collector* pattern. Specifically, coastal areas are marked by a large proportion of residential sites that suggests a forager mobility strategy. Ethnohistoric accounts indicate that local people stored food such as fish and plant resources (particularly pine nuts and acorns), which is consistent with the collector model. Late Period populations appear to have been residentially mobile, however, occupying a higher proportion of shorter-term habitation sites. Most of the sites are single components, suggesting a shift in settlement from earlier intervals. The shallow middens may also be characteristic of the shorter occupation interval attributed to the Late Period.

This model of settlement could be a result of resource stress put in motion during the Middle/Late Transition, where drought conditions made an already patchy environment even more heterogeneous. Terrestrially based adaptations appear less viable, as decreased rainfall would coincide with a reduction in plant productivity, particularly flowering plants and bulbs associated with wetlands. A decrease in terrestrial plant productivity would, in turn, affect the deer and rabbit populations. To adapt, prehistoric groups may have turned to a more mobile settlement pattern as a means of risk management, acquiring resources from all available locations. As will be discussed in the next section, the importance of marine resources to populations is suggested by the increase in shellfish remains at interior locations 30 km east in the Lower Nacimiento River watershed. Although this coastal-interior relationship cannot be elucidated as part of this research, the data hint at subsistence and settlement practices that at least for part of the year were centered on coastal environments.

### LATE HOLOCENE SEASONALITY STABILITY

Recent oxygen isotope determinations from ten Middle Period through Mission Period inland and coastal sites and an analysis of historic contact records provide the most revealing details on settlement and seasonality (Jones et al. 2008a). The findings imply that coastal residents harvested mussels nearly year-round, with reduced frequency in the winter, and appear to have occupied individual residential bases throughout the seasonal cycle. Researchers have suggested two interdependent foraging strategies with distinct seasonal settlement strategies: "…inland people who were reliant on acorns and other nut crops harvested in the fall (e.g., pine and buckeye nuts), and coastal inhabitants who were less reliant on acorns" (Jones et al. 2008a:2292). This is a pattern consistent with accounts by the first Spanish explorers moving along the open coast who observed Native Americans during spring, late summer, fall, and winter, as well as concentration of populations in the late summer/early fall at the same time that a substantial aggregation was documented in the interior harvesting nuts. Collectively, the isotope findings and ethnohistoric accounts suggest that the coast seems never to have been abandoned during any time of the year, and the interior settlement strategy involved periodic coastal migrations while the coastal system included year-round occupation of individual residential bases (Jones et al. 2008a:2292). It seems, then, that coastal resources supported a settlement system over approximately a 4000 year interval that did not conform to either of Binford's collector or forager settlement strategy and is characterized by the Jones et al. (2008a) as "semi-sedentary."

The settlement systems presented here clearly illustrates that low population density was an important determinant of the nature of a settlement system, perhaps allowing for far more flexibility. It also illustrates the potential to oversimplify site types and functions, particularly in a rich marine environment (Habu and Fitzhugh 2002). The San Simeon Reef is one of the areas where hunter-gatherer-fishers shifted along the forager/collector continuum rather frequently, and as a result, settlement patterns varied even at local level (Chatters 1987; Laylander 1997; Zeanah 2002).

## INTER-REGIONAL EXCHANGE

Economic exchange systems are potentially an important buffer between population and fluctuation in subsistence resources. Evidence of subsistence exchange, however, is difficult to document due to preservation, making more durable toolstones the best index. As most researchers recognize, adaptive changes are associated with a series of important socio-economic developments, particularly those associated with sedentism, territorial circumscription, and inter-regional exchange. Jones and Waugh (1995) proposed that increased complexity occurred sometime during the Early Period, around the time the earliest study sites were occupied, and was probably due to a major reorganization of the subsistence-settlement system. They propose that increased population pressure led to greater sedentism and increased territoriality that in turn led to greater reliance on inter-group exchange for the acquisition of non-local resources.

Obsidian is perhaps the most important indicator of intra- and inter-regional exchange systems. Most of the obsidian found along the central coast originated from either Casa Diablo or the Coso volcanic fields in the eastern Sierra. Analysis of obsidian hydration data from these two source areas shows that the trade of these commodities into the central coast did not remain constant over time, with the peak of exchange during the Middle Period (3000-1000 calBP) and limited exchange after 1000 calBP (Jones and

Ferneau 2002a). Obsidian recovered from two Early Period study sites, though of low frequency, shows populations along the southern San Simeon Reef were part of this exchange system, with a regional focus on these two sources. Of the seven pieces of obsidian debitage recovered from Early Period sites CA-SLO-1622 and SLO-1677, five flakes are from the Casa Diablo area and two from the Coso volcanic field. No obsidian was recovered from the Late Holocene sites.

The study of transportation and exchange of marine fish and shellfish from the coast to interior locations can provide significant insights on both exchange and regional patterns of settlement organization (Hildebrandt 2002; Joslin 2006). Along the southern San Simeon Reef, evidence of subsistence exchange comes from the transportation of rocky intertidal shellfish to interior site CA-SLO-1180 located in the lower Nacimiento watershed approximately 30 km northeast (Figure 11.17, Carpenter et al. 2007). The movement of marine shellfish to this region shows a dramatic increase over time at sites situated in productive habitats along the Nacimiento River that would not have required access through long-distance logistical strategies (Basgall 2007; Carpenter et al. 2007). Shellfish, a resource that required prolonged travel to acquire, occurs at CA-SLO-1180 at the termination of the Middle/Late Transition (58 $g/m^3$) and increases through the Late Period (325 grams) to 1,273 grams by the end (Carpenter et al. 2007:189).

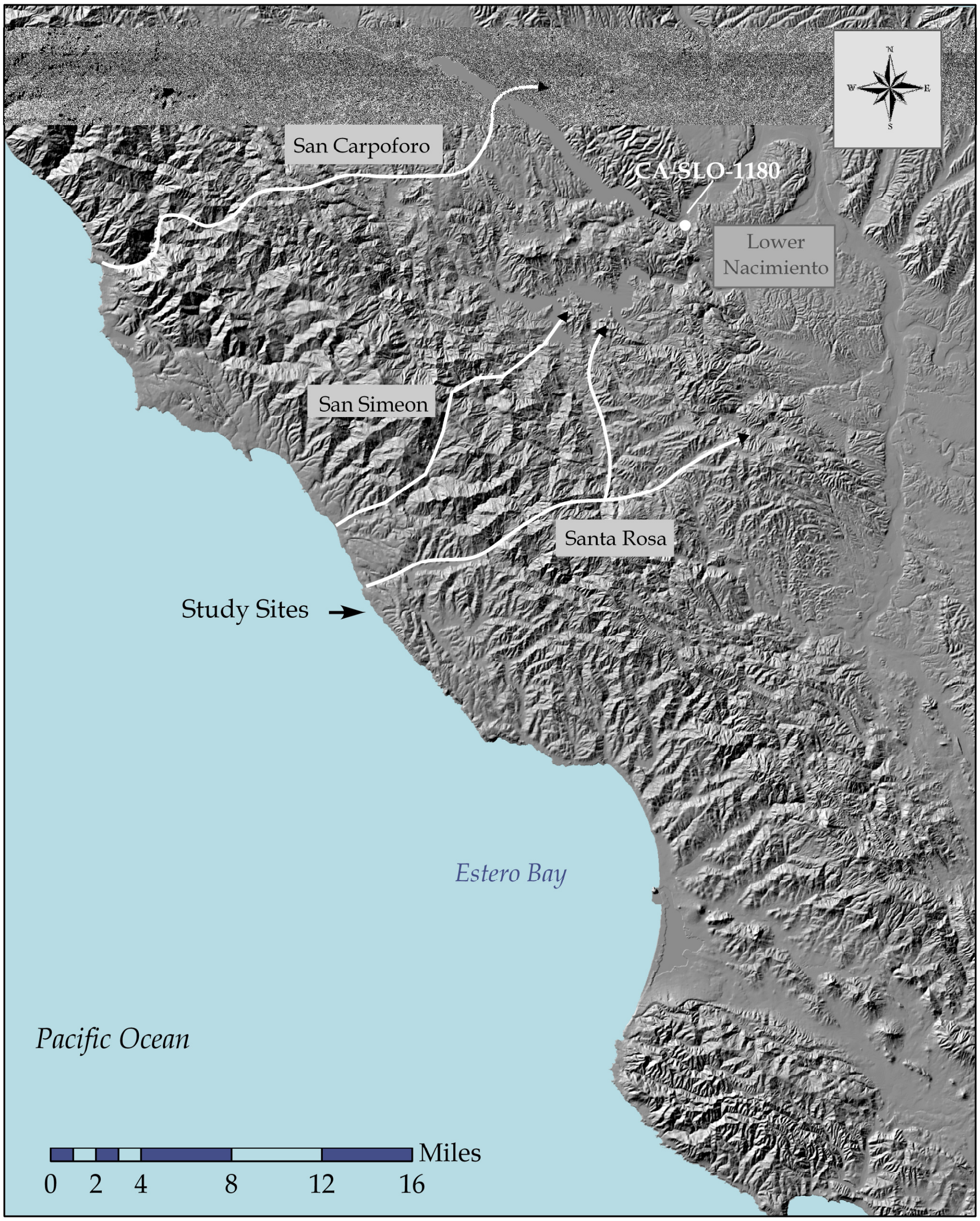


Figure 11.17. Potential Routes for Interior Transportation of Marine Resources.

One means of interpreting this pattern is through central place foraging models that are concerned with efficiency in field processing (Bettinger et al. 1997; Bird and Bliege Bird 1997). Hildebrandt et al. (2007:117) suggest that a significant amount of field processing should occur on the coast prior to moving resources over long distances. In the case of shellfish, it is expected that selective transportation of higher ranking species should occur, in this case California mussel. An analysis of the metabolic costs and benefits of collecting and transporting California mussel resulted in a return rate of 300 kcal/hour for the 30-kilometer trip, which is much lower than many alternative resources that could have been obtained in the interior (e.g., deer) (Carpenter et al. 2007:194). The CA-SLO-1180 shellfish assemblage suggests that although larger proportions of California mussel (54%) and black turban snail (36%) were targeted, so were a diverse array of other species (Table 11.21). The CA-SLO-1180 collection may have originated from the northern San Simeon Reef, where mussel beds are productive, or mussel was specifically targeted for transportation to the interior. This diverse assemblage suggests a non-selective approach to collecting and transporting.

Transportation of shellfish into the interior may also have a foundation in maintaining social ties with neighboring groups to insure access to a variety of resources after the catastrophic droughts associated with the Medieval Climatic Anomaly (Jones et al 1999). Under the severe drought

Table 11.21. Comparison of Late Period Coastal and Interior Shellfish Assemblages.

| | **Coastal** ----- CA-SLO-71/115 ---- | | **Interior** ----- CA-SLO-1180 ----- | |
|---|---|---|---|---|
| | Weight (g) | Percent | Weight (g) | Percent |
| Black Turban Snail | 784.6 | 49.6 | 269.6 | 36.4 |
| Limpet | 230.5 | 14.6 | 17.4 | 2.4 |
| Chiton | 134.6 | 8.5 | 25.4 | 3.4 |
| Mussel | 129.6 | 8.2 | 396.6 | 53.6 |
| Barnacle | 4.9 | 0.3 | 16.9 | 2.3 |
| Other | 297.3 | 18.8 | 14.3 | 1.9 |
| Total | 1,581.5 | 100.0 | 740.2 | 100.0 |

Notes: CA-SLO-71/115 (Joslin 2006); CA-SLO-1180 (Carpenter et al. 2007).

conditions, when interior terrestrial mammals were severely depleted and possibly over-hunted, shellfish may have been added to the diet despite the high costs associated with transportation. However, an analysis of the vertebrate remains for the lower Nacimiento River does not indicate depletion of the local game populations, as deer-sized animals are well-represented in the assemblage (Carpenter et al. 2007:192). Although it is uncertain how shellfish reached the interior, through direct access by groups from the interior, by exchange with coastal people, or as part of an interior-coastal seasonal round, this pattern indeed had its foundation in a time of unprecedented climatic fluctuations. A similar pattern of social responses to climate change beginning around the time of the Middle/Late Transition also occurred in the Santa Barbara Channel region (Johnson 2000). It is also possible that the shellfish are a result of coastal people attending multicommunity gatherings hosted by an interior village and it this context, the imported shellfish would have been a delicacy.

## CONCLUSION

The data presented in this chapter set the stage for addressing the research questions on social, economic, and ecological developments among the Playano and their predecessors in the next chapter. The detailed analysis of subsistence remains, particularly marine shellfish and fish, provides a perspective on both dietary choices and how humans interacted with, and potentially altered, local habitats through time.

# CHAPTER XII: ADDRESSING THE RESEARCH QUESTIONS

> Conditions of risk sensitivity (especially in times of economic crisis) should compel more inventive behavior, and more inventive behavior will increase the probability of an improvement that could get picked up and replicated at an archaeologically visible scale through processes of innovation (Fitzhugh 2001:156).

Having presented information on population fluctuation and environmental change, and investigated the nature of subsistence and settlement pursuits along the southern San Simeon Reef, I now turn to the task of addressing the three major research questions. The research questions are directly related to understanding how local people utilized coastal resources and how their marine resource subsistence-settlement strategies were affected by diachronic environmental fluctuations.

- **USE OF MARINE ENVIRONMENTS**: Do episodes of more frequent coastal occupations appear in the archaeological record during the Middle and Late Holocene? If so, is this increase a result of population changes caused by environmental factors, such as fluctuations in marine and terrestrial productivity?

Based on the site frequency data, at the onset of the Middle Holocene around 5700 calBP, population density appears to have increased along the open coastline of the San Simeon Reef area. There is no indication that the increase in sites is a reflection of regional population movement. Marine resource productivity appears to have been high, as cooler than current seawater surface temperatures existed around 5750 and 5150 calBP in the Santa Barbara Channel area (Kennett et al. 2007) and greater upwelling off the mouth of San Francisco Bay is reported at this time (van Geen et al. 1992). Sites are located at frequent intervals along the coast, and compared to sites in the interior Lower Nacimiento watershed, there appears to be no major difference between interior and coastal sites with respect to size and intensity of occupation, perhaps due to low population density, high mobility, and limited territoriality. Lodge Hill sites and CA-SLO-1677, perhaps due to the expansive viewsheds and abundant and diverse resources, continue to be central places where primary residential activities took place. Secondary habitation sites (e.g., CA-SLO-1295 and SLO-1622) are situated in a variety of environments. Higher mobility is reflected in relatively shallow midden deposits and the apparent low rate of accumulation of cultural remains. Greater mobility or interregional trade is also suggested by the high frequencies of interior Franciscan chert and imported obsidian in Early Period sites. The initial occupants focused on a highly diversity of near shore marine resources, with apparently minor hunting of marine and terrestrial mammals. Off-site butchering practices and the small sample size may bias the assemblage of large mammal bones. The abundance of small sites at regular intervals implies that smaller social groups were very mobile during at least portions of the year, moving along the land at more frequent intervals to target locally abundant and diverse resources, and reliable fresh water.

During the Late Holocene, after the effects of the Medieval Climatic Anomaly drought intervals around 1000 calBP, populations occupied the coastline in higher frequencies to target more dependable marine resources, particularly near fresh water. Ethnographic information suggests population densities remained relatively low, with pre-mission population along the San Simeon Reef only around 300 people (Milliken and Johnson 2005). Although frequencies of radiocarbon-dated deposits increase, to 18 or almost half of the total dated components, the increase does not appear to a result from higher population density but rather a more mobile strategy that left more traces of smaller sites with shallower deposits.

Much like the land use of San Simeon Creek, new settlements during the Late Period are spatially distinct from earlier occupation, for the purpose of focusing on new resources, namely marine fish, sea mammals, and birds. Populations along the north coast of San Luis Obispo appeared to have congregated in residential bases during the Middle Period (Jones and Ferneau 2002a); however, by the Late Period populations appear residentially mobile, occupying a higher proportion of short term habitation sites. This residential strategy appears to be a result of resource stress put in motion during the Middle/Late Transition, where drought conditions made an already patchy environment even more heterogeneous. Terrestrially focused adaptations appear to have been less viable, as decreased rainfall would coincide with a reduction in plant productivity, particularly flowering plants and bulbs associated with wetlands. A decrease in terrestrial plant productivity would, in turn, affect the deer and rabbit populations. To adapt, prehistoric groups appear to have turned to reliable coastal resources. The Late Period CA-SLO-71 and SLO-115 site assemblages are consistent with a model in which foragers were experiencing a change in their surrounding environment and faced this change by adjusting their technology and subsistence strategies by diversifying.

- SITES IN THE SETTLEMENT SYSTEM: Are diachronic shifts in the location of particular types of sites a result of changes in the distribution and abundance of marine resources brought about by environmental change, the changing importance of terrestrial resources, or resource intensification?

The earliest known San Simeon Reef site occupations are residential bases on Lodge Hill dating between about 9300 and 8900 calBP. After this time period there is an occupational hiatus along the north coast, with no sites dating between approximately 8800 and 6300 calBP. It appears that by around 6400 calBP the cultural type characterizing the Millingstone Period came to an end. Population density may have been responding to the onset of the long period of relatively arid climatic conditions and fluctuating sea water temperatures associated with the Altithermal.

At the onset of the Middle Holocene, population appears to have increased, as suggested by the higher frequencies of radiocarbon dated components. Cooler and wetter climatic conditions, a more productive terrestrial environment, and cooler sea water temperatures may have been the precursor to population growth, as substantial population growth after 5200 calBP along the Santa Barbara Channel (Glasow 1996:113). The settlement system appears to be a variant of collecting, with primary residential and secondary residential bases represented in almost equal proportions. As populations were oriented towards exploitation of marine resources, particularly shellfish, all sites are situated on marine terraces above the rocky intertidal sections of the coastline and immediately adjacent to fresh water. An increase in the number of milling tools in the Early Period sites indicates that plant resources appear to be of greater dietary significance to occupants along southern San Simeon Reef than to the north along the open coast. Temporally (5400 and 3000 calBP) and spatially discrete to the southern

San Simeon Reef are 11 distinctive red abalone middens. The shellfish assemblages are comprised of red abalone as well as the shells of cold-water, lower intertidal species, suggesting cooler surface seawater temperatures and a change in human collecting strategies initialing resource diversification.

At the onset of the Late Holocene, the Middle Period (3000 to 1000 calBP) residential bases appear to be loci of population aggregation, evidenced by the low frequency of spatially extensive deposits containing high densities of subsistence remains and a diversity of artifacts suggesting a wide range of domestic activities. Sites from this interval reveal continuity with the Early Period, but Jones and Ferneau (2002a) suggest an increase in the use of marine resources, specifically mussel and fish, consistent with a limited amount of subsistence intensification. This shift to a greater emphasis on fish and shellfish may have been a result of the reduction in the abundance of land mammals, particularly deer, compared to their abundance during the Early Period.

Coinciding with the end of this period is the Medieval Climatic Anomaly, between approximately 1000 and 650 calBP, marked by unusual and prolonged droughts and low terrestrial productivity through much of North America. During this interval of short-term and sporadic fluctuations in rainfall and sea temperature, there appears to be a decline in permanent residences and a concomitant increase in both short-term occupation and abrupt subsistence shifts. Across the central coast there appears to be fewer and less substantial sites located in the interior relative to the coast due to a decline in fresh water and terrestrial plant resources.

Significantly, populations respond to resource instability by adopting a mixed forager and collector subsistence strategy entailing the use the complex mosaic of land and near shore habitats along the coast. Such changes are generally consistent with foragers experiencing a change in their surrounding environment, and confronting that change by intensifying their technology and subsistence strategies. One example is the reduction in shellfish dependence, which coincides with a marked increase in the importance of fishing. More dependence on fishing required greater 'start-up' technological investment, especially in the acquisition of inshore/offshore migratory species such as anchovies and sardines.

Late Period settlement patterns depart in significant ways from those of earlier intervals. The general distribution and composition of sites along the San Simeon Reef reflect an increasing emphasis on marine resource exploitation and, therefore, coastal locations. The southern San Simeon Reef Late Period subsistence system is marked by a high proportion of residential sites that suggests a relatively mobile strategy. Ethnohistoric accounts indicate that local people stored food such as fish and plant remains (particularly pine nuts and acorns), which is consistent with the mobile collector model.

Resource intensification is evident in a gradual transition in behavior such as the use of more marginal environments and a diversification of a settlement system targeting lower-ranking resource patches requiring greater technological investment.  Specific to the Late Holocene, an increased focus on fish coincides with a greater number of secondary residential sites with high frequencies of fire-altered rock resulting that may be related to processing fish.  An increased use of fisheries involves manufacturing and maintaining fishing equipment (shell or bone fishhooks, plant fiber lines, and nets) that are expected to have relatively high labor requirements compared to shellfish collecting. Procuring, processing, and storing fish may have required changes in social organization.

Coastal resources therefore supported a settlement system over this approximately 4000 year interval that can be characterized as "semi-sedentary" (Jones et al. 2008a). To adapt to environmental fluctuations, people appear to have turned to a more mobile settlement pattern as a means of risk-management, entailing acquisition of resources from all available locations. Such a pattern entails occupation of subsidiary residential bases in a greater diversity of environmental contexts. The low population numbers could support a more fluid settlement system, where occupying productive resource patches in an effective manner would make sedentary lifestyles appear unnecessary. Southern San Simeon Reef settlement systems reflect the adaptations in a marine environment.

Trade or social factors may have buffered these climatic changes. Along the southern San Simeon Reef, compelling information on interregional subsistence exchange comes from the transportation of rocky intertidal shellfish to interior site CA-SLO-1180 located in the Lower Nacimiento watershed approximately 30 kilometers northeast (Carpenter et al. 2007). Starting around 1000 calBP and increasing into the Late Period, a diversity of rocky intertidal shellfish similar is transported to this interior site through direct access by logistical groups from the interior, by exchange with coastal people to maintain social ties, or as part of an interior-coastal seasonal round. This pattern seems have its foundation during severe droughts that undermined local socio-economic systems.

The data presented here reflects of only one aspect of a settlement system that would potentially encompass interior locations. It is clear that coastal locations were a part of this system in a manner not previously recognized. Although this coastal-interior relationship cannot be elucidated as part of this research, it hints at the subsistence and settlement practices that at least for part of the year were centered on coastal environments. Currently, data from adjacent interior sites are limited, as chronological control is imprecise due to poor preservation and limited radiocarbon dates.

- <u>VARIATIONS IN MARINE FAUNA UTILIZATION</u>: Are changes in the importance of different marine resources over time a result of environmental changes, marine resource intensification brought about by the depletion of terrestrial resources or population growth, or adoption/ development of new technology? If it occurred, did intensification affect the marine environment by shifting the ecological balance between competing marine taxa?

As expected, during the Middle Holocene small and highly mobile groups employed strategies to maximize the exploitation of high ranked, diverse, and dense resource patches containing resources such as terrestrial mammals and shellfish species such as red abalone, and nearshore fish. Therefore limited intensification strategies were required. Early Period sites have a higher percentage of terrestrial animal bone than sites of any other period, and remains of large land mammals, likely deer, are in highest frequencies. Shellfish collecting was an attractive resource to the early site occupants, accounting for about 96 to 99 percent of the estimated meat weights. Near the sites a variety of rocky intertidal shellfish was collected, perhaps by all members of the social group. Small black turban snails could be harvested with ease as they are located in predictable habitats and in tight clusters. Therefore, the economy of collecting what appears to be a low ranking resource was significant as black turbans are relatively abundant and can be obtained with minimal technology (Braje and Erlandson 2009; Erlandson 1988; Glassow and Wilcoxon 1988). Based on the sample of Early Period sites presented here, during this period of low population, site occupants had narrow diet breadth that included high ranked resources from all available habitats.

By the Late Holocene, southern San Simeon Reef populations responded to climate-driven resource stress by intensifying existing subsistence strategies through technological innovation (e.g., the advent of the bow and arrow and increased use of small watercraft) and resource intensification with increased emphasis on fishing and dried fish storage. Intensified use of a greater variety of marine resources over time also is evident in an overall expansion of diet breadth, a shift to lower-ranking land mammals that coincides with a reduction of high-ranking terrestrial species (e.g., deer), and an increase in dependency on sea mammals (e.g., sea otter, northern fur seal, California sea lion) that have high search and handling costs.

Changes in the importance of marine resources are most apparent in an increase in fishing. At Middle/Late Transition sites CA-SLO-2563 and

Arroyo de los Chinos (CA-SLO-273/H and SLO-274), marine fish — particularly herrings northern anchovy, and silversides—are of greater importance to the diet. By the Late Period, there is a clear trend in the diversified use of marine resources, predominately increase in diet breadth to include greater proportions of fish from a wider range of offshore habitats. As fishing from watercraft intensified, the diversity and density of kelp-bed fish species increased significantly relative to nearshore species, implying greater technological investment in nets and boats.

A transition to more intensified fishing may have involved a change in social organization, with most members of social groups engaged in procurement, processing, storage, and fishing tackle manufacture and maintenance activities. In particular, an increased focus on storage also suggests a reorganization of labor, group interaction, cooperation, and sharing. Although the smaller inshore/offshore migratory fish would potentially have higher return rates than was possible with single-catch hook and line technology, the initial investment nets and watercraft may reflect technological intensification. Ugan (2005:85) suggests, "We would expect mass collecting to be taken up not only when it provides returns superior to those of larger game taken on encounter, but also when overall returns for taking all resources in the optimal diet are quite low." I therefore posit that community interaction was particularly important in light of short-term environmental fluctuations during the Medieval Climatic Anomaly, and increased sharing may have built social relationships to buffer short- and long-term environmental fluctuations.

Although a moderate level of intensification occurred, population density remained low and dispersed across the region so that marine environment, particularly shellfish populations, remained stable over time. The same three species, black turban snail, California mussel, and red abalone dominate the shellfish assemblages, although the proportions vary in importance. Collectively, the shellfish data suggest that human collecting strategies altered red abalone populations over the course of occupation. Red abalone size and frequencies from my study sites and paleoclimatic data suggest that during intervals of low population – during the Early Period and decreased populations after the Medieval Climatic Anomaly– larger abalones are present in higher numbers. Impacts on the littoral environment may have been mediated by mobile settlement patterns, low population densities, a widening of diet breadth, increased technological investment, and intensification of other resources such as marine fish. However, by the Late Period these strategies may have become difficult as human population growth and territorial circumscription limited access to resources, as suggested by the small numbers of red abalone.

The contemporary distribution of black turban snails and California mussel, the prehistoric dietary focus of black turban snail, and the low frequency and diminutive size of recovered mussel shells appears to be attributed to ecology and invertebrate behavior rather than resource intensification. Exploitation of small shellfish species such as black turban snails suggests we have to adopt a multivariate approach to understanding diachronic trends in shellfish collecting. This pattern shows that interpreting archaeological observations of shellfish ecology are ultimately a reflection of environmental conditions that constrain or support the growth of particular species such as California mussel.

## SUMMARY

It is clear that my ambitious efforts have only begun to address the research questions I formulated in anticipation of this research. Clearly, there are general relationships between fluctuations in population and the environment are precursors to subsistence and settlement change. Deciphering the nature of these variables requires a great deal of information on both human behavior and environmental factors to understand specific change in local intertidal and nearshore habitats as well as human-induced changes to local marine ecosystems.

# XIII: CONCLUDING THOUGHTS ON THE PREHISTORY OF THE SOUTHERN SAN SIMEON REEF

My research provides new insights into Middle to Late Holocene coastal adaptations along the open coastline of northern San Luis Obispo County, referred to here as the southern San Simeon Reef. Once considered something of a back water, a considerable amount of research within this region has brought to light the adaptive variability of local hunter-gatherer-fishers. Over the last 6000 years subsistence became more diverse and technology became more elaborate, while changes in exchange, settlement, and social organization are less tangible and more difficult to understand. Both large-scale and localized environmental changes affected human populations and induced shifts in cultural adaptations. In this chapter I provide some concluding thoughts on the use of marine resources and environments by populations, and I identify future research requirements for refining or clarifying some of the patterns identified over the course of this project.

Coastlines and coastal resources vary dramatically throughout space and time (Erlandson 2001). Understanding the prehistory of any coastal region requires not only a general consideration of the spatial and temporal variations in the archaeology, but a wealth of data on the diversity, productivity, and seasonality of marine and terrestrial resources. As

Erlandson and Fitzpatrick (2006:10) state, "…generalizations obscure considerable adaptive diversity among the coastal and interior Chumash and their neighbors, differences conditioned by a combination of environmental variations and unique cultural histories." The rocky shoreline and adjacent marine terraces of the San Simeon Reef comprise a distinct environment for investigating how local environmental variation and long-term ecological changes affected human populations.

Information obtained from the Middle and Late Holocene sites appears to reflect a general transition common to California from predominately littoral economies to an increased focus on nearshore fish. Although this shift occurs later along the San Simeon Reef than some areas of southern California. This process of resource diversification is consistent with the overall trend of intensifying and diversifying the use of marine resources. Subsistence intensification by the Late Holocene is apparent from multiple lines of evidence. These include an expansion of diet breadth; increased dependence on marine fisheries, inclusion of low-ranking species such as birds and reptiles; a reduction in high-ranking species such as deer, sea otter, and red abalone; an increase in marine mammal hunting that potentially equates with high search and handling costs; and evidence for storage of fish.

Along the southern San Simeon Reef Middle Holocene red abalone middens provide the most apparent evidence of human adaptations to intertidal and subtidal ecosystems. As population density increased and land use expanded along the open coast around 5700 calBP, the formation of red abalone middens between Point Estero and Cambria shows a focus on the collection of this large subtidal species. The unique middens cannot be associated with millennial-scale changes in sea surface temperatures, but might be better explained by shorter sea surface fluctuations currently undetectable with available climate records and cultural changes in shellfish collecting strategies. The rather sudden development and end of the unique middens clearly has the potential to provide insights into the complex relationship between human behavior and environmental change. Additional data on chronology and distribution of Middle Holocene red abalone middens is needed. With additional information on the impacts of slowing sea level rise on intertidal and nearshore environments and changes in sea surface temperatures, a clearer picture of the nature and causes of local red abalone middens will arise.

The data collected on red abalone length demonstrates a decline in their size and frequency between the Middle and Late Holocene. Occupants harvested a high frequency of adult abalones (mean shell length of 11.6 cm) at the initial occupation of the two red abalone middens. This suggests that people were harvesting red abalone shells from littoral habitats that had not been heavily preyed on by humans or sea otters. By the Late Holocene sites contain a small numbers of shells with average shell means between 8.1 and 8.5 cm. This general reduction of the mean size suggests that human collecting strategies altered local red abalone populations over time, potentially impacting the local ecosystems. Additional data on the mean sizes of red abalone shells through time, and comparing these measurements to historic and modern measurements independent of sea otter predation, will assist with evaluating human impacts (Braje et al. 2009).

Optimal foraging theory suggests that small resources are optimal when they are abundant and gathered with ease (Raab 1992:77). However, using economic models alone cannot account for the black turban middens that are common along the southern San Simeon Reef. The consistent focus on black turban snails over the 5000 years studied, and the low frequency and diminutive size of recovered mussel shells seems more closely linked to local habitat than human population growth.

One of the clearest examples of change along the San Simeon Reef is settlement pattern fluctuations that we are only beginning to understand. A lack of information about settlement and resource use in the pericoastal valleys, such as Green Valley, currently impedes our understanding of changes in regional subsistence systems. Around the time of the severe droughts associated with the Medieval Climatic Anomaly, there was a population decline, with large trans-Holocene sites abandoned and other disruptions in settlement, and a distinct rise in interregional movement (or trade) of small shellfish to the interior. Jones and Ferneau (2002b) characterize this shift as "deintensification", but we are just beginning to identify the single-component sites that need to be investigated to adequately understand these changes. Overall population along the San Simeon Reef appears to have remained relatively low, perhaps especially low during the drought intervals. Faced with unforeseen climatic fluctuations, lower population density perhaps allowed more flexible adaptive strategies.

Recent isotope analysis of shells and a comprehensive review of ethnohistoric accounts suggest that the coast was generally not abandoned during any time of year. The interior settlement strategy apparently involved periodic coastal visits whereas the coastal system included year-round occupation of individual residential bases (Jones et al. 2008a:2292). The co-existence of two distinctive settlement strategies demonstrates the influence of coastal environments on hunter-gather mobility, which in this case encouraged relative sedentism among shoreline inhabitants at the same time that it encouraged interior populations to make periodic visits to the coast. These patterns also demonstrate the oversimplification of assigning simple forager-collector dichotomies to settlement patterns and land-use organization to situations in which shellfish provided dependable resources and collecting success in marine environments (Habu 2002; Fitzhugh 2002).

## FUTURE ENDEAVORS

Erlandson and Fitzpatrick (2006), Erlandson and Glassow (1997), and Erlandson and Jones (2002) eloquently lay out research avenues of importance to coastal California for enhancing knowledge of the nature of cultural developments, environmental change, and human impacts to coastal ecosystems. Future endeavors will require a good deal of fine-grained data from many sites and collaboration within multidisciplinary research groups. My recommendations for future research include the following endeavors that are very fundamental in nature.

- **Radiocarbon Dating**: After hiking open coastline and seeing the severe coastal erosion along the southern San Simeon Reef it is clear we need to procure the funding to date sites before we lose them to the sea. Nothing now remains of three recorded red abalone middens from which I returned to collect samples. Globally, marine erosion is destroying the coastal sites that contain data essential to most coastal research problems. Radiocarbon dating should not only include samples from the earliest occupation at a site, but be sufficient to identify each of the occupations to understand temporal spans of site use and mobility. We clearly need to accelerate our efforts to inventory and date endangered coast sites before they are lost forever (Erlandson 2008; Erlandson and Moss 1999).
- **Collection of Larger Sample Sizes:** The test excavation of a small portion of the total site deposit results in significant limitations on inferences about the site as a whole. When faced with losing sites due to erosion we clearly are justified in using larger excavation units to understand intersite variability and to recover assemblages for characterizing the nature of site activities.
- **Gaining Access to Private Land**: Although we have a greater understanding of site patterns along the central California Coast in recent years, vast private landholdings contain much of our prehistory and preclude collecting even the most basic site information. Access to these properties for research is necessary for developing a full understanding of

subsistence-settlement systems. We need to work with private landowners to obtain site information and collaborate on the protection of non-renewable resources.

- **Understanding Social Organization and Ideology:** The focus of this research has been to define subsistence and settlement systems in a previously unstudied region. Although much of hunter-gatherer social organization depends on the nature of subsistence patterns, there are many unanswered questions concerning religious rituals, ideology, cosmology, and symbolism that are critical to understanding the culture system. The only known features that provide insights into the ideological realm of behavior are three pit-and-groove rocks located 1.5 miles east of the study sites in pericoastal Green Valley. Efforts need to be made to identify archaeological signatures of ideology and social organization.
- **Collaboration with Multidisciplinary Groups**: To adequately characterize littoral habitats and vegetation communities it is clear that an understanding of midden sites must be undertaken within the context of multi-dimensional research. We need to work with biologists and ecologists who can assist us with interpreting our data. Increased collaboration will make use of current ecological data available for archaeologists and provide a temporal dimension of ecologists, biologists, and historians (Rick and Erlandson 2008).
- **Acquisition of Higher-resolution Holocene Marine Temperature Curves**: Oxygen isotope analysis of shells from a wide range of sites types and temporal contexts will provide essential data to answer many of our questions on seasonality of site occupation, fluctuations in sea surface temperatures through time, and temporal changes in subsistence and settlement patterns.

Understanding the diversity of the archaeological record along the California Coast requires consideration of the dynamic variation within and between regions. Approaching studies of natural and cultural landscapes requires a continued focus on the relationship between environmental fluctuation and human adaptations at various local, spatial, and temporal levels. Information from the sites that have been the topic of this study adds considerably to our knowledge of littoral subsistence and settlement in open-coast environments. Each site tells a unique cultural history of coastal use by Playano people and their predecessors.  These sites clearly demonstrate the choices their occupants made to more intensively procure a variety of marine resources over time, and they hint at a way of life previously unknown.

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## APPENDIX A: INTERTIDAL SPECIES LISTS AND SHELLFISH SPECIES IDENTIFIED AT STUDY SITES.

Table A1. Kenneth S. Norris Rancho Marino Reserve Shellfish and Marine Fish Intertidal Species List UC Santa Barbara.

Table A2. Shellfish Species Identified at CA-SLO-1295, -1622, -1677, and -2563.

**Appendix A, Table A1.** Kenneth S. Norris Rancho Marino Reserve Shellfish and Marine Fish Intertidal Species List UC Santa Barbara.
Prepared by Reserve Manager Don Canestro, 7/26/05

| **INVERTEBRATES GENUS/SPECIES** |
|---|
| *Tunicate* unid. |
| *Chaceia* sp. (boring clam) |
| *Diodora* sp. |
| *Hiatella arctica* |
| *Musculus pygmaeus* |
| *Mytilus californianus* |
| *Pholididae* unid. |
| *Septifer bifurcatus* |
| *Octopus rubescens* |
| *Cryptochiton stelleri* |
| *Cyanoplax hartwegii [Lepidochitona hartwegii]* |
| *Lepidozona* spp. [see below] |
| *Mopalia muscosa* |
| *Nuttallina californica* |
| *Placiphorella velata* |
| *Stenoplax* spp. [see below] |
| *Tonicella lineata* [*Tonicella lokii* see below] |
| [*Lepidochitona dentiens*] |
| [*Lepidozona cooperi*] |
| [*Lepidozona mertensii*] |
| [*Leptochiton rugatus*] |
| [*Stenoplax heathiana*] |
| [*Tonicella lokii*] |
| *Anthopleura elegantissima* |
| *Anthopleura solas* |
| *Anthopleura xanthogrammica* |
| *Epiactis prolifera* |
| *Balanus glandula* |
| *Cancer antennarius* |
| *Caprellidae* (amphipod) |
| *Chthamalus fesus/dalli* |
| *Gammaridea* unid. |
| *Hemigrapsus nudus* |
| *Hemigrapsus oregonensis* |
| *Heptacarpus* sp. |
| *Heterocrypta* sp. |
| *Idotea wosnesenskii* |
| *Lophopanopeus bellus bellus* |
| *Pachygrapsus crassipes* |

| **INVERTEBRATES GENUS/SPECIES** |
|---|
| *Pagarus granosimanus* |
| *Pagarus hirsutiusculus* |
| *Pagarus samuelis* |
| *Pandalus* sp. |
| *Petrolisthes cinctipes* |
| *Petrolisthes eriomerus* |
| *Pollicipes polymerus* |
| *Pugettia producta* |
| *Tetraclita rubescens* |
| *Asterina miniata* |
| *Eupentacta quinquesemita* |
| *Leptasterias hexactis* |
| *Leptosynapta albicans* |
| *Ophiothrix spiculata* |
| *Pisaster brevispinus* |
| *Pisaster ochraceus* |
| *Strongylocentrotus franciscanus* |
| *Strongylocentrotus purpuratus* |
| *Bryozoan* |
| *Membranipora* sp. |
| *Polyclad* sp. |
| *Collisella scabra* [*Lottia scabra*] |
| *Acanthina punctulata* |
| *Acanthina spirata* |
| *Acmea limatula* [*Lottia limatula* -- see below] |
| *Acmea mitria* [*Acmaea mitra*] |
| *Acmea peltis/conus* [*Lottia pelta*? -- see below] |
| *Amphissa versicolor* |
| *Caliostoma ligatum* [*Calliostoma ligatum*] |
| *Calliostoma annulatum* |
| *Crepidula* sp. |
| *Epitonium tinctum* |
| *Erato* spp. |
| *Fissurella volcano* |
| *Haliotis cracherodii* |
| *Hopkinsia rosacea* |
| *Lacuna* sp. |
| *Littorina keenae* |
| *Littorina plena/scutulata* |
| *Lottia "pelta"* |
| *Lottia asmi* |
| *Lottia digitalis/austrodigitalis* |
| *Lottia gigantea* |
| *Lottia limatula* |

| INVERTEBRATES GENUS/SPECIES |
|---|
| *Lottia paradigitalis* |
| *Lottia pelta* |
| *Macclintockia scabra* [*Lottia scabra*] |
| *Mcclintockia scabra [Lottia scabra*] |
| *Megatebennus bimaculatus* |
| *Mitra idea* |
| *Mitrella* sp. |
| *Notacmea insessa* |
| *Notoplana* sp. |
| *Nucella* spp. |
| *Ocenebra circumtexta* |
| *Rostangia pupulchra* |
| *Serpula vermicularis* |
| *Serpulorbis squamigerus* |
| *Spirorbis* sp. |
| *Tectara somi* (on *T. funebralis*) [*Tectura asmi*] |
| *Tectura scutum* |
| *Tegula brunnea* |
| *Tegula funnebralis* |
| *Aglaophenia* sp. |
| *Dodecaceria fewkesi* |
| *Phragmatopoma californica* |
| *Salmacina tribranchiata* |
| *Spirobranchus* sp. |
| *Haliclonia* (*permolis*?) |
| *Haliclonia* sp. (pink) |
| Yellow sponge |

| MARINE FISH GENUS/SPECIES |
|---|
| Mosshead Sculpin - *Clinocottus globiceps* |
| Smoothhead Sculpin - *Artedius lateralis* |
| Fluffy Sculpin - *Oligocottus snyderi* |
| Saddleback Sculpin - *Oligocottus rimensis* |
| Wooly Sculpin - *Clinocottus analis* |
| Northen Clingfish - *Gobiesox maeandricus* |
| Rockweed Gunnel - *Xererpes fucorum* |
| High Cockscomb - *Anoplarchus purpurescens* |
| Black Prickelback - *Xiphister atropurpureus* |
| *Stichaeidae* unid. |

Table A2. Shellfish Species Identified at CA-SLO-1295, -1622, -1677, and -2563.

| | | CA-SLO- | | | |
|---|---|---|---|---|---|
| Species Name | Common Name | 1295 | 1622 | 1677 | 2563 |
| **Abalones** | | | | | |
| *Haliotis cracherodii* | Black abalone | ✓ | ✓ | ✓ | ✓ |
| *Haliotis rufescens* | Red abalone | ✓ | ✓ | ✓ | ✓ |
| **Barnacles** | | | | | |
| *Balanus glandula* | White acorn barnacle | ✓ | | ✓ | |
| *Balanus spp.* | Barnacle | ✓ | ✓ | ✓ | ✓ |
| *Pollicipes polymerus* | Leaf barnacle | ✓ | | ✓ | ✓ |
| **Clams** | | | | | |
| *Epilucina californica* | California Lucine | | | ✓ | ✓ |
| *Protothaca staminea* | Pacific littleneck clam | ✓ | ✓ | ✓ | ✓ |
| **Chitons** | | | | | |
| *Crytochiton stelleri* | Giant Pacific or Gumboot chiton | ✓ | ✓ | ✓ | ✓ |
| *Mopalia ciliata* | Hairy chiton | ✓ | | ✓ | |
| *Mopalia hindsii* | Hind's chiton | | ✓ | ✓ | |
| *Mopalia lignosa* | Woody chiton | ✓ | ✓ | ✓ | |
| *Mopalia muscosa* | Mossy chiton | ✓ | ✓ | ✓ | ✓ |
| *Nuttallina californica* | California Nuttall chiton | ✓ | ✓ | ✓ | ✓ |
| *Tonicella lineata* | Lined chiton | ✓ | ✓ | ✓ | ✓ |
| **Crabs** | | | | | |
| *Cancer antennarius* | Red-spotted rock crab | ✓ | ✓ | ✓ | ✓ |
| **Limpets** | | | | | |
| *Collisella asmi* | Black limpet | ✓ | ✓ | ✓ | ✓ |
| *Collisella digitalis* | Finger limpet | ✓ | ✓ | ✓ | ✓ |
| *Collisella pelta* | Shield limpet | ✓ | ✓ | ✓ | ✓ |
| *Collisella scabra* | Rough limpet | ✓ | ✓ | ✓ | ✓ |
| *Lottia gigantia* | Owl limpet | ✓ | ✓ | ✓ | |
| *Lottia limatula* | File limpet | | ✓ | ✓ | |
| *Notoacmea scutum* | Pacific plate limpet | ✓ | | ✓ | ✓ |
| **Keyhole limpets** | | | | | |
| *Diodora aspera* | Rough keyhole limpet | ✓ | ✓ | ✓ | ✓ |
| *Fissurella volcano* | Volcano limpet | ✓ | ✓ | ✓ | ✓ |
| **Mussels** | | | | | |
| *Mytilus californianus* | California mussel | ✓ | ✓ | ✓ | ✓ |
| *Septifer bifurcatus* | Platform mussel | ✓ | ✓ | ✓ | ✓ |

| | | CA-SLO- | | | |
|---|---|---|---|---|---|
| Species Name | Common Name | 1295 | 1622 | 1677 | 2563 |
| **Snails (gastropods)** | | | | | |
| *Cerithidea californica* | California Horn | ✔ | ✔ | ✔ | ✔ |
| *Crepidula adunca* | Hooked slipper shell | ✔ | ✔ | ✔ | ✔ |
| *Crepidula nummaria* | White slipper shell | ✔ | ✔ | ✔ | |
| *Lacuna vincta* | Northern chink shell | ✔ | ✔ | ✔ | |
| *Littorina keenae* | Eroded periwinkle | ✔ | ✔ | ✔ | ✔ |
| *Littorina planaxis* | Flat periwinkle | ✔ | ✔ | ✔ | |
| *Littorina scutulata* | Checkered periwinkle | | ✔ | ✔ | |
| *Nucella canaliculata* | Emarginate dogwinkle | ✔ | ✔ | ✔ | ✔ |
| *Nucella emarginata* | Channeled dogwinkle | ✔ | ✔ | ✔ | |
| *Ocenebra circumtexta* | Circled rock shell | ✔ | ✔ | ✔ | |
| *Olivella biplicata* | Purple olive | ✔ | ✔ | ✔ | |
| *Trivia californiana* | California trivia | ✔ | ✔ | ✔ | |
| **Turban Snails** | | | | | |
| *Astraea Gibberosa* | Red Turban | ✔ | ✔ | ✔ | ✔ |
| *Tegula funebralis* | Black turban snail | ✔ | ✔ | ✔ | ✔ |
| *Tegula brunnea* | Brown turban snail | ✔ | ✔ | ✔ | ✔ |
| *Tegula montereyi* | Monterey top | ✔ | ✔ | ✔ | |
| **Urchins** | | | | | |
| *Strongylocentrotus purpuratus* | Purple urchin | ✔ | ✔ | ✔ | ✔ |
| **Worms** | | | | | |
| Serpula vermicularis | Red tube worm | ✔ | | ✔ | |

Note: ✔ - Species present at site

## APPENDIX B:

## RADIOCARBON DATES FOR SAN SIMEON REEF SITES

Table B1. Radiocarbon Dates for San Simeon Reef Millingstone, Early, and Middle Periods.

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-72*** | | | | | | |
| UCR- 3992 | Tsp | Point B, 80cmbs | - | 5025±40 | 4990 (4920) 4850 BP<br>3040 - 2900 BC | Laurie and Jones 2001 |
| ***SLO-77*** | | | | | | |
| Beta-211103 | Organic Sediment | TU 1, 90-100cm | 2990±80 | 2990±80 | 2509(2378) 2246 BP<br>570 - 300 BC | Clifford et al. 2006 |
| Beta-212126 | Mixed shell | TU 2, 120-130 cm | 2640±50 | 3070±50 | 2550 (2450) 2340 BP<br>560 – 400 BC | Clifford et al. 2006 |
| ***SLO-116*** | | | | | | |
| UCR-3993 | *Collisella* sp | Point A 110 | - | 3910±60 | 3560 (3480) 3400 BP<br>1610 - 1440 BC | Laurie and Jones 2001 |
| ***SLO-175*** | | | | | | |
| UCLA-1092 | Human Bone | Buvial V, 91 | 3180±600 | 3590±670 | 4410 (3570) 2720 BP<br>2470 - 770 BC | Abrams 1968 |
| WSU-4101 | Hr | Unit 5, 20-30cm | 4430±60 | 4430±60 | 4270 (4170) 4060 BP<br>2320-2110 BC | Jones and Waugh 1995 |
| WSU-4100 | *Hr* | Unit 3, 30-40cm | 4530±70 | 4530±70 | 4410 (4300) 4190 BP<br>2460 - 2240 BC | Jones and Waugh 1995 |
| WSU-4103 | *Hr* | Unit 6 60-70cm | 4880±110 | 4880±110 | 4100 (3900) 3740 BP<br>2110 - 1790 BC | Jones and Waugh 1995 |
| WSU-4102 | *Hr* | Unit 5, 50-60cm | 5020±80 | 5020±80 | 5050 (4930) 4820 BP<br>3100 - 2870 BC | Jones and Waugh 1995 |
| ***SLO-177*** | | | | | | |
| WSU-4024 | *Hr* | Surface | 3710±105 | 3710±105 | 3380 (3240) 3100 BP<br>1430 - 1150 BC | WSU Data Sheet 1989 |
| UCR-0789 | *Mc* and *HP* | Unit 60S/60W, 122-145cm | 8430±200 | 8840±200 | 9420 (9170) 8910 BP<br>7470 - 6960 BC | Pierce 1979 |
| Beta-07035 | Mc | 60-80cm | 8290±100 | 8700±100 | 9100 (8940) 8780 BP<br>7160 - 6830 BC | Roudolph 1983 |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC) [2] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-179 (Pico Creek)*** | | | | | | |
| Beta-105982 | *Mc* | Unit 13, 100-110cm | 1780±50 | 2200±50 | 1490 (1420) 1350 BP<br>AD 460 - 600 | Jones and Ferneau 2002a |
| Beta-49775 | *Hr* | Unit 1W, 60-70cm | 4130±90 | 4570±90 | 4490 (4350) 4220 BP<br>2540 - 2270 BC | Jones and Ferneau 2002a |
| Beta-48662 | *Hr* | Unit 1W, 90-100cm | 4300±90 | 4750±90 | 4480 (4610) 4730<br>2780 - 2530 BC | Jones and Ferneau 2002a |
| ***SLO-187*** | | | | | | |
| UCR-1669 | *Mc* | Unit 2, 30-40cm | 1920±100 | 2330±100 | 1690 (1570) 1440 BP<br>AD 260 - 510 | Hines 1986 |
| UCR-1668 | *Mc* | Unit 1, 100-110cm | 2000±100 | 2410±100 | 1790 (1660) 1540 BP<br>AD 160 - 410 | Hines 1986 |
| UCR-1670 | *Mc* | Unit 2, 80-90cm | 2650±100 | 3160±100 | 2710 (2580) 2450 BP<br>770 - 500 BC | Hines 1986 |
| ***SLO-265*** | | | | | | |
| Beta-226193 | *Mc* | Unit S20/E9, 20-30cm | 4720±40 | 5130±40 | 5210 (5110) 5010 BP<br>3260 - 3060 BC | Hildebrandt et al. 2007 |
| Beta-226194 | *Mc* | Unit S20/E9, 50-60cm | 4720±70 | 5130±70 | 5220 (5100) 4980 BP<br>3270 - 3030 BC | Hildebrandt et al. 2007 |
| Beta-226195 | *Mc* | Unit S20/E9, 90-100cm | 4740±50 | 5140±50 | 5230 (5120) 5020 BP<br>3280 - 3070 BC | Hildebrandt et al. 2007 |
| Beta-226196 | *Mc* | Auger 1, 100-160cm | 4940±40 | 5330±40 | 5430 (5360) 5300 BP<br>3480 - 3350 BC | Hildebrandt et al. 2007 |
| Beta-226192 | *Mc* | Unit 1S1/E0, 110-120cm | 5670±50 | 5670±50 | 5780 (5700 )5620 BP<br>3830 - 3670 BC | Hildebrandt et al. 2007 |
| *SLO-267* | | | | | | |
| *Beta-38126* | *Mc* | Unit N0/E0, 20-30cm | 132 ±60 | 1730±60 | 1040 (970) 890 BP<br>AD 908–1062 | Bouey and Basgall 1991 |
| *Beta-37482* | *Hr* | Unit N180/W60, 20-30cm | 1380±60 | 1820±60 | 1120 (1040) 9620 BP<br>AD 830 – 990 | Bouey and Basgall 1991 |
| *Beta-1454452* | Deer Bone | Unit 8, 60-70cm | 2100±30 | 2180±30 | 1460 (1400) 1340 BP<br>AD 490–610 | Jones and Ferneau 2002a |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date<br>1 Sigma Range | Reference |
|---|---|---|---|---|---|---|
| Beta-38127 | Tsp | Unit N0/E0, 20-30cm | 1850±80 | 2270±80 | 1600 (1490) 1390 BP<br>AD 360 - 560 | Bouey and Basgall 1991 |
| Beta-37484 | Hr | Unit N115/E35,80-90cm | 1900±60 | 2340±60 | 1680 (1590) 1510 BP<br>AD 270– 450 | Bouey and Basgall 1991 |
| Beta-37486 | *Hr* | Unit N115/E35,80-90cm | 1980±80 | 2430±80 | 1800 (1690) 1580 BP<br>AD 150–370 | Bouey and Basgall 1991 |
| Beta-105986 | *Mc* | Unit 12, 30-40cm | 2260±50 | 2670±50 | 2040 (1960) 1880 BP<br>90 BC–AD70 | Jones and Ferneau 2002a |
| Beta-37483 | *Hr* | Unit N160/W70,20-30 cm | 2370±70 | 282±70 | 2280 (2180) 2070 BP<br>330 - 120 BC | Jones and Ferneau 2002a |
| Beta-38122 | *Hr* | Unit N60/E0, 40-50 cm | 2480±70 | 2920±70 | 2340 (2250) 2150 BP<br>400 - 200 BC | Bouey and Basgall 1991 |
| Beta-37485 | *Hr* | Unit N39/E7,20-30 cm | 2550±70 | 2990±70 | 2490 (2380) 2260 BP<br>540 - 310 BC | Bouey and Basgall 1991 |
| Beta-37479 | *Hr* | Unit N1/E0, 30-40 cm | 2560±70 | 3000±70 | 2500 (2390) 2280 BP<br>560 – 330 BC | Bouey and Basgall 1991 |
| Beta-37481 | *Hr* | Unit N39/E7,50-60 cm | 2590±70 | 3040±70 | 2540 (2430) 2320 BP<br>590 – 370 BC | Bouey and Basgall 1991 |
| Beta-1454453 | Deer Bone | Unit 11, 40-50 cm | 2940±30 | 3020±30 | 2450 (2390) 2330 BP<br>500 – 380 BC | Jones and Ferneau 2002a |
| Beta-105985 | *Mc* | Unit 8, 20-30cm | 3000±50 | 3440±50 | 2970 (2890) 2800 BP<br>1020 – 850 BC | Jones and Ferneau 2002a |
| Beta-105987 | *Mc* | Unit 28, 70-80cm | 3100±60 | 3500±60 | 3070 (2970) 2870 BP<br>1120–920 BC | Jones and Ferneau 2002a |
| ***SLO-273/H*** | | | | | | |
| Beta-167351 | *A*spp. | Unit S22/W44, 60-70cm | 3140±50 | 3360±40 BP | 2850 (2800 )2740 BP<br>904-793 BC | Hildebrandt et al. 2002 |
| Beta-165524 | *C. stelleri* | Unit S10/W36, 50-60cm | 3770±80 | 3990±70 BP | 3670 (3570) 3470 BP<br>1720 - 1520 BC | Hildebrandt et al. 2002 |
| Beta-167350 | *A*spp. | Unit S6/W30, 70-80cm | 4060±100 | 4280±90 BP | 4090 (3950) 3820 BP<br>2140 -1870 BC | Hildebrandt et al. 2002 |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| *SLO-274* | | | | | | |
| Beta-167352 | *Aspp.* | Unit S31/W36, 20-30cm | 3150±50 | 3370±40 BP | 2860 (2810) 2750 BP<br>910 - 770 BC | Hildebrandt et al. 2002 |
| Beta-165527 | *Hr* | Unit S11/E2,30-40cm | 3210±60 | 3430±50 BP | 2950 (2870) 2790 BP<br>1000 - 840 BC | Hildebrandt et al. 2002 |
| Beta-165526 | *Hr* | Unit S31/W36, 40-50cm | 4850±70 | 5070±60 BP | 5110 (5110) 5100 BP<br>3130 - 2910 BC | Hildebrandt et al. 2002 |
| Beta-165529 | *Mc* | SC, Marine Terrace, 200cm | 4910±60 | 5130±50 | 5210 (5010) 4990 BP<br>3260 - 3040 BC | Hildebrandt et al. 2002 |
| Beta-165528 | *Hr* | Unit S11/E2, 120-130cm | 5270±60 | 5490±50 BP | 5580 (5520) 5460 BP<br>3630 - 3510 BC | Hildebrandt et al. 2002 |
| Beta-165525 | Mc | Unit S17/E4, 110-120cm | 5460±60 | 5680±50 BP | 5800 (5720) 5640 BP<br>3850 - 3690 BC | Hildebrandt et al. 2002 |
| ***SLO-369*** | | | | | | |
| Beta 155848 | *Charcoal* | Burial 1, upper component | 1110±80 | 1110±80 | 1090 (1010) 930 BP<br>AD 860 - 1020 | Parker 2004 |
| WSU-3798 | *Hr* | 1, 0-15 | 1440±70 | 1850±70 | 1170 (1080) 990 BP<br>AD 790 - 970 | WSU Data Sheet 1988 |
| WSU-3797 | *Hr* | Unit 1, 45-60 | 2480±110 | 2890±110 | 2360 (2210) 2060 BP<br>410 - 110 BC | WSU Data Sheet 1988 |
| UCR -791 | *Hr* | 2, 40cmbs | 3355±150 | 3505±150 | 3180 (2990) 2800 BP<br>1230 – 850 BC | Gibson 1979b |
| UCR-792 | *Hr* | 2,54 cmbs | 4090±150 | 4530±150 | 4500 (4290) 4080 BP<br>2550 – 2130 BC | Gibson 1979b |
| WSU-4028 | *Hr* | Unit NE, 30-40 | 5340±115 | 5750±115 | 5910 (5780) 5650 BP<br>3960 - 3700 BC | WSU Data Sheet 1989 |
| *SLO-369* | | | | | | |
| Beta-155105 | *Hr* | A, 60cmBS | 4760±70 | 5200±60 | 5280 (5180) 5070 BP<br>3330 – 3130 BC | Parker 2004 |
| Beta-167300 | Mc | Unit A, 100-110 cm, house floor | 8830±40 | 8610±50 | 8960 (8850) 8750 BP<br>7010 - 6800 BC | Parker 2004 |
| Beta-165338 | Mixed shell | Unit A, 100-120 cm, house floor | 9050±60 | 8830±70 | 9230 (9130) 9020 BP<br>7290 - 7070 BC | Parker 2004 |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-369*** | | | | | | |
| Beta-167229 | Mixed shell | Unit A, 100-110 cm, house floor | 9200±70 | 8980±80 | 9440 (9330) 9230 BP 7490-7280 BC | Parker 2004 |
| ***SLO-327*** | | | | | | |
| Beta-275277 | *Hr* | [3]SC, 100 cmBS | 4380±50 | 4820±50 | 4800 (4700) 4600 2850 - 2650 BC | Reported Here |
| ***SLO-383*** | | | | | | |
| UCR-1738 | *Bsp* | Unit 2, 89-90 | 4685±90 | 5095±90 | 5200 (5050) 4910 BP 3250 - 2960 BC | Hines 1986 |
| UCR-1739 | *Mc* | Unit 6, 70-80 | 5330±100 | 5740±100 | 5900 (5780) 5670 BP 3950 - 3720 BC | Hines 1986 |
| UCR-1736 | *Mc* | Unit 1, 110-120 | 5630±100 | 6040±100 | 6240 (6120) 6000 BP 4870 - 4050 BC | Hines 1986 |
| UCR-1740 | *Mc* | Unit 6, 80-90 | 5650±100 | 6060±100 | 6260 (6140) 6020 BP 4310 - 4070 BC | Hines 1986 |
| UCR-1737 | *Mc* | Unit 1, 140-160 | 5850±100 | 6260±100 | 6470 (6360) 6250 BP 4520 - 4300 BC | Hines 1986 |
| ***SLO-697*** | | | | | | |
| WSU-3900 | *Hr* | Feature 1 | 4010±110 | 4420±110 | 4300 (4140) 3970 BP 2350-2020 BC | Breschini and Haversat 2004 |
| WSU-3903 | *Hr* | Feature 1 | 4030±70 | 4440±70 | 4300 (4180) 4060 BP 2350 - 2110 BC | Breschini and Haversat 2004 |
| UCR-794 | *Hr* | Unit 3,35 cmbs | 4160±160 | 4320±160 | 4240 (4020) 3790 BP 2290 – 1840 BC | Gibson 1979b |
| WSU-3902 | *Hr* | Feature 1 | 4160±80 | 4570±80 | 4300 (4180) 4060 BP 2500 - 2280 BC | Breschini and Haversat 2004 |
| *SLO-697* | | | | | | |
| WSU-3901 | *Hr* | Feature 1 | 4370±80 | 4780±80 | 4770 (4650) 4530 BP 2820 - 2580 BC | Breschini and Haversat 2004 |
| UCR-795 | *Hr* | Unit 3, 30-40 cmbs | 4900±150 | 5310±150 | 5520 (5320) 5120 BP 3570 - 3170 BC | Gibson 1979b |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-762*** | | | | | | |
| Beta-62287 | *Hr* | East Trench, 80 cmBS | 3470±70 | 3910±70 | 3570 (3480) 3380 BP<br>1620 – 1430 BC | Sawyer 1993 |
| Beta-65727 | *Hr* | Backdirt pile | 4560±70 | 5000±70 | 5010 (4910) 4820 BP<br>3060 – 2870 BC | Breschini and Haversat 1993 |
| Beta-65728 | *Hr* | Backdirt pile | 4580±70 | 5020±70 | 5030 (4930) 4830 BP<br>3080 – 2880 BC | Breschini and Haversat 1993 |
| Beta-62288 | *Hr* | East Trench, 50 cmbs | 4650±70 | 5090±70 | 5170 (5030) 4890 BP<br>3220 – 2940 BC | Sawyer 1993 |
| ***SLO-1218*** | | | | | | |
| WSU-3878 | *Hr* | SC, 50-60 | 2730±100 | 3140±100 | 2700 (2560) 2430 BP<br>750 - 480 BC | WSU Data Sheet 1988 |
| ***SLO-1223*** | | | | | | |
| WSU-3917 | *Hr* | SC, 1.5 m | 4420±100 | 4860±100 | 4840 (4710) 4570 BP<br>2900 – 2620 BC | WSU Data Sheet 1989 |
| WSU-3918 | *Hr* | SC, 2.1 m | 4480±115 | 4920±115 | 4960 (4790) 4620 BP<br>3010 – 2670 BC | WSU Data Sheet 1989 |
| ***SLO-1288*** | | | | | | |
| WSU-4125 | *Hr* | SC, 60 | 4070±80 | 4480±80 | 4360 (4240) 4110 BP<br>2410-2160 BC | WSU Data Sheet 1990 |
| ***SLO-1253*** | | | | | | |
| WSU-3946 | *Hr* | SC, 1.5 m | 4560± 60 | 5000±100 | 5080 (4930) 4780 BP<br>3130– 2830 BC | WSU Data Sheet 1989 |
| ***SLO-1290*** | | | | | | |
| Beta-38452 | *Hr* | SC, 45-60 | 1460±50 | 1870±50 | 1180 (1100) 1020 BP<br>AD 770-930 | Beta Analytic Data Sheet 1990 |
| Beta-38453 | *Hr* | SC, 30-45 | 1660±60 | 2070±60 | 1370 (1300) 1230 BP<br>AD 580 - 720 | Beta Analytic Data Sheet 1990 |
| *SLO-1294* | | | | | | |
| Beta-41781 | *Hr* | SC, 50-60 | 4420±70 | 4490±70 | 4360 (4250) 4140 BP<br>2420 – 2190 BC | Dills 1990 |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventional date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| *SLO-1295* | | | | | | |
| LLML-143916 | *Hr* | Unit 4, 7 cmbd | - | 3420±30 | 2930 (2860) 2780 BP<br>980 – 850 BC | Reported Here |
| LLML-141624 | *Hr* | Unit 1, 25 cmbd | - | 4405± 30 | 4210 (4130) 4060 BP<br>2260 - 2110 BC | Reported Here |
| LLML-143915 | *Hr* | Unit 4, 75 cmbd | - | 5080± 40 | 5110 (4500) 4880 BP<br>3130 - 2930 BC | Reported Here |
| LLML-141625 | *Hr* | Unit 1,127 cmbd | - | 5190± 35 | 5270 (5190) 5110 BP<br>3320 - 3160 BC | Reported Here |
| SLO-1485 | | | | | | |
| Beta-53114 | *Hr* | SC, 5 cmbd | 4640± 80 | 5080± 80 | 5130 (4500) 4860 BP<br>3180 – 2910 BC | Beta Analytic Data Sheet 1992 |
| SLO-1487 | | | | | | |
| Beta-53115 | *Hr* | SC, 5 cmbd | 4420±90 | 4860±90 | 4590 (4720) 4840 BP<br>2890 – 2640 BC | Beta Analytic Data Sheet 1992 |
| SLO-1622 (Norris Site) | | | | | | |
| Beta-186772 | *Hr* | 2, 35 cmBD | 3690± 60 | 4140± 60 | 3860 (3760) 3670 BP<br>1910 – 1720 BC | Reported Here |
| Bet -186773 | *Hr* | 2,73 cmBD | 4350± 80 | 4790± 80 | 4780 (4660) 4550 BP<br>2830 – 2600 BC | Reported Here |
| Beta-87627 | *Hr* | 30 cmBS | 4220±40 | 4650±40 | 4530 (4450) 4390 BP<br>2580 – 2440 BC | Beta Analytic Data Sheet 1996 |
| Beta-87628 | *Hr* | T2, 55 cmBS | 4020±30 | 4450±40 | 4260 (4180) 4090 BP<br>2320 – 2140 BC | Beta Analytic Data Sheet 1996 |
| *SLO- 1677 (Spring Site)* | | | | | | |
| Beta-186774 | *Hr* | 2, 44 cmBD | 3590± 70 | 4040± 70 | 3753 (3640) 3540 BP<br>1800 – 1590 BC | Reported Here |
| Beta-186775 | *Hr* | 65, cmBD | 4570± 60 | 5010± 60 | 5000 (4910) 4830 BP<br>3050 – 2880 BC | Reported Here |
| Beta-87629 | *Hr* | T2, 80 cmBS | 3930± 70 | 4380± 80 | 4220 (4090) 3960 BP<br>2270 – 2010 BC | Beta Analytic Data Sheet 1996 |
| Beta-87630 | *Hr* | T2, 80 cmBS | 3950± 70 | 4380± 70 | 4140 (4080) 4010 BP<br>2190 – 2060 BC | Beta Analytic Data Sheet 1996 |

| Lab Number | Material | Provenience | Measured Date B.P. | Conventiona l date B.P.[1] | Calibrated Date 1 Sigma Range (325± 35 UC)[2] | Reference |
|---|---|---|---|---|---|---|
| Gold Rush Bay | | | | | | |
| Beta-275276 | *Hr* | [3]SC,90 cmBS | 4950±50 | 5380±60 | 5470(5390)5310 BP<br>3530–3360 BC | Reported Here |

Notes: [a] *Assp-Acmaea* spp, *Bsp- Balanus* sp. Hc- *Haliotis cracherodii*; Hr- *Haliotis rufescens; Mc- Mytilus californianus*; *Tsp-Tegula* sp; BD-Below Datum; BS- Below Surface; LLNL- Lawrence Livermore National Laboratory CAMS; [1]Corrected $^{13}C/^{12}C$;[2]Calibrated using CALIB REV 5.0.2 (Stuiver and Reimer 2005), Rounded calendar ages include midpoint;[3]Collected from sea cliff wall.

Table B2. Radiocarbon Dates for the San Simeon Reef Middle/Late Transition and Late Period Sites.

| Lab No. | Material[a] | Provenience | Measured Radiocarbon Age (B.P.) | Conventional Radiocarbon Age (B.P.)[b] | Calibrated Date 1 Sigma Range[c] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-71 (White Rock)*** | | | | | | |
| Beta-186768 | *Hr* | Unit 1, 35 cmbd | 730± 60 | 1180± 70 | 544(477)409 BP<br>AD 1406 - 1541 | Joslin 2006 |
| Beta-186769 | *Hr* | Unit 2, 55 cmbd | 940± 60 | 1380± 60 | 668 (612)555 BP<br>AD 1282 - 1395 | Joslin 2006 |
| ***SLO-115 (Prehistorics)*** | | | | | | |
| Beta- 186770 | *Hc* | SC[3], 14cm | 350± 60 | 780± 60 | 146 (73) 0 BP<br>AD 1820 - 1955 | Joslin 2006 |
| Beta-186771 | *Hc* | SC[3], 15 cm | 330± 60 | 750± 70 | 124 (99)0 BP<br>AD 1826 - 1955 | Joslin 2006 |
| Beta- 189343 | Wood Charcoal | Unit 1, 26 cmbd | 380±60 | 380±60 | 505 (465) 425 BP<br>AD 1445 - 1525 | Joslin 2006 |
| Beta-203143 | Wood Charcoal | Unit 1, 50 – 60 | 720±60 | 730±60 | 690(670)650 BP<br>AD 1260 - 1300 | Joslin 2006 |
| ***SLO-175 (Little Pico Creek)*** | | | | | | |
| UCLA-1231 | *Hr* | NW65/ NE40, 30-61cm | 690±80 | 1100±106 | 493 (398)303 BP<br>AD 1457-1647 | Jones and Waugh 1995 |
| ***SLO-178 (Lodge Hill)*** | | | | | | |
| UCR-790 | *Hr* | Unit 1, 60 cm | 340±100 | 750±170 | 226 (113) 0 BP<br>AD 1724 - 1955 | Gibson 1979a |
| WSU-4291 | *Hr* / *Ts* | SC | 670±70 | 1080±140 | 514 (385)256 BP<br>AD 1436 -1689 | Gibson 1979a |
| ***SLO-179 (Pico Creek)*** | | | | | | |
| Beta- 48663 | *Hr* | Unit 6, 30-40cm | 1030±60 | 1470±60 | 762(701)639 BP<br>AD 1188 - 1311 | Waugh 1992 |
| Beta- 48664 | *Hr* | Unit 7, 30-40cm | 1080±80 | 1510±80 | 818 (736) 653 BP<br>AD 1132 - 1297 | Waugh 1992 |
| Beta- 48665 | *Hr* | Unit 7, 100-110cm | 1145±55 | 1565±55 | 862 (790) 717 BP<br>AD 1088 - 1233 | Waugh 1992 |
| Beta-105980 | *Mc* | Unit 9, 60-70cm | 1240±40 | 1670±40 | 945 (883)820 BP<br>AD 1005 - 1130 | Waugh 1992 |

| Lab No. | Material[a] | Provenience | Measured Radiocarbon Age (B.P.) | Conventional Radiocarbon Age (B.P.)[b] | Calibrated Date 1 Sigma Range[c] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-179 (Pico Creek)*** | | | | | | |
| Beta-105983 | *Mc* | Unit 14, 30-40cm | 1180±50 | 1610±50 | 898 (832)766 BP<br>AD 1052 – 1184 | Waugh 1992 |
| ***SLO-184*** | | | | | | |
| UCR-3994 | *Haliotis* sp. | SC | 415±40 | 835±40 | 233 (117) 0 BP<br>AD 1717-1955 | Hines 1986 |
| ***SLO-186*** | | | | | | |
| UCR-1881 | *Hr* | Unit 1, 30-40cm | 100±0 | 510±70 | 61 (32)3 BP<br>AD 1889 - 1947 | Hines 1986 |
| UCR-1784 | Shell | Unit 1, 50-60cm | 950±90 | 1360±90 | 672 (600) 527 BP<br>AD 1278- 1423 | Hines 1986 |
| UCR-1783 | *B* sp | Unit 2, 0-20cm | 980±90 | 1390±90 | 700 (621) 541 BP<br>AD 1250 - 1409 | Hines 1986 |
| ***SLO-187*** | | | | | | |
| UCR-907 | *Hr* | N88, 15-20cm | 1010±100 | 1430±70 | 737 (667) 597 BP<br>AD 1213 - 1353 | Gibson 1979b |
| UCR-908 | *Hr* | N50, 30-40cm | 1100±100 | 1520±70 | 816 (740) 663 BP<br>AD 1134 - 1287 | Gibson 1979b |
| UCR-909 | *Hr* | N92, 30cm | 1255±100 | 1675±100 | 1000 (885) 770 BP<br>AD 950 - 1180 | Gibson 1979b |
| ***SLO-221*** | | | | | | |
| Beta-51014 | *Mc* | Unit 1, 20-40cm | 490±60 | 910±60 | 296 (210) 124 BP<br>AD 1654 - 1826 | Gibson 1992a |
| Beta-51015 | *Mc* | Unit 1, 40-60cm | 520±60 | 950±60 | 354 (250) 145 BP<br>AD. 1596 - 1805 | Gibson 1992a |
| ***SLO-267 (Piedras Blancas)*** | | | | | | |
| Beta-37487 | *Hr* | N19/E37,50-60cm | 540±60 | 990±60 | 407 (332) 256 BP<br>AD 1543 -1694 | Jones and Ferneau 2002a |
| Beta-38124 | *Hr* | N19/E37, 10-20cm | 840±70 | 1270±70 | 614 (535) 496 BP<br>AD 1336 - 1454 | Jones and Ferneau 2002a |
| Beta -37480 | *Hr* | N60/E10, 20-30cm | 1290±70 | 1660±70 | 952 (868) 783 BP<br>AD 998 - 1167 | Jones and Ferneau 2002a |

| Lab No. | Material[a] | Provenience | Measured Radiocarbon Age (B.P.) | Conventional Radiocarbon Age (B.P.) [b] | Calibrated Date 1 Sigma Range[c] | Reference |
|---|---|---|---|---|---|---|
| Beta -38123 | *Hr* | N9/E11, 20-30cm | 1030±70 | 1470±70 | 774(703) 632 BP<br>AD 1176 - 1318 | Jones and Ferneau 2002a |
| Beta -37428 | *Ts* | N115/E35, 30-40cm | 1230±70 | 1660±70 | 952(868) 783 BP<br>AD 998 - 1167 | Jones and Ferneau 2002a |
| Beta -105984 | *Mc* | Unit 8, 10-20cm | 1090±40 | 1520±40 | 816 (740) 663 BP<br>AD 1166 - 1275 | Jones and Ferneau 2002a |
| ***SLO-273 (Arroyo de los Chinos)*** | | | | | | |
| Beta- 165523 | *Hr* | S10/ W36, 30-40cm | 1040±50 | 1460±50 | 741(689)636 BP<br>AD 1209-1314 | Hildebrandt et al. 2002 |
| Beta- 165521 | *Hr* | N7/W5, 20-30 cm | 1190±60 | 1610±60 | 903 (831)758 BP<br>AD 1047-1192 | Hildebrandt et al. 2002 |
| Beta- 165522 | *Hr* | N7/W5, 50-60 cm | 1360±60 | 1780±60 | 1074(998)921 BP<br>AD 876-1029 | Hildebrandt et al. 2002 |
| ***SLO-274/H (Arroyo de los Chinos)*** | | | | | | |
| Beta- 167353 | *Acmaea* spp. ring | S11/ E2, 30-40cm | 1150±40 | 1570±40 | 855 (791) 726 BP<br>AD 1095-1224 | Hildebrandt et al. 2002 |
| ***SLO-369*** | | | | | | |
| WSU-4027 | *Hr* | Unit NW, 30-40 | 960±90 | 1370±90 | 680 (606) 531 BP<br>AD 1270 - 1419 | WSU Data Sheet 1988 |
| WSU-3798 | *Hr* | Unit 1, 0-15cm | 1440±70 | 1850±70 | 1165 (1075)985 BP<br>AD 785 - 965 | Breschini and Haversat 1988 |
| Beta- 55106 | *Haliotis* sp. | Unit D, 40-55cm | 1170±60 | 1590±60 | 886 (813)740 BP<br>AD 1064 - 1210 | Parker 2004 |
| ***SLO-460*** | | | | | | |
| UCR-793 | *Hr* | SC[3], 20cm | 475±100 | 885+100 | 286 (175) 64 BP<br>AD 1664 - 1882 | Gibson 1979b |
| ***SLO-826*** | | | | | | |
| Beta- 224356 | *Mc* | N30/E0.5, 70-80cm | - | 1070±40 | 439 (331) 322 BP<br>AD 1511 - 1628 | Hildebrandt et al. 2007 |
| Beta- 224354 | *Mc* | N30/E0.5, 10-20cm | - | 1160±40 | 509 (467) 425 BP<br>AD 1441 - 1525 | Hildebrandt et al. 2007 |
| Beta- 224355 | *Mc* | N30/E0.5, 40-50cm | - | 1290±40 | 607 (563) 519 BP<br>AD 1343 - 1431 | Hildebrandt et al. 2007 |

| Lab No. | Material[a] | Provenience | Measured Radiocarbon Age (B.P.) | Conventional Radiocarbon Age (B.P.) [b] | Calibrated Date 1 Sigma Range[c] | Reference |
|---|---|---|---|---|---|---|
| ***SLO-1259 (Little Pico Creek)*** | | | | | | |
| Beta-36630 | *Hr* | Unit 1, 10-20 cm | 710±65 | 1120±65 | 496 (418) 339 BP<br>AD 1454 - 1611 | Jones and Waugh 1995 |
| ***SLO-1289*** | | | | | | |
| WSU-4127 | *Hc* | SC, 20cm | 530±70 | 940±70 | 332 (233) 134 BP<br>AD 1618 -1816 | WSU Data Sheet 1990 |
| WSU-4126 | *Hr* | SC, 20cm | 580±70 | 990±70 | 413 (542) 129 BP<br>AD 1537 - 1698 | WSU Data Sheet 1990 |
| ***SLO-1290*** | | | | | | |
| Beta-038454 | *Hr* | SC, 45-60 cm | 1200±60 | 1610±60 | 758 (831)903 BP<br>AD 1047-1192 | WSU Data Sheet 1990 |
| WSU-4128 | *Hr* | SC, 30 cm | 1365±80 | 1765±80 | 1176 (983)790 BP<br>AD 865 - 1049 | WSU Data Sheet 1990 |
| ***SLO-1373*** | | | | | | |
| Beta-51016 | *Mc* | Unit, 4 20-40 cm | 970±70 | 1400±70 | 693 (625) 557 BP<br>AD 1257 - 1393 | Gibson 1992a |
| Beta-51017 | *Mc* | Unit 1, 20-40cm | 460±60 | 890±60 | 280 (195) 109 BP<br>AD 1670-1841 | Gibson 1992a |
| ***SLO-1437 (Perry Creek)*** | | | | | | |
| Beta-49357 | *Hc* | SC, 10 cm | 750±80 | 1170±80 | 542 (463)384 BP<br>AD 1408 - 1566 | WSU Data Sheet 1990 |
| ***SLO-2563 (The Ravine)*** | | | | | | |
| Beta-251136 | *Hr* | Unit 1, 5 cm | 1060± 40 | 1470± 40 | 738 (693) 647 calBP<br>A.D. 1212 (1258) 1303 | Reported here |
| Beta-249369 | *Hr* | Unit 1, 65 cm | 1420± 40 | 1818± 40 | 991 (924) 857 calBP<br>A.D. 959 (1026) 1093 | Reported here |

Note: [a] *Bsp- Balanus* sp. Hc- *Haliotis cracherodii*; Hr- *Haliotis rufescens; Mc- Mytilus californianus*; Ts-*Tegula* sp SC-Surface Collected from cliff exposure
[b]Corrected $^{13}C/^{12}C$; [3]Calibrated 1 sigma results using 325± 35 UC CALIB REV 5.0.1 (Stuiver and Reimer 2004)

**APPENDIX C:**
FLAKED, GROUND, AND BATTERED STONE CLASSIFICATIONS

**FLAKE STONE** ~ Flaked stone materials were classified into the nine artifact categories listed below. All flaked stone artifacts were separated by material and artifact type. Tools and cores were measured, weighed, and completeness recorded and evaluated to determine function, evidence of use-wear, type of reworking, and evidence of heat alteration.

**Cores**: Cobbles, nodules, or blocks of tool stone from which flakes are detached for use or further modification. As defined here, one or more complete negative flake scars must be present to be classified as a core.

**Core Tools**: Cores modified through use and show edge damage, which typically occurs on tool edges is a result of battering and/or flaking. Under this category, the core analysis described above was expanded to include modification attributes.

**Bifaces:** Artifacts with two sides meeting to form a single edge that circumscribes the entire artifact (Andrefsky 1998:20). Recorded biface attributes include: origin, evidence of reworking or use, presence or absence of cortex, and apparent reason for discard. Based on technological and morphological characteristics, bifaces are further subdivided on the basis of the five stages (Jones and Ferneau 2002a:90-91). These include:

Stage 1 **–** Thick, crude bifacial cores or flake blanks that display rough edges, thick sinuous margins, and less than 50.0% of the perimeter edge shaped.

Stage 2 – Percussion-shaped specimens with a rough outline that exhibit a moderate degree of variability in flake scar morphology.

Stage 3 – Percussion-thinned bifaces with a regular outline and relatively regularly spaced flake scars.

Stage 4 – Thin bifaces reduced to symmetrical preforms with fairly regular margins and uniform cross-sections.

Stage 5 – Bifaces that have extensively-flaked edges and are essentially considered finished tools. These area considered non-diagnostic projectile points or formalized bifacial knives/blades.

**Projectile Points:** Points that exhibit a diagnostic hafting element were classified on the basis of both morphological attributes and typological data available from the central California coast (Jones 1993, 1995, 2003).

**Drills and Reamers:** Artifacts displaying substantial bifacial or trifacial modification, which terminate in a narrow elongate, pointed distal end suitable for drilling or puncturing. Drills are classified as small (<50 mm in length; 10 mm in thickness) artifacts that exhibit use-related damage (e.g., rotary or bi-directional edge wear that appears as polish or abrasion and grinding or crushing). Reamers are larger, thicker and more robust specimens. Working edges on drills were examined, and proximal shape and distal diameter were recorded.

**Formed Flake Tools:** Distinguished from simple or casual flake tools based on two attributes: the degree to which retouch has altered the shape of the original flake blank, and the extent to which the body of the flake has been intentionally modified. Unlike simple utilized flakes, formed or retouched flake tools display morphological modifications generally associated with particular activities such as scraping or perforating.

**Simple Flake Tools:** Casual or simple tools that display minimal edge modification and only incidental retouch. The goal of flake tool analysis was to determine the character of use-wear (e.g., casual flake tools with a single, uniform working edge versus those that exhibit several, varied working edges).

**Cobble Tools:** Cortex-covered Monterey or Franciscan chert cobbles or cobble pieces with a minimal number of flake removal scars, often with evidence of heavy battering. Wear patterns suggest that this tool type includes hammers (battering) and chopper/scrapers (flaking). Functionally these tools probably represent both kinds of processing implements.

**Debitage:** The flake debris resulting from biface and core reduction. Although detailed analysis of flake stone debitage may provide invaluable insights into prehistoric technological processes, mobility strategies, and raw material procurement; for the purpose of this research, analysis was focused on more general categories in order to characterize course-grained trends.

Specifically, these include material selection, morphological/technological character of raw materials, and the manner in which materials were modified and used. All debitage was sorted by material type and reduction sequence, then counted, weighed, and assessed for evidence of heat alteration. Debitage was then classified according to standardized flake type definitions (Jackson 1994). Six flake types are defined based on their relationship to a specific reduction strategy and three general categories:

(1) Primary reduction flakes: debitage with more than 50.0% of its dorsal surface covered by cortex

(2) Secondary reduction flakes: debitage with less than 50.0% of its dorsal surface covered by cortex;

(3) Core rejuvenation flakes: chunky, thick debitage removed to make the core reducible;

(4) Shatter: irregular debitage pieces lacking any recognizable morphology, includes both cortical and interior;

(5) Interior flakes: percussion flakes with dorsal flake scars and no cortex;

(6) Biface thinning flakes: curved longitudinal cross-sections, with dorsal flake scars;

(7) Pressure flakes: small, salient flakes with bulbs of force, minute and oblique platforms, and simple dorsal surfaces;

(8) Chunks: blocky non-diagnostic pieces that may or may not be culturally modified;

(9) Undifferentiated fragments: technologically non-diagnostic flake parts.

GROUND STONE ~ Eleven categories of ground and battered stone were recovered from the study sites. The specimens were assigned to morphological/ functional categories based on the methods and terminology developed by Mikkelsen (1985, 1993) and applied by local researchers. Measurements were recorded for all tools. Morphological traits and functional attributes associated with tool use (e.g., polish, battering, pattern of wear) and the location of residue, if present, were recorded for all specimens.

**Millingslabs:** Artifacts with a stable stone platform on which material was ground or pounded with a hand-held stone. Millingslabs are associated with processing seeds and other resources such as shell, bone, and ocher. The tools have at least one modified (polished, pecked, or ground) surface.

**Bowl Mortars:** Artifacts formed from large cobbles or boulders that were used with numerous pestle forms to grind and pound a variety of resources. Bowl mortars have a relatively high degree of shaping and contain single mortar cups.

**Handstones:** Very common multi-purpose tools with varying degrees of modification. Handstones were often used in conjunction with millingslabs for vegetal or animal resource processing as well as stone tool shaping. The tools regularly exhibit end-battering resulting from alternating crushing and pounding. The artifacts were used for a range of activities that required grinding, pounding, crushing, polishing, and rubbing.

**Miscellaneous Handstones**: Similar to miscellaneous ground stone, this category encompasses fragmented portions of milling equipment. However, an analysis of artifact attributes suggests that the specimens are handstones rather than the general category of miscellaneous ground stone.

**Cobble Pestles**: These tools were held in the hand and used to pound and/or grind resource on or in concave lower stones. They display a distinctive end grinding with smoothed surface elongating over the faces and edges, as well as batter and peck marks. The pestles identified in this study are classified as cobble pestles as they are only partly modified through use, compared to elongated pestles that are highly shaped and often decorated.

**Pitted Stones**: A diverse group of artifacts that exhibit restricted or localized pits created by pecking of the central portion of both modified and unmodified cobbles. The pits occur on one or both stone faces, and some stones contain up to six pits or depressions ranging between 0.3 and 4.0 centimeters deep. Various functions have been ascribed to the artifacts, including anvils and hammerstones for the purposes of acorn processing, chert core reduction, shellfish cracking, and hard nut/seed fracturing.

**Grooved Stone**: Grooved stones or net weights display batter/pecked marks that are linear along the artifact margin. These shaped tools often function as net weight, with plant fibers attached to the stone along the groove.

**Cobble Hammerstones**: These are differentiated from handstones and battered cobbles by the presence of edge flaking and battering; however, they lack any other form of wear. The tools are unmodified, rounded cobbles often showing extensive batter/peck marks that may form into clusters, and flake scars. The wear is concentrated along the edge of the tool, often consistent with the processing of lithic knapping (Jones and Ferneau 2002a:133). To perform such heavy pounding, oval, flat cobbles of dense hard materials are frequently selected. In contrast, processing tools not used to process lithics are used for grinding, pounding, and crushing.

**Battered Cobbles**: The general category of battered cobbles includes fist-sized or slightly larger, sub-angular cobbles that exhibit battering, striated surfaces, and/or flake scars. These casual tools do not display the formal shaped attributes of a handstone or hammerstone, and their use likely was ephemeral. Battered cobbles were likely used for a range of activities such as pounding or crushing fibrous roots or tubers, or lithic resource procurement.

**Miscellaneous Ground Stone**: This broad category includes fragmented portions of milling equipment. Specimens display characteristics of grinding and/or polish associated with more formal ground stone artifacts; however, the specimens are too fragmentary to ascribe to a specific category.

## APPENDIX D:

## CA-SLO-1295, -1622, -1677, AND -2563 DETAILS OF ESTIMATED DIETARY RECONSTRUCTION BASED ON MEAT WEIGHT

Table D1. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-1295

| TAXON | BONE /SHELL WEIGHT | MEAT WEIGHT (G) |
|---|---|---|
| **Terrestrial Mammals** | | |
| Brush rabbit | 1.38 | 0.83 |
| Deer | 7.87 | 267.58 |
| Medium carnivore | 3.10 | 9.83 |
| Mammal | 2.35 | 23.5 |
| Large mammal | 34.14 | 1160.76 |
| Medium mammal | 12.64 | 40.00 |
| Small mammal | 0.62 | 0.62 |
| **Subtotal** | 62.1 | 1503.12 |
| **Marine Mammal** | | |
| Large | 5.92 | 142.08 |
| Medium | 3.30 | 79.86 |
| **Subtotal** | 9.22 | 221.94 |
| **Birds** | | |
| Medium Bird | 0.72 | 0.95 |
| Large Bird | 0.81 | 1.07 |
| **Subtotal** | 1.53 | 2.02 |
| **Reptiles** | | |
| *Pituophis catenifer catenifer* | 0.15 | 0.07 |
| Snake | 0.32 | 0.15 |
| **Subtotal** | 0.47 | 0.22 |
| **Marine Fish** | | |
| Atherinidae | 0.02 | 0.55 |
| *Scorpaenichthys marmoratus* | 1.58 | 42.98 |
| Clinidae | 0.01 | 0.28 |
| Stichaeidae | 0.49 | 13.57 |
| *Hexagrammos decagrammus* | 0.28 | 22.16 |
| *Gobiesox maeandricus* | 0.01 | 0.28 |
| *Sebastes* spp. | 1.28 | 35.46 |
| *Xiphister* spp. | 0.15 | 4.16 |
| *Heterostichus rostatus* | 0.06 | 1.67 |
| *Actinopterygii* | 1.90 | 52.63 |
| **Subtotal** | 5.78 | 173.74 |
| **Shellfish** | | |
| *Mytilus californianus* | 3910.34 | 1165.28 |
| *Tegula funebralis* | 3604.15 | 1315.51 |
| *Mopalia* spp. | 279.83 | 324.32 |
| Cancer | 152.85 | 86.05 |
| *Balanus* spp. | 129.41 | 132.20 |
| *Lithopoma gibberosa* | 66.13 | 20.30 |
| *Haliotis rufescens* | 37.54 | 51.05 |
| *Collisella* spp. | 32.28 | 25.18 |
| Minor species | 74.08 | 70.52 |
| Excavation unit shell | 154,951.00 | 147,651.00 |
| **Subtotal** | 163,237.61 | 150,841.41 |
| Total | 163,316.71 | 152,742.45 |

Table D2. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-1622.

| TAXON | BONE/SHELL WEIGHT | MEAT WEIGHT (G) |
|---|---|---|
| **Terrestrial Mammals** | | |
| Brush rabbit | 0.47 | 0.28 |
| Deer | 6.04 | 205.36 |
| Mammal | 16.19 | 161.90 |
| Large mammal | 42.15 | 1433.10 |
| Medium mammal | 50.46 | 159.96 |
| Small mammal | 2.26 | 2.26 |
| **Subtotal** | 117.57 | 1962.86 |
| **Marine Mammal** | | |
| Medium | 16.94 | 1185.80 |
| **Birds** | | |
| Large bird | 0.34 | 0.45 |
| Medium bird | 0.05 | 0.06 |
| Small bird | 0.45 | 0.59 |
| Bird | 0.24 | 0.32 |
| **Subtotal** | 1.08 | 1.42 |
| **Reptiles** | | |
| Lizard | 0.02 | 0.00 |
| **Marine Fish** | | |
| *Scorpaenichthys marmoratus* | 0.70 | 19.39 |
| Clinidae | 0.07 | 1.94 |
| *Rhacochilus vacca* | 0.01 | 0.28 |
| Stichaeidae | 0.32 | 8.86 |
| *Hexagrammos decagrammus* | 0.00 | 0.00 |
| *Gobiesox maeandricus* | 0.00 | 0.00 |
| *Sebastes* spp. | 0.89 | 24.65 |
| *Xiphister* spp. | 0.38 | 10.53 |
| Cottidae | 0.03 | 0.83 |
| *Clinocottus* spp. | 0.10 | 2.77 |
| *Heterostichus rostatus* | 0.02 | 0.55 |
| Actinopterygii | 15.65 | 433.50 |
| **Subtotal** | 18.17 | 503.30 |
| **Shellfish** | | |
| *Haliotis rufescens* | 788.37 | 892.43 |
| *Tegula funebralis* | 429.97 | 156.93 |
| *Mytilus californianus* | 147.93 | 44.08 |
| *Lithopoma gibberosa* | 92.92 | 28.52 |
| *Mopalia* spp. | 80.54 | 93.34 |
| *Haliotis* spp. | 35.31 | 48.13 |
| *Collisella* spp. | 27.58 | 21.51 |
| Cancer | 17.46 | 9.83 |
| *Tegula brunnea* | 15.29 | 5.58 |
| Minor Species | 12.41 | 11.81 |
| Excavation unit shell | 11,628.83 | 13,042.13 |
| **Subtotal** | 13,276.61 | 14,354.29 |
| Total | 13,430.39 | 18,007.67 |

Table D3. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-1677.

| TAXON | BONE/SHELL WEIGHT | MEAT WEIGHT (G) |
|---|---|---|
| **Terrestrial Mammals** | | |
| Brush Rabbit | 0.80 | 0.48 |
| Deer | 4.90 | 166.6 |
| Dog/coyote | 1.85 | 11.1 |
| Mammal | 23.06 | 139.7 |
| Large mammal | 73.95 | 2514.2 |
| Medium mammal | 59.77 | 189.47 |
| Small mammal | 2.01 | 2.01 |
| **Subtotal** | 166.34 | 3023.56 |
| **Marine Mammal** | | |
| Large | 2.18 | 52.76 |
| Medium | 1.47 | 35.57 |
| Marine mammal | 9.33 | 225.79 |
| **Subtotal** | 12.98 | 314.12 |
| **Birds** | | |
| Large bird | 1.83 | 2.41 |
| Medium bird | 0.20 | 0.26 |
| Small bird | 0.14 | 0.18 |
| Bird | 2.89 | 3.81 |
| **Subtotal** | 5.06 | 6.66 |
| **Reptiles** | | |
| Pacific Gopher Snake | 0.05 | 0.02 |
| Western Rattlesnake | 0.22 | 0.11 |
| Snake | 0.02 | 0.10 |
| Reptile | 0.15 | 0.07 |
| **Subtotal** | 0.44 | 0.30 |
| **Marine Fish** | | |
| *Scorpaenichthys marmoratus* | 5.24 | 145.15 |
| Clinidae | 0.06 | 1.67 |
| *Rhacochilus vacca* | 0.33 | 9.14 |
| Stichaeidae | 2.94 | 81.44 |
| *Gibbonsia spp.* | 0.02 | 0.55 |
| *Hexagrammos decagrammus* | 0.09 | 2.49 |
| Cebidichthys violaceus | 0.07 | 1.94 |
| Gobiesox maeandricus | 0.04 | 1.11 |
| *Sebastes* spp. | 4.66 | 129.08 |
| *Xiphister* spp. | 0.44 | 12.19 |
| *Heterostichus rostatus* | 0.33 | 9.14 |
| *Oxyjulis californica* | 0.01 | 0.28 |
| Triakididae | 0.28 | 7.76 |
| *Ophioden elongates* | 0.21 | 5.82 |
| Embiotocidae | 0.04 | 1.11 |
| Actinopterygii | 31.56 | 874.21 |
| **Subtotal** | 46.32 | 1,283.08 |

Table D3 Continued. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-1677.

| Taxon | Bone/Shell Weight | Meat Weight (g) |
|---|---|---|
| **Invertebrate** | | |
| *Tegula funebralis* | 4,855.23 | 1,772.16 |
| *Haliotis rufescens* | 4,044.62 | 4,578.51 |
| *Mytilus californianus* | 1,277.48 | 380.69 |
| *Lithopoma gibberosa* | 723.86 | 222.23 |
| *Mopalia* spp. | 450.47 | 522.09 |
| *Tegula brunnea* | 246.82 | 90.09 |
| Cancer | 153.84 | 86.61 |
| *Collisella* spp. | 128.47 | 100.20 |
| *Strongylocentrotus* spp. | 64.06 | 27.29 |
| Minor species | 201.19 | 191.53 |
| Excavation unit shell | 103,249.30 | 98,880.73 |
| **Subtotal** | 115,395.34 | 106,852.13 |
| Total | 115,626.48 | 111,479.85 |

Table D4. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-2563.

| TAXON | BONE/SHELL WEIGHT | MEAT WEIGHT (G) |
|---|---|---|
| **Terrestrial Mammals** | | |
| *Canis* spp. | 0.21 | 1.26 |
| Large mammal | 0.90 | 9.0 |
| Medium mammal | 3.06 | 12.3 |
| Small mammal | 0.01 | 0.1 |
| Unidentified mammal | 0.62 | 6.2 |
| **Subtotal** | 5.62 | 28.86 |
| **Marine Mammal** | | |
| Medium | 3.06 | 74.6 |
| **Birds** | | |
| Small bird | 0.02 | 0.03 |
| Medium bird | 0.18 | 0.24 |
| Large bird | 0.07 | 0.09 |
| **Subtotal** | 0.27 | 0.36 |
| **Reptiles** | | |
| *Pituophis catenifer catenifer* | 0.02 | 0.01 |
| Snake | 0.18 | 0.09 |
| **Subtotal** | 0.20 | 0.10 |
| **Marine Fish** | | |
| Clupeidae | 0.02 | 0.55 |
| *Engraulis mordax* | 0.01 | 0.28 |
| Atherinidae | 0.07 | 1.94 |
| *Scorpaenichthys marmoratus* | 1.03 | 28.53 |
| Clinidae | 0.05 | 1.39 |
| *Gibbonsia montereynsis* | 0.14 | 3.88 |
| Sciaenidae spp. | 4.81 | 133.23 |
| *Gibbonsia* spp. | 0.14 | 3.88 |
| *Hexagrammos decagrammus* | 0.44 | 12.19 |
| *Gobiesox maeandricus* | 0.21 | 5.82 |
| *Sebastes* spp. | 2.33 | 64.54 |
| Cottidae | 0.08 | 2.22 |
| *Clinocottus* spp. | 0.02 | 0.55 |
| *Oxyjulis californica* | 0.03 | 0.83 |
| Embiotocidae | 0.23 | 6.47 |
| Actinopterygii | 13.31 | 368.68 |
| **Subtotal** | 22.98 | 634.98 |
| **Shellfish** | | |
| *Tegula funebralis* | 666.32 | 243.20 |
| *Haliotis rufescens* | 270.71 | 306.44 |
| *Collisella* spp. | 111.07 | 86.63 |
| *Mopalia* spp. | 67.26 | 77.95 |
| Cancer | 21.13 | 11.90 |
| *Mytilus californianus* | 18.49 | 5.51 |
| *Lithopoma gibberosa* | 18.03 | 5.54 |
| Minor species | 10.83 | 1.89 |
| Excavation unit shell | 10,425.99 | 9,925.54 |

Table D4 Continued. Estimated Dietary Reconstruction Based on Meat Weight for CA-SLO-2563.

| TAXON | BONE/SHELL WEIGHT | MEAT WEIGHT (G) |
|---|---|---|
| **Subtotal** | 11,609.83 | 10,664.60 |
| Total | 11,641.96 | 11,403.50 |